

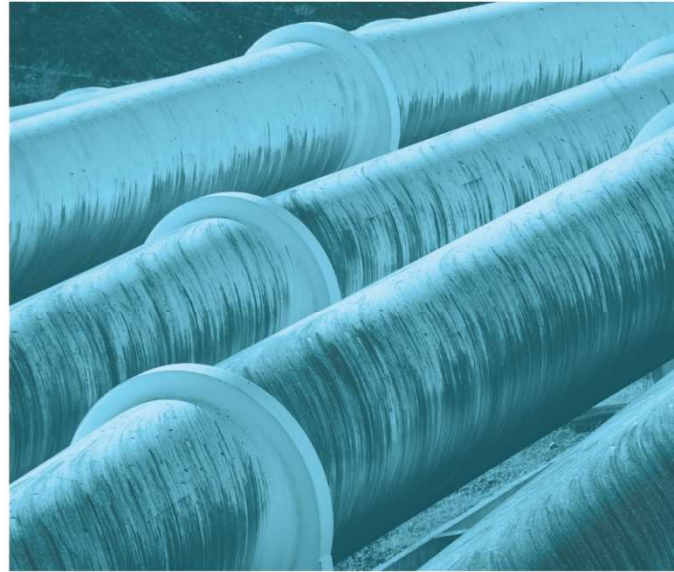


# M4-M5 Link Mainline Tunnels

Site Establishment Construction Noise and Vibration Impact  
Statement | Parramatta Road East and West, Pyrmont Bridget Road  
and Campbell Road

---

Prepared for Lendlease Samsung Bouygues Joint Venture  
October 2018





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Site Establishment Construction Noise and Vibration Impact Statement | Parramatta Road East and West, Pyrmont Bridget Road and Campbell Road

## Report Number

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J180225 RP1

## Client

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Lendlease Samsung Bouygues Joint Venture

## Date

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17 October 2018

## Version

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5 Final

## Prepared by

## Approved by

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**Daniel Weston**

Associate

17 October 2018

**Najah Ishac**

Director

17 October 2018

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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# 1 Introduction

## 1.1 Context

This Construction Noise and Vibration Impact Statement (CNVIS) supplements the Site Establishment Management Plan (SEMP) for M4-M5 Link Mainline Tunnels (the Project).

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

## 1.2 Background and Project description

### 1.2.1 Project background

An Environmental Impact Statement (EIS) (AECOM 2017) included an assessment of the noise and vibration impacts from construction and operation of the Project.

The EIS identified the potential noise and vibration impacts during construction typically associated with noise intensive initial site works. It concluded any potential impacts could be managed by tailored mitigation and management measures.

This CNVIS builds upon the noise and vibration assessment detailed within Appendix J of the EIS using latest detailed design information provided by LSBJV. The CNVIS is to be read in conjunction with the project's Noise and Vibration Management Plan (NVMP) and Site Establishment Management Plan (SEMP).

### 1.2.2 Project description

The WestConnex M4-M5 Link project is being constructed in two stages:

- Stage 1 (the Project and subject of this document): M4-M5 Link Mainline tunnels.
- Stage 2: Rozelle interchange.

Sydney Motorway Corporation (SMC) has engaged Lendlease Samsung Bouygues Joint Venture (LSBJV) to design and construct Stage 1 of the project (Figure 1.1). The key features of the Mainline tunnels project include:

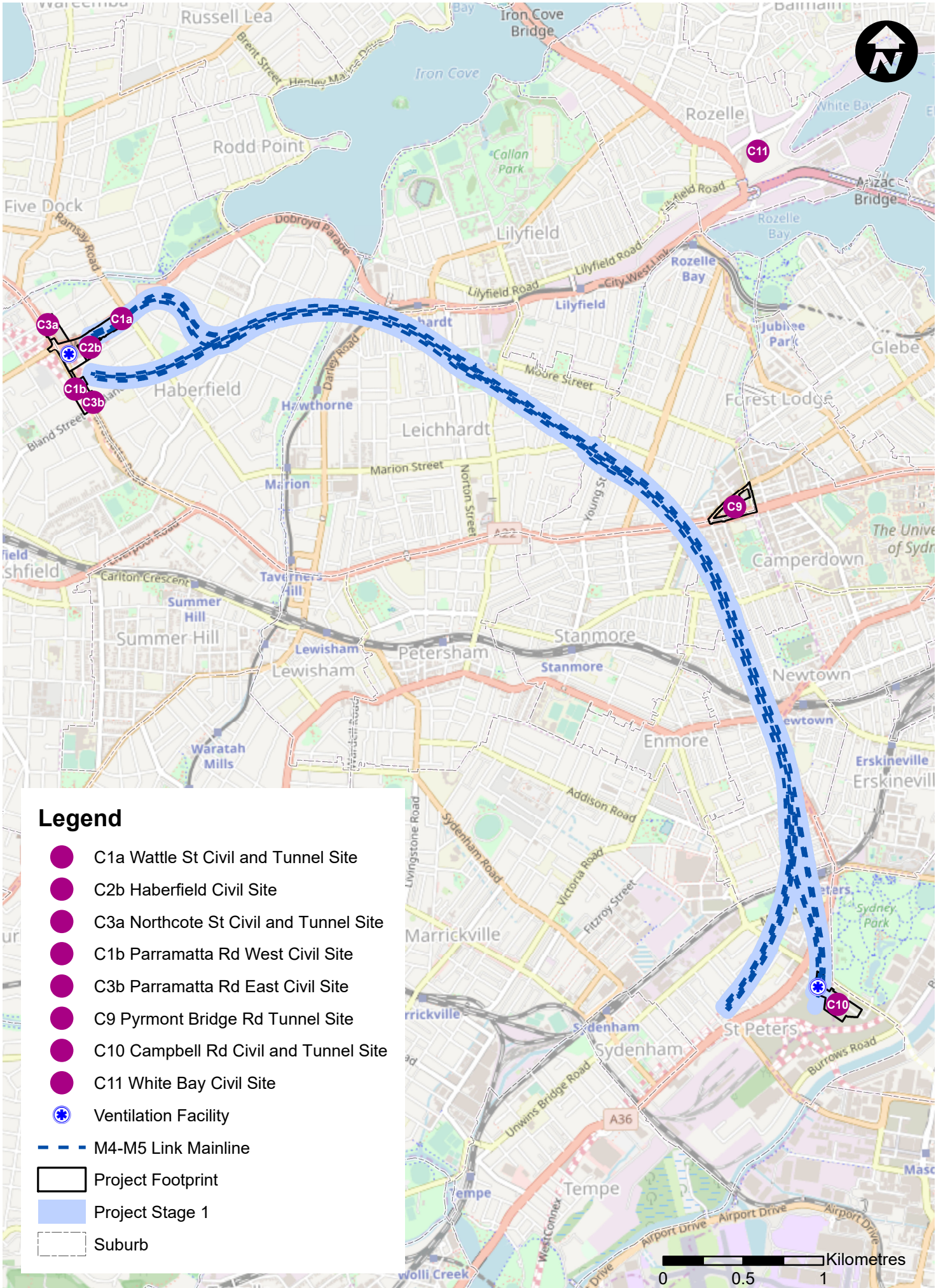
- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction.
- Connections of the mainline tunnels to the M4 East project, comprising:
  - A tunnel-to-tunnel connection to the M4 East mainline stub tunnels east of Parramatta Road near Alt Street at Haberfield.
  - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project).

- Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking.
- Connections of the mainline tunnels to the New M5 project, comprising:
  - A tunnel-to-tunnel connection to the New M5 mainline stub tunnels north of the Princes Highway near the intersection of Mary Street and Bakers Lane at St Peters.
  - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project).
  - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and line marking.
- Construction of tunnel stubs to provide for future underground connection of the mainline tunnels to the Rozelle interchange and Iron Cove Link.
- A motorway operations complex at St Peters (Campbell Road) (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets (the Campbell Road ventilation facility), offices, on-site storage and parking for employees.
- Tunnel ventilation systems, including ventilation supply and exhaust facilities, ventilation fans, ventilation outlets and ventilation tunnels.
- One new ventilation facility located at the Campbell Road, St Peters.
- Fitout (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of M4 East project) for use by the M4-M5 Link project.
- Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities.
- Water treatment would occur at the operational water treatment facility at the Campbell Road motorway operations complex (subject to future Modification).
- Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage).
- Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems.
- Utility works, including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities.
- Temporary construction ancillary facilities to facilitate construction of the project at the following locations:
  - Northcote Street civil and tunnel site (C3a), Haberfield (subject to future Modification)
  - Haberfield civil site (C2b), Haberfield
  - Parramatta Road East civil site (C3b), Haberfield

- Parramatta Road West civil site (C1b), Ashfield
- Wattle Street civil and tunnel site (C1a), Haberfield
- Pyrmont Bridge Road tunnel site (C9), Camperdown/Annandale
- Campbell Road civil and tunnel site (C10), St Peters
- White Bay civil site (C11), Rozelle.

An overview of the Project footprint and ancillary facilities is presented in the CEMP and SEMP. Further detail of the Project description is presented in Section 1.3 of the CEMP.

Further detail of the project description is presented in Section 1.3 of the CEMP.



**Legend**

- C1a Wattle St Civil and Tunnel Site
- C2b Haberfield Civil Site
- C3a Northcote St Civil and Tunnel Site
- C1b Parramatta Rd West Civil Site
- C3b Parramatta Rd East Civil Site
- C9 Pymont Bridge Rd Tunnel Site
- C10 Campbell Rd Civil and Tunnel Site
- C11 White Bay Civil Site
- ★ Ventilation Facility
- M4-M5 Link Mainline
- ▭ Project Footprint
- ▭ Project Stage 1
- ▭ Suburb

Figure 1-1 Overview of Stage 1 - M4-M5 Link Mainline Tunnels (the Project)

### 1.3 Scope of this CNVIS

The scope of this CNVIS is to assess potential noise and vibration impacts from the site establishment phase of the Campbell Road, Pyrmont Bridge Road and Parramatta Road East and West ancillary facilities and to develop feasible and reasonable noise management and mitigation measures where impacts are identified. Further CNVIS will be prepared to assess the operational stages of these ancillary facilities.

### 1.4 Environmental management systems overview

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

## 2 Purpose and objectives

The key objective of the CNVIS is to ensure all CoA, revised environmental management measures (REMM) 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;
- Conditions of Approval granted to the project on 17 April 2018;
- Roads and Maritime specifications G36;
- The Project's Environmental Protection Licence (EPL); and
- All relevant legislation and other requirements described in Section 3 of this Plan.

# 3 Environmental requirements

## 3.1 Legislation

This CNVIS has been prepared in accordance with:

- Environmental Planning and Assessment Act 1979; and
- Protection of the Environment Operations Act 1997 (POEO Act).

## 3.2 Guidelines

The following guidelines apply to Project related construction noise and vibration:

- *NSW Industrial Noise Policy (INP) 2000*, Environmental Protection Authority<sup>1</sup>;
- *NSW Interim Construction Noise Guideline (ICNG) 2009*, Department of Environment and Climate Change;
- *NSW Road Noise Policy*, Department of Environment 2011, Climate Change and Water;
- *NSW Assessing Vibration – a technical guideline (AVTG) 2006*, Department of Environment and Conservation;
- *NSW Noise Criteria Guideline (NCG) 2015*, Roads and Maritime Services;
- *NSW Noise Mitigation Guideline (NMG) 2015*, Roads and Maritime Services;
- *Construction noise and vibration guideline (CNVG) 2016*, Roads and Maritime Services;
- Australian Standard AS/NZS 2107:2000 ‘*Acoustics - Recommended design sound levels and reverberation times for building interiors*’;
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration;
- Australian Standard AS 2187.2 ‘*Explosives - Storage and use - Part 2 Use of explosives*’;
- Australian Standard AS2436-1981 ‘*Guide to Noise Control on Construction, Maintenance and Demolition Sites*’;
- British Standard BS 6472-2008, ‘*Evaluation of human exposure to vibration in buildings (1-80Hz)*’;
- British Standard 7385: Part 2-1993 ‘*Evaluation and measurement of vibration in buildings*’;
- German Standard DIN4150-1999 ‘*Structural vibration Part 3: Effects of vibration on Structures*’;
- *Construction Noise Strategy 7TP-ST-157/2.0 (CNS) 2012*, Transport for NSW; and

<sup>1</sup> This document has since been superseded by the NSW Noise Policy for Industry (NPfi) 2017. However, the INP remains the relevant policy in accordance with the project’s Instrument of Approval and NPfi transitional requirements.

- *Environmental Noise Management Manual (ENMM) 2001, Roads and Traffic Authority.*

### 3.3 Conditions of approval

The CoA relevant to ancillary facility construction noise and vibration are listed in Table 3.1.

**Table 3.1 Conditions of Approval for construction noise and vibration**

Condition	Key requirement
<b>Noise Assessments</b>	
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.
<b>Works Hours</b>	
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.
E69	Notwithstanding <b>Condition E68</b> , works may be undertaken between 1:00 pm to 6:00 pm on Saturday.
<b>Highly Noise Intensive Works</b>	
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 (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.
<b>Out-of-Hours Work Scheduling and Respite</b>	
E75	Out-of-hours works that are regulated by an EPL as per <b>Condition E73(c)</b> or through the <b>Out-of-Hours Work Protocol</b> as per <b>Condition E77</b> 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. NSW Government 49 Department of Planning and Environment Conditions of Approval for WestConnex M4-M5 Link SSI 7485  <i>Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project's <b>Out-of-Hours Work Protocol</b> for works not subject to a EPL.</i>



**Table 3.1 Conditions of Approval for construction noise and vibration**

Condition	Key requirement
E76	<p>In order to undertake out-of-hours work described in <b>Condition E75</b>, 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:</p> <ul style="list-style-type: none"> <li>(a) a schedule of likely out-of-hours work for a period no less than three (3) months;</li> <li>(b) the potential works, location and duration;</li> <li>(c) the noise characteristics and likely noise levels of the works; and</li> <li>(d) likely mitigation and management measures.</li> </ul> <p>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 <b>AA</b>, EPA and the Secretary.</p>
<b>Out-of-Hours Work Protocol – Works not subject to an EPL</b>	
E77	<p>An <b>Out-of-Hours Work Protocol</b> must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in <b>Conditions E68</b> and <b>E69</b>, 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:</p> <ul style="list-style-type: none"> <li>(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;</li> <li>(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;</li> <li>(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: <ul style="list-style-type: none"> <li>i) low risk activities can be approved by the ER in consultation with the AA, and</li> <li>ii) high risk activities that are approved by the Secretary; and</li> </ul> </li> <li>(e) identify Department, EPA and community notification arrangements for approved out of hours works, which maybe detailed in the Communication Strategy.</li> </ul>
<b>Out-of-Hours Works – Utility Coordination and Respite</b>	
E78	<p>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:</p> <ul style="list-style-type: none"> <li>(a) reschedule any works to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with <b>Condition E76</b>; or</li> <li>(b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and</li> <li>(c) provide documentary evidence to the <b>AA</b> in support of any decision made by the Proponent in relation to respite or mitigation.</li> </ul>
<b>Construction Noise and Vibration – General</b>	
E79	<p>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.</p>
E80	<p>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.</p>

**Table 3.1 Conditions of Approval for construction noise and vibration**

Condition	Key requirement
E81	<p>Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria:</p> <p>(a) construction ‘Noise affected’ noise management levels established using the <i>Interim Construction Noise Guideline</i> (DECC, 2009);</p> <p>(b) vibration criteria established using the <i>Assessing vibration: a technical guideline</i> (DEC, 2006) (for human exposure);</p> <p>(c) Australian Standard AS 2187.2 - 2006 “<i>Explosives - Storage and Use - Use of Explosives</i>”;</p> <p>(d) BS 7385 Part 2-1993 “<i>Evaluation and measurement for vibration in buildings Part 2</i>” as they are “applicable to Australian conditions”; and</p> <p>(e) the vibration limits set out in the <i>German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures</i> (for structural damage).</p> <p>Any works identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the <b>Construction Noise and Vibration Management Sub-plan</b>.</p> <p><i>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.</i></p>
E83	<p>Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, 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 <b>Construction Noise and Vibration Management Sub-plan</b>.</p>
E84	<p>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.</p>
E85	<p>The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.</p>

# 4 Existing environment

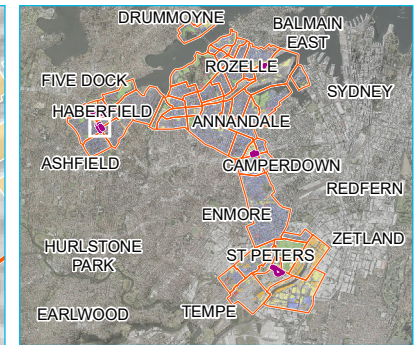
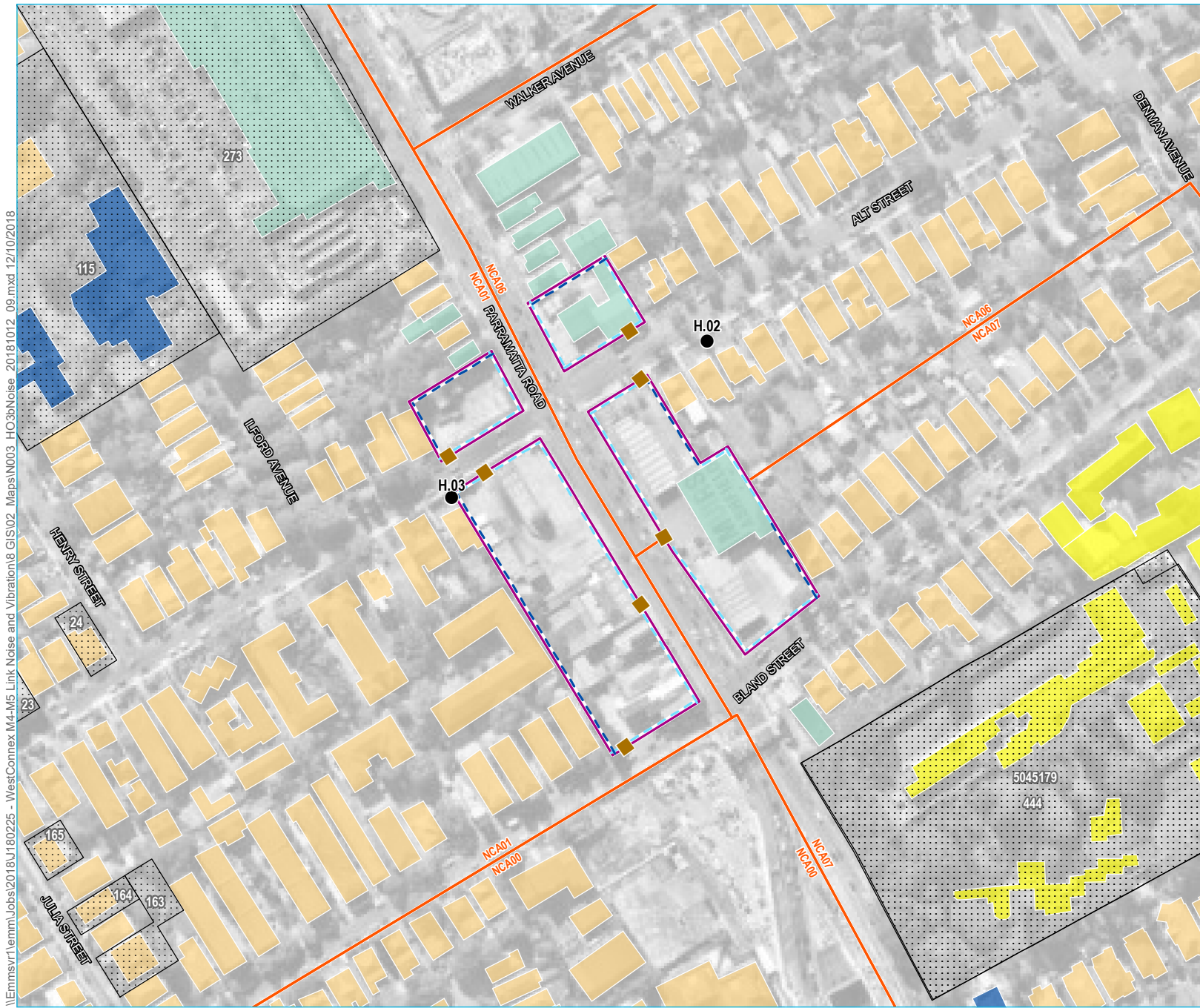
## 4.1 Noise and vibration sensitive receivers

A detailed land use survey has been undertaken to address E66 of the CoA. The outcomes of the land use survey have been incorporated into this CNVIS. A visual representation of the survey is provided in the NVMP. For the purpose of this assessment, receivers potentially sensitive to noise have been categorised as:

- residential dwellings;
- commercial, retail and industrial properties; and
- other, including:
  - education institutions;
  - childcare centres;
  - medical (hospital wards or other uses including medical centres);
  - places of worship;
  - outdoor open areas (passive and active recreation);
  - aged care;
  - hotel;
  - theatre/auditorium;
  - public building; and
  - recording studio.

The sensitive receivers for each site are shown in Figure 4.1, Figure 4.2 and Figure 4.3.

Heritage items of importance where vibration emission needs to be considered are also shown in Figure 4.1, Figure 4.2 and Figure 4.3.



- KEY**
- Noise logger location
  - Gate
  - - - Hoarding (3 m ply)
  - - - Noise barrier (5 m)
  - ▭ Site boundary
  - ▭ Noise catchment boundary
  - ▭ Heritage item (LEP/SHR)
  - Noise receiver
    - ▭ Residential
    - ▭ Commercial
    - ▭ Other - childcare
    - ▭ Other - educational

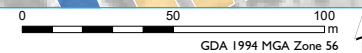
Parramatta Road east and west  
 – noise catchment areas,  
 receivers and noise monitoring  
 locations

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 Site establishment construction noise  
 and vibration impact statement

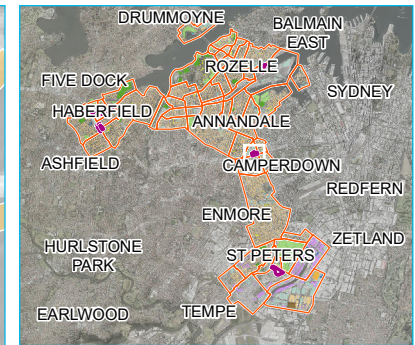
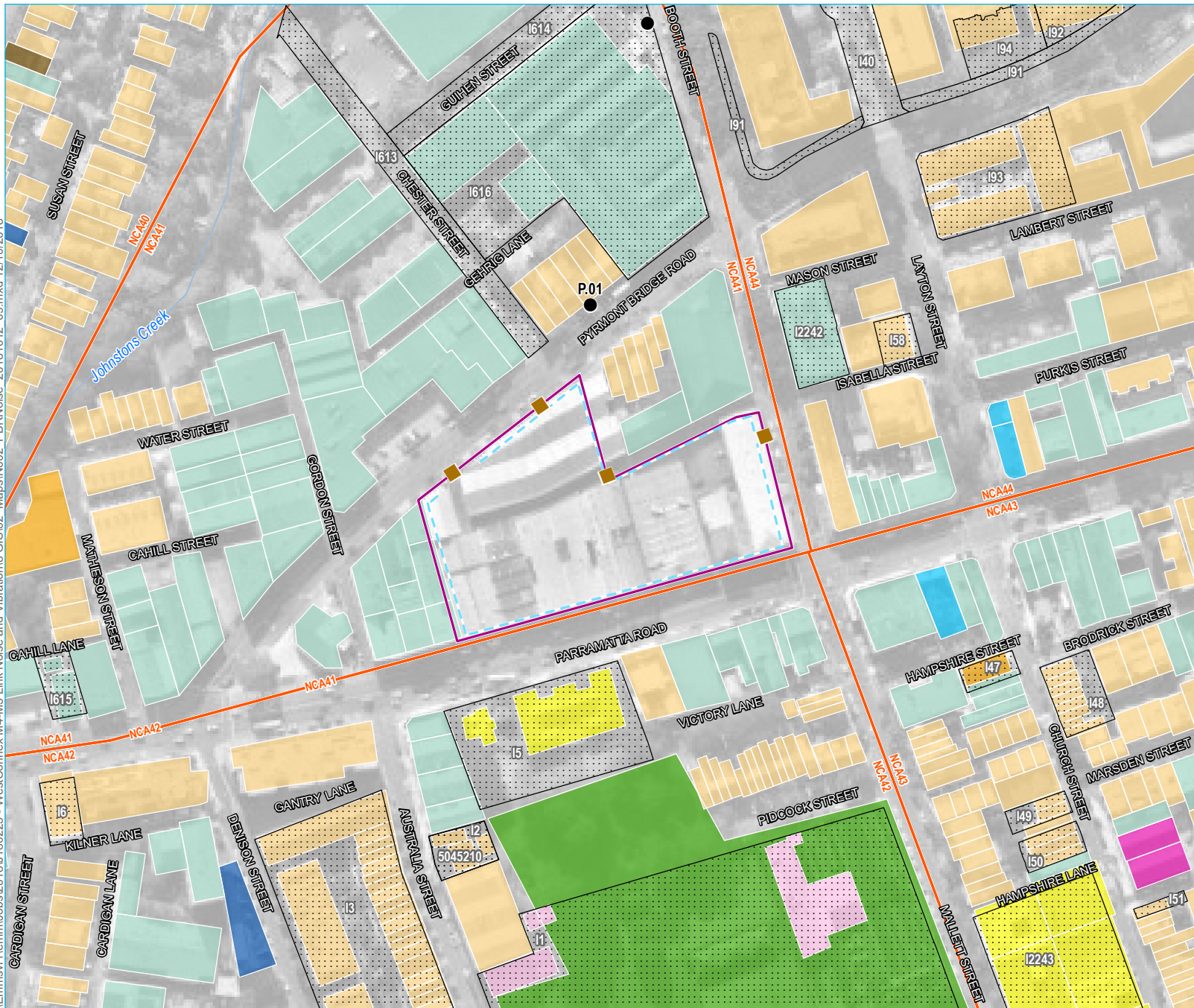
Figure 4.1

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



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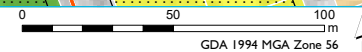
**KEY**

- Noise logger location
- Gate
- Watercourse / drainage line
- - - Hoarding (4 m ply)
- ▭ Site boundary
- ▭ Noise catchment boundary
- ▭ Heritage item (LEP/SHR)
- Noise receiver
  - Residential
  - Commercial
  - Other - café/bar
  - Other - childcare
  - Other - educational
  - Other - medical
  - Other - outdoor active
  - Other - place of worship
  - Other - public building
  - Other - recording studio

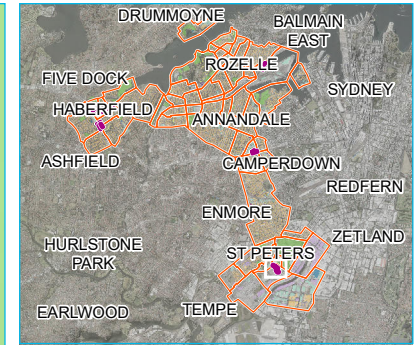
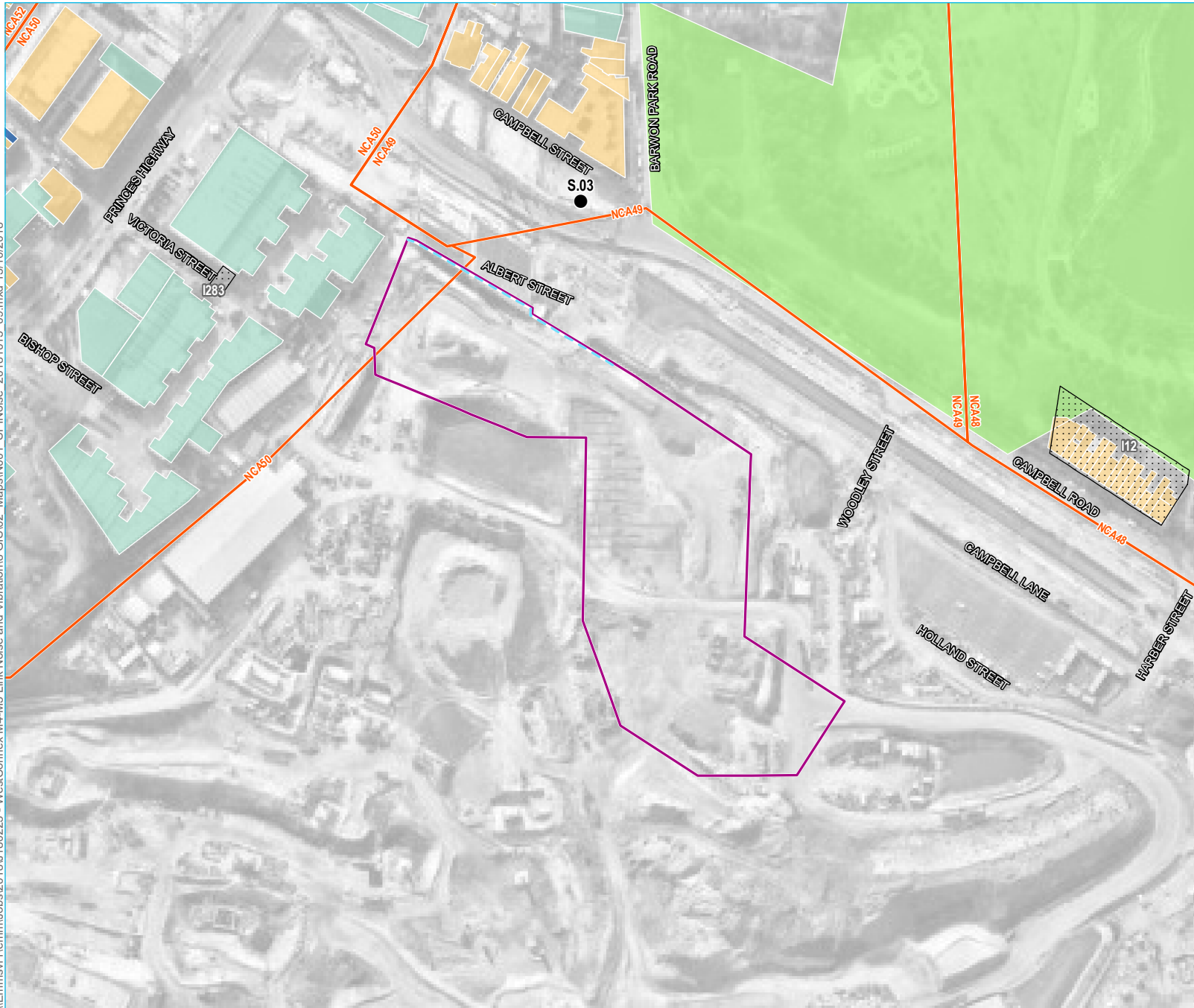
Pyrmont Bridge Road - noise catchment areas, receivers and noise monitoring locations  
 Westconnex M4-M5 Link Tunnels  
 Site establishment construction noise and vibration impact statement

Figure 4.2

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



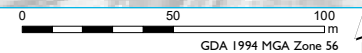
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- KEY**
- Noise logger location
  - - - Hoarding (3 m ply)
  - ▭ Site boundary
  - ▭ Noise catchment boundary
  - ▭ Heritage item (LEP/SHR)
  - Noise receiver
    - ▭ Residential
    - ▭ Commercial
    - ▭ Other - childcare
    - ▭ Other - hotel
    - ▭ Other - outdoor passive

Campbell Road - noise catchment areas, receivers and noise monitoring locations  
 Westconnex M4-M5 Link Tunnels  
 Site establishment construction noise and vibration impact statement  
 Figure 4.3

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



## 4.2 Noise catchment areas

The study area has 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 works.

The noise catchment areas of relevance to this CNVIS are shown in Figure 4.1, Figure 4.2 and Figure 4.3 and are explained in Table 4.1.

**Table 4.1 Noise catchment areas**

Site of relevance	NCA	Minimum distance (m) <sup>1</sup>	Description
Parramatta Road East and West	NCA00	40	South of Parramatta Road between Bland Street and Orpington Street. Land use consists of residential receivers
	NCA01	<5	South of Parramatta Road between Iron Cove Creek and Bland Street. Land use comprises of a mix of residential receivers, special use facilities, active and passive recreation areas and commercial receivers fronting Parramatta Road
	NCA02	<5	North of Parramatta Road between Henley Marine Drive and Walker Avenue. Land use comprises of a mix of residential and commercial receivers, a place of worship and a childcare centre
	NCA03	20	Catchment adjoins either side of Wattle Street between Ash Lane and Ramsay Street. Land use consists of residential receivers
	NCA04	30	Catchment area adjoins Ramsay Street and the western side of Wattle Street. Land use consists of residential receivers, isolated commercial receivers and a passive recreational area
	NCA05	n/a <sup>2</sup>	South of Dobroyd Parade between Hawthorne Parade and Martin Street. Land use consists of residential receivers with isolated commercial receivers and educational facilities
	NCA06	<5	North of Parramatta Road between Walker Avenue and Alt Street residences. Land use consists of residential and commercial receivers and an educational facility on Ramsay Street
	NCA07	<5	North of Parramatta Road between Dalhousie Street and Bland Street residences. Land use comprises of a mix of residential and commercial facilities, other sensitives and active and passive recreation areas
Pyrmont Bridge Road	NCA22	300	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
	NCA40	160	East of Johnston Street between Booth Street, Johnstons Creek and Parramatta Road. Land use comprises of a mix of residential and commercial receivers and special use facilities
	NCA41	<5	North of Parramatta Road between Booth Street/Mallett Street and Johnstons Creek. Land use comprises of a mix of residential and commercial receivers and a place of worship
	NCA42	25	South of Parramatta Road between Mallett Street and Salisbury Road. Land use comprises of a mix of residential and commercial receivers, special use facilities and active and passive recreation areas
	NCA43	35	South of Parramatta Road, east of Mallett Street. Land use comprises of a mix of residential and commercial receivers and special use facilities
	NCA44	20	North of Parramatta Road, east of Booth Street. Land use comprises of a mix of residential and commercial receivers.

**Table 4.1 Noise catchment areas**

Site of relevance	NCA	Minimum distance (m) <sup>1</sup>	Description
	NCA45	n/a <sup>2</sup>	Catchment area extends from Salisbury Road in the north to the Illawarra Rail Line/St Peters Rail Station in the south. Land use comprises of a mix of residential and commercial receivers and special use facilities.
Campbell Road	NCA46	750	North of Sydney Park Road between Concord Street, Coulson Street and Maddox Street. Land use comprises of a mix of residential receivers and isolated commercial receivers
	NCA47	150	East of Euston Road, between Maddox Street and Campbell Road. Land use consists of commercial receivers
	NCA48	50	South of Sydney Park Road between Barwon Park Road, Campbell Road and Euston Road. Land use comprises of a passive recreation area and isolated commercial receivers
	NCA49	75	Catchment area adjoins either side of Barwon Park Road, between Campbell Road and Crown Street. Land use comprises of a mix of residential and commercial receivers
	NCA50	<5	Catchment area adjoins either side of Princes Highway, between Mary Street, Church Street/Applebee Street and May Street. Land use comprises of a mix of residential and commercial receivers, an educational facility and an active recreation area
	NCA51	225	North of Campbell Street between Applebee Street and the Illawarra Rail Line/St Peters Rail Station. Land use comprises of a mix of residential and commercial receivers and active and passive recreation areas
	NCA52	225	South of the Illawarra Rail Line between Campbell Street, Sutherland Street and Princes Highway premises. Land use comprises of a mix of residential and commercial receivers, an educational facility and active and passive recreation areas
	NCA53	n/a <sup>2</sup>	West of Princes Highway, south of Sutherland Street. Land use comprises of a mix of residential and commercial receivers
	NCA54	n/a <sup>2</sup>	East of Princes Highway between Canal Street and Alexandra Canal. Land use comprises of a mix of residential and commercial receivers.
	NCA55	190	East of Burrows Road. Land use comprises of a mix of residential and commercial receivers

Source: M4-M5 Link EIS

- Note:
1. Approximate minimum horizontal offset distance from the nearest receiver building facade (receiver of any type) to the nearest point that construction works are occurring.
  2. No surface works are proposed in this NCA. Receivers in this catchment would therefore only be potentially affected by impacts from tunnelling works during construction.



## 4.3 Background noise levels

This CNVIS has adopted background noise levels from the EIS which are presented in Table 4.2 for each relevant NCA. Representative monitoring locations are shown in Figure 4.1, Figure 4.2 and Figure 4.3.

**Table 4.2 Rating background levels**

Site	NCA	Rep. monitoring location	Receiver type	Address	Rating background level (RBL)		
					L <sub>A90</sub> (15min)		
					Daytime	Evening	Night
Parramatta Road East and West	NCA02	H.01 <sup>3</sup>	Residential	1A Wattle St, Haberfield	58	58	52
	NCA06	H.02 <sup>3</sup>	Residential	141 Alt St, Haberfield	46	46	43
	NCA01	H.03 <sup>3</sup>	Residential	119 Alt St, Ashfield	46	46	38
	NCA03	H.04 <sup>3</sup>	Residential	35 Wattle St, Haberfield	58	55	44
	NCA06	H.05 <sup>3</sup>	Residential	259 Ramsay St, Haberfield	60	58	44
	NCA04	H.06 <sup>3</sup>	Residential	68 Wattle St, Haberfield	56	53	43
Pyrmont Bridge Road	NCA41	P.01	Residential	62 Pyrmont Bridge Rd, Camperdown	51	49	41
	NCA41	P.02	Commercial	Coates Hire, Booth St, Camperdown	53	50	46
Campbell Road	NCA48	S.01 <sup>4</sup>	Residential	400 Sydney Park Rd, Alexandria	57	51	40
	NCA52	S.02 <sup>4</sup>	Residential	108 Campbell St, St Peters	50	46	39
	NCA49	S.03 <sup>4</sup>	Residential	18 Campbell St, St Peters	54	45	40
	NCA50	S.04 <sup>4</sup>	Residential	187-211 Princes Hwy, St Peters	52	50	44
	NCA54	S.05 <sup>4</sup>	Residential	608 Princes Hwy, Tempe	58	56	49

Notes: 1. ICNG defines daytime period as 7:00am to 6:00pm Monday to Saturday, 8:00am to 6:00 pm Sunday; Evening as 6:00pm to 10:00pm; Night as 10:00pm to 7:00am Monday to Saturday, 10:00pm to 8:00am Sunday.

2. Taken from M4-M5 Link EIS.

3. Taken from M4 East EIS.

4. Taken from New M5 EIS.

# 5 Construction noise criteria

## 5.1 Construction Noise and Vibration Guideline (CNVG)

The Roads and Maritime Construction Noise and Vibration Guideline, August 2016 (CNVG) outlines Roads and Maritime’s approach to assessing and mitigating construction noise. The approach outlined in the CNVG has been adopted in this CNVIS.

## 5.2 Interim Construction Noise Guideline (ICNG)

The CNVG draws upon the NSW EPA’s ICNG, which provides guidelines for the assessment and management of noise from construction works.

Table 5.1 is an extract from the ICNG and provides construction noise management levels (NMLs) for residential receivers for both recommended standard construction hours and outside of these periods.

It is noted that the CoA allows extended standard hours of construction during 1pm to 6pm on Saturdays which deviates slightly from ICNG recommended standard hours.

**Table 5.1 ICNG residential noise management levels**

Time of day	Management level $L_{Aeq,15\text{ minute}}$	How to apply
Recommended standard hours: Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 6:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> <li>Where the predicted or measured <math>L_{Aeq,15\text{ minute}}</math> is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> <li>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> <li>times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; and</li> <li>if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ol> </li> </ul>

**Table 5.1 ICNG residential noise management levels**

Time of day	Management level $L_{Aeq,15\text{ minute}}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> <li>• A strong justification would typically be required for works outside the recommended standard hours.</li> <li>• The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>• Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.</li> </ul>

Notes: 1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 5.2 summarises noise management levels for non-residential land uses as defined in the ICNG.

**Table 5.2 ICNG noise management levels at other land uses**

Land use	Management level, $L_{Aeq,15\text{ minute}}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC, 2009).

The ICNG provides further guidance for construction noise levels at commercial and industrial premises as follows:

*Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises:*

- *Industrial premises: external  $L_{Aeq(15\text{ min})}$  75 dB(A)*
- *offices, retail outlets: external  $L_{Aeq(15\text{ min})}$  70 dB(A)*
- *other businesses that may be very sensitive to noise, where the noise level is Project specific as discussed below.*

*Examples of other noise-sensitive businesses are theatres and child care centres. The proponent should undertake a special investigation to determine suitable noise levels on a Project-by-project basis; the recommended 'maximum' internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).*

*The proponent should assess construction noise levels for the project, and consult with occupants of commercial and industrial premises prior to lodging an application where required.*

*During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.*

### 5.3 Sleep disturbance at residences

Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road compounds will have select operations during the night-time period (10pm to 7am). Therefore the assessment of potential sleep disturbance at residences is required in accordance with the INP. Sleep disturbance is defined as both awakenings and disturbance to sleep stages.

The INP guideline suggests that an  $L_{A1(1min)}$  or  $L_{Amax}$  level of RBL plus 15 dB is a suitable screening criteria for sleep disturbance for the night-time period.

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

- how often high noise events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the Project;
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods); and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

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

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

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade of a residential building of standard construction including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB  $L_{Amax}$  calculated at the facade of a residence are unlikely to cause sleep disturbance affects. Similarly, the World Health Organisation Guidelines for Community Noise (WHO 1999) suggest that levels below 45 dB  $L_{Amax}$  inside homes are unlikely to wake sleeping occupants. This equates to an external noise level of 55 dB  $L_{Amax}$  at the facade.

### 5.4 Project specific NMLs - residences

In accordance with the ICNG and based on the RBLs presented in Table 4.2, Table 5.3 presents the Project specific construction noise affected NMLs applicable to residential premises during the proposed work hours. The highly noise affected NML also applies to all residential receivers during standard hours.

**Table 5.3 Project specific NMLs at residential locations**

Site	NCA	Representative monitoring location	Standard construction NMLs (RBL + 10dB) Day <sup>1</sup>	Out of hours NMLs (RBL + 5dB) <sup>1</sup>			Sleep disturbance screening criteria (RBL + 15 dB) <sup>2</sup>
				Day <sup>3</sup>	Evening	Night	
Parramatta Road East and West	NCA00	H.03	56	51	51	43	53
	NCA01	H.03	56	51	51	43	53
	NCA02	H.01	68	63	63	57	67
	NCA03	H.04	68	63	60	49	59
	NCA04	H.06	66	61	58	48	58
	NCA05	L.02	61	56	54	47	57
	NCA06	H.02	56	51	51	48	58
Pyrmont Bridge Road	NCA07	H.02	56	51	51	48	58
	NCA40	P.01	61	56	54	46	56
	NCA41	P.01	61	56	54	46	56
	NCA42	P.01	61	56	54	46	56
	NCA43	P.01	61	56	54	46	56
Campbell Road	NCA44	P.01	61	56	54	46	56
	NCA47	S.01	67	62	56	45	55
	NCA48	S.01	67	62	56	45	55
	NCA49	S.03	64	59	50	45	55
	NCA50	S.04	62	57	55	49	59
	NCA51	S.02	60	55	51	44	54
	NCA52	S.02	60	55	51	44	54
	NCA54	S.05	68	63	61	54	64
NCA55	S.05	68	63	61	54	64	

- Notes:
1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
  2. Level applies at the nearest and/or most exposed facade to construction noise levels.
  3. This applies to daytime and outside of standard ICNG hours.

## 5.5 Project specific NMLs – non-residential

Table 5.4 presents the Project specific construction NMLs applicable to non-residential land uses as defined in the NSW ICNG and AS2107.

**Table 5.4 Project specific NMLs at non-residential land uses**

Land use	Noise management level (when in use), $L_{Aeq,15\text{ minute}}$
Industrial premises	External noise level 75 dB
Offices, retail outlets	External noise level 70 dB
Classrooms at schools and other educational institutions	Internal noise level 45 dB
Hospital wards and operating theatres	Internal noise level 45 dB
Places of worship	Internal noise level 45 dB
Active recreation areas	External noise level 65 dB
Passive recreation areas	External noise level 60 dB
Child care centres <sup>1</sup>	External noise level 65 dB
Aged care <sup>1</sup>	External noise level 65 dB (7am to 10pm) 60 dB (10pm to 7am)
Hotels <sup>1</sup>	External noise level 65 dB (7am to 10pm) 60 dB (10pm to 7am)
Theatre/auditorium <sup>1</sup>	External noise level 45 dB
Recording studio <sup>1</sup>	External noise level 45 dB
Public building <sup>1</sup>	Determined on site specific basis

Notes: 1. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development would typically remain closed, providing 20 dB of outdoor to indoor construction noise level reduction.

2. Notwithstanding NMLs in this table, Condition E80 states “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.”

## 5.6 Off-site road traffic noise criteria

When construction related traffic moves onto the public road network a different noise assessment method applies, as vehicle movements are regarded as ‘additional road traffic’ rather than as part of the construction works and as such would be assessed under the Roads and Maritime Noise Criteria Guideline (NCG) (2015). The NCG documents Roads and Maritime’s approach to implementing the EPA’s Road Noise Policy (RNP).

The NCG requires that an initial screening test should be applied by evaluating whether noise levels would increase by more than 2 dBA due to construction traffic or a temporary reroute due to a road closure. Where increases are 2 dBA or less then no further assessment is required as noise level changes would most likely not be perceptible to most people.

Where noise levels increase by more than 2 dBA further assessment is required using criteria presented in the RNP provided in Table 5.5.

**Table 5.5 RNP criteria for assessing construction vehicles on public roads**

Road category	Type of project/land use	Assessment criteria (external) (dB)	
		Day	Night
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 $L_{Aeq}(15 \text{ hour})$	55 $L_{Aeq}(15 \text{ hour})$
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	55 $L_{Aeq}(1 \text{ hour})$	50 $L_{Aeq}(1 \text{ hour})$

# 6 Construction vibration criteria

## 6.1 Overview

Vibration criteria adopted for the works are consistent with those established in the EIS and in accordance with the Instrument of Approval (SSI 7485). Condition E81 of SSI 7485 states that mitigation measures must be implemented with the aim of achieving the following vibration criteria:

- vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);
- Australian Standard AS 2187.2 - 2006 “Explosives - Storage and Use - Use of Explosives”;
- BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” as they are “applicable to Australian conditions”; and
- the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage).

It is noted that blasting is not part of the scope for works relevant to this CNVIS.

## 6.2 Human comfort – Assessing vibration: a technical guideline (DEC)

*Environmental Noise Management – Assessing Vibration: a technical guideline* (DEC, 2006) is based on guidelines contained in *BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz)*.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 6.1.

**Table 6.1 Examples of types of vibration (from Table 2.1 of the guideline)**

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.



Intermittent vibration is representative of activities such as impact hammering, vibratory rolling or general excavation work (such as an excavator tracking) and, as such, is most relevant to this assessment.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula (refer *section 2.4.1* of the guideline) was used:

$$VDV = \left[ \int_0^T a^4(t) dt \right]^{0.25}$$

Where VDV is the vibration dose value in  $m/s^{1.75}$ ,  $a(t)$  is the frequency-weighted rms of acceleration in  $m/s^2$  and  $T$  is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for intermittent vibration are reproduced in Table 6.2.

**Table 6.2 Acceptable vibration dose values (VDV) for intermittent vibration ( $m/s^{1.75}$ )**

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.

2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The Guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

### 6.3 Structural vibration criteria

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

### 6.3.1 Australian Standard AS 2187.2 - 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 “Explosives - Storage and Use - Use of Explosives” recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” be used as they are “applicable to Australian conditions”.

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

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 6.3 and graphically in Figure 6.1.

**Table 6.3 Transient vibration guide values - minimal risk of cosmetic damage**

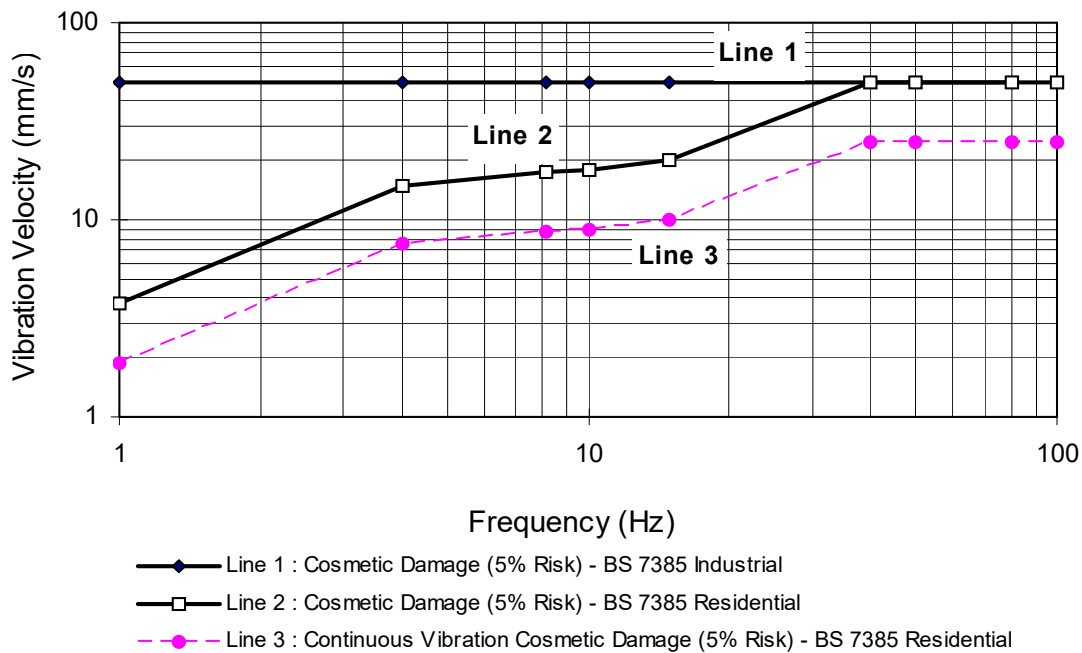
Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial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

Notes: Source: BS 7385 Part 2-1993.

The standard states that the guide values in Table 6.3 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration 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 6.3 may need to be reduced by up to 50%.

Sheet piling activities (for example) are considered to have the potential to cause dynamic loading in some structures (eg residences) and it may therefore be appropriate to reduce the transient values by 50%.



**Figure 6.1** Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz. The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 6.3, and major damage to a building structure may occur at values greater than four (4) times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 6.3 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Figure 6.1.

It is noteworthy that extra to the guide values nominated in Table 6.3, the standard states that:

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

Also that:

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

A vibration screening criterion of 15 mm/s is recommended for structures surrounding the site for vibration inducing construction. This should be reduced to 7.5mm/s (by 50%) if the vibration activity is continuous and has the potential to cause resonance effects in surrounding structures (eg sheet piling).

### 6.3.2 German Standard DIN 4150-3:1999

The German Standard DIN 4150 - Part 3: 1999, provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 6.4 and shown graphically in Figure 6.2.

For residential and commercial type structures, the standard recommends safe limits as low as 5mm/s and 20mm/s respectively. These limits increase with frequency values above 10Hz. The operational frequency of construction plant typically ranges between 10Hz to 30Hz, and hence according to DIN4150, the safe vibration guide limit range for dwellings is 5 to 15 mm/s. For reinforced commercial type buildings the limit is as low as 20mm/s, while for heritage or sensitive structures the lower limit is 3mm/s.

**Table 6.4 Structural damage guideline values of vibration velocity – DIN4150**

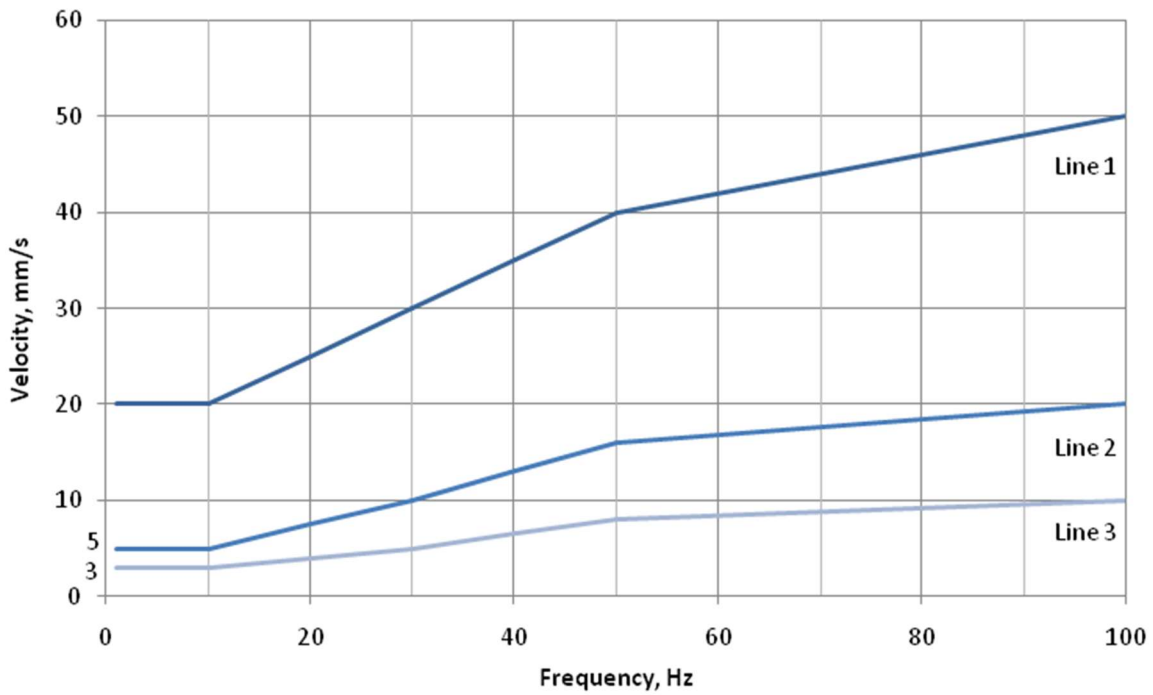
Line*	Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		1Hz to 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

- Notes:
1. "Line\*" refers to curves in Figure 1 of DIN4150.
  2. For frequencies above 100Hz the higher values in the 50Hz to 100Hz column should be used.

These levels are "safe limits", for which damage due to vibration effects is unlikely to occur. "Damage" is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the "safe limits" then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the "safe limits" are present, it does not necessarily follow that damage will occur.

As indicated by the guide levels from DIN 4150 in Figure 6.2, high frequency vibration has less potential to cause damage than lower frequencies. Furthermore, the "point source" nature of vibration from plant causes the vibratory disturbances to arrive at different parts of nearby large structures in an out-of-phase manner, thereby reducing its potential to excite in-phase motion of the low order modes of vibration in such structures.



**Figure 6.2** DIN4150 structural damage guideline values of vibration velocity

### 6.3.3 Project specific structural vibration criteria

Condition E81 requires that BS7385-2 and DIN4150-3 are both satisfied. DIN4150-3 is more conservative and provides more information for the assessment of heritage structures. If DIN4150-3 limits are satisfied, it can also be inferred that BS7385-2 limits are satisfied.

DIN4150-3 has therefore been adopted as the structural vibration criteria for the project.

# 7 Construction noise assessment

## 7.1 Assessment method

Methods and base parameters used to model construction noise emissions from site establishment phase are presented in this section.

Potential construction noise levels from the Project were predicted using a computer generated model using Brüel & Kjær Predictor Version 11 software (the model). The model calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. It considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area, other noise attenuating features such as buildings and barriers and applicable meteorological conditions.

The model was populated with 3-D topography of the Project area and surrounding area, extending out to nearest assessment locations and 3-D buildings. Construction plant and equipment representing the range of proposed construction scenarios was placed at locations which would represent typical to worst case noise levels throughout the construction program.

## 7.2 Construction scenarios and sound power levels

Acoustically significant fixed and mobile equipment items considered in the model are provided in Table 7.1, Table 7.2 and Table 7.3 for Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road, respectively. A detailed list of equipment items per scenario is provided in Appendix A, B and C for Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road, respectively.

Equipment sound power levels have been sourced from:

- Construction Noise and Vibration Guideline (RMS 2016);
- AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance;
- Department of Environment, Food and Rural Affairs (DEFRA) 2005, Update of Noise Database for Prediction of Noise on Construction and Open Sites; and
- EMM in-house measurement databases.

A 5 dB penalty has been added to plant that is considered to be impulsive, intermittent or contain other characteristics relative to overall construction activity noise that may cause greater annoyance as required by the ICNG and the CoA.

### 7.2.1 Parramatta Road East and West

Works at the Parramatta Road East and West site have been separated into five scenarios which represent a possible worst case noise level snapshot in time. These scenarios are detailed in Table 7.1.

The majority of the works are proposed to occur within ICNG standard hours only. Out of hours work addressed in this CNVIS will be required for bridge construction to minimise disruption to the traffic network during the day.

Noise barriers/site hoarding included in the noise model for each scenario are discussed in Table 7.1 and shown in Figure 4.1.

**Table 7.1 Parramatta Road East and West site establishment scenarios (approx. 3 to 5 months total)**

ID	Description	Hours of work (ICNG hours)				Activity sound power level, dBA			Approximate works program			Physical noise mitigation (refer Figure 4.1)
		Day	Day OOH	Eve OOH	Night OOH	Day Leq	OOH Leq	OOH Lmax	Q4 2018	Q1 2019	Q2 2019	
1	Site setup	Yes				109	n/a	n/a				
2	Geotech investigations	Yes				115	n/a	n/a				
3	Deliveries	Yes				106	n/a	n/a				
4	Asbestos removal and demolition	Yes				123	n/a	n/a				
5	Install plywood hoardings/noise barriers, set-up environmental controls	Yes				122	n/a	n/a				
6	Pedestrian bridge construction	Yes		Yes	Yes	112	112	112				Plywood hoarding
7	Deliveries and installation of site facilities and services	Yes				115	n/a	n/a				Plywood hoarding

Notes: OOH – Out-of-hours  
 Day – 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
 Day OOH – Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
 Eve – Evening 6:00 pm to 10:00 pm Monday to Sunday  
 Night – Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays  
 Leq – Leq,15minute  
 5 dB penalty factor added for activities that may cause greater annoyance such as hammering, piling and crushing

## 7.2.2 Pyrmont Bridge Road

Pyrmont Bridge Road works have been separated into eight scenarios which represent typical to possible worst case noise for each snapshot in time. These scenarios are detailed in Table 7.2.

The majority of the works are proposed to occur within ICNG standard hours only. Out of hours work relevant to this CNVIS will be required for temporary hoarding construction which requires access to the local road network due to the positioning of utilities such as overhead powerlines.

Noise barriers/site hoarding included in the noise model for each scenario are described in Table 7.2 and shown in Figure 4.2.



**Table 7.2 Pyrmont Bridge Road site establishment scenarios (approx. 4 to 6 months total)**

ID	Description	Hours of work (ICNG hours)				Activity sound power level, dBA			Approximate works program			Physical noise mitigation features (refer Figure 4.2)
		Day	Day OOH	Eve OOH	Night OOH	Day Leq	OOH Leq	OOH Lmax	Q4 2018	Q1 2019	Q2 2019	
1	Site setup	Yes				108	n/a	n/a				
2	Geotech investigations	Yes				115	n/a	n/a				
3	Asbestos removal and demolition	Yes				124	n/a	n/a				
4	Deliveries	Yes				105	n/a	n/a				
5	Installation of site facilities and services	Yes				115	n/a	n/a				
6	Earthworks, protect utilities, install plywood hoardings	Yes		Yes	Yes	118	107	110				
7	Foundations and pavements	Yes				119	n/a	n/a				Plywood hoarding
8	Bored piling for shed and cut and cover	Yes				117	n/a	n/a				Plywood hoarding
9	Build acoustic shed	Yes				112	n/a	n/a				Plywood hoarding
10	Decline cut and cover earthworks, and shaft excavation	Yes				123	n/a	n/a				Plywood hoarding
11	Shotcrete trials, complete site set-up and deliveries	Yes				115	n/a	n/a				Plywood hoarding, acoustic shed

Notes: OOH - Out-of-hours  
 Day - 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
 Day OOH - Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
 Eve - Evening 6:00 pm to 10:00 pm Monday to Sunday  
 Night - Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays  
 Leq - Leq,15minute  
 5 dB penalty factor added for activities that may cause greater annoyance such as hammering, piling and crushing

### 7.2.3 Campbell Road

Campbell Road works have been separated into seven scenarios which represent typical to possible worst case noise for each snapshot in time. These scenarios are detailed in Table 7.3.

The majority of the works are proposed to occur within ICNG standard hours only. Out of hours work relevant to this CNVIS will be required for temporary hoarding construction which requires access to the local road network due to the positioning of utilities such as overhead powerlines.

Noise barriers/site hoarding included in the noise model for each scenario are described in Table 7.3 and shown in Figure 4.3.

**Table 7.3 Campbell Road site establishment scenarios (approx. 4 to 6 months total)**

ID	Description	Hours of work (ICNG hours)				Activity sound power level, dBA			Approximate works program			Physical noise mitigation features (refer Figure 4.3)
		Day	Day OOH	Eve OOH	Night OOH	Day Leq	OOH Leq	OOH Lmax	Q4 2018	Q1 2019	Q2 2019	
1	Site setup	Yes				108	n/a	n/a				
2	Geotech investigations	Yes				115	n/a	n/a				
3	Earthworks, drainage and install plywood hoardings	Yes				118	n/a	n/a				
4	Foundations and pavements	Yes				117	n/a	n/a				Plywood hoarding
5	Deliveries	Yes		Yes	Yes	105	105	110				Plywood hoarding
6	Install of site facilities and services	Yes		Yes	Yes	107	107	111				Plywood hoarding
7	Bored piling for shed and cut and cover	Yes				117	n/a	n/a				Plywood hoarding
8	Build acoustic shed	Yes				113	n/a	n/a				Plywood hoarding
9	Decline cut and cover earthworks, and shaft excavation	Yes				123	n/a	n/a				Plywood hoarding
10	Shotcrete trials, complete site set-up and deliveries	Yes				115	n/a	n/a				Plywood hoarding

Notes: OOH - Out-of-hours  
 Day - 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
 Day OOH - Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
 Eve - Evening 6:00 pm to 10:00 pm Monday to Sunday  
 Night - Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays  
 Leq -  $L_{eq,15minute}$   
 5 dB penalty factor added for activities that may cause greater annoyance such as hammering, piling and crushing.

## 7.3 Results

Predicted construction noise levels from site establishment are provided in the following sections for Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road ancillary facilities. Predictions have been split into four categories to represent the number of receivers which exceed NMLs by:

- 1 to 10 dB;
- 11 to 20 dB;
- 21 to 25 dB; and
- greater than 25 dB.

### 7.3.1 Parramatta Road East and West

#### i Residential

A summary of predicted noise levels which exceed NMLs at the Parramatta Road East and West site are provided in Table 7.4 for standard and out of hours periods. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above the noise affected NMLs are predicted at a number of residential properties surrounding the site. Construction noise levels are greatest during asbestos removal and demolition (scenario 4). Modelling shows that noise levels will progressively decrease over time after scenario 4, and that site hoardings installed during scenario 6 will also reduce offsite noise levels and the number of receivers with construction noise levels above NMLs reduces significantly.

The bridge construction over Parramatta Road requires a Road Occupancy License (ROL) and therefore construction must be undertaken during OOH evening and night periods. Predicted noise levels from this activity are above the noise affected NMLs at a number of residential receiver locations, the majority of which fall into the 1 to 10 dB exceedance category. There is greater scope to reduce noise levels of this magnitude to below the NMLs. For example, localised noise barriers around a static noise source can provide 5 to 10 dB of noise reduction.

Construction noise levels above the sleep disturbance screening criterion are also predicted during bridge construction. Again, these are in the 1 to 10 dB exceedance category with greater scope to mitigate closer or to below the screening criteria.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.

**Table 7.4 Parramatta Road East and West assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75 dB)	Evening noise affected NML(RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
1 Site setup	Total exceedances	30	3	n/a	n/a	n/a
	1-10dB	23	n/a	n/a	n/a	n/a
	11-20dB	4	n/a	n/a	n/a	n/a
	21-25dB	1	n/a	n/a	n/a	n/a
	>25dB	2	n/a	n/a	n/a	n/a
2 Geotech investigations	Total exceedances	69	6	n/a	n/a	n/a
	1-10dB	50	n/a	n/a	n/a	n/a
	11-20dB	14	n/a	n/a	n/a	n/a
	21-25dB	2	n/a	n/a	n/a	n/a
	>25dB	3	n/a	n/a	n/a	n/a
3 Deliveries	Total exceedances	26	1	n/a	n/a	n/a
	1-10dB	22	n/a	n/a	n/a	n/a
	11-20dB	3	n/a	n/a	n/a	n/a
	21-25dB	1	n/a	n/a	n/a	n/a
	>25dB	0	n/a	n/a	n/a	n/a
4 Asbestos removal and demolition	Total exceedances	1031	19	n/a	n/a	n/a
	1-10dB	926	n/a	n/a	n/a	n/a
	11-20dB	92	n/a	n/a	n/a	n/a
	21-25dB	7	n/a	n/a	n/a	n/a
	>25dB	6	n/a	n/a	n/a	n/a
5 Install plywood hoardings/noise barriers, set-up environmental controls	Total exceedances	915	15	n/a	n/a	n/a
	1-10dB	831	n/a	n/a	n/a	n/a
	11-20dB	73	n/a	n/a	n/a	n/a
	21-25dB	7	n/a	n/a	n/a	n/a
	>25dB	4	n/a	n/a	n/a	n/a
6 Pedestrian bridge construction	Total exceedances	5	0	62	424	21
	1-10dB	5	n/a	62	403	21
	11-20dB	0	n/a	0	21	0
	21-25dB	0	n/a	0	0	0
	>25dB	0	n/a	0	0	0

**Table 7.4 Parramatta Road East and West assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75 dB)	Evening noise affected NML(RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
7	Total exceedances	50	0	n/a	n/a	n/a
Installation of site facilities and services	1-10dB	48	n/a	n/a	n/a	n/a
	11-20dB	2	n/a	n/a	n/a	n/a
	21-25dB	0	n/a	n/a	n/a	n/a
	>25dB	0	n/a	n/a	n/a	n/a

ii Non-residential

A summary of predicted noise levels which exceed noise affected NMLs during standard hours are provided in Table 7.5. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above noise affected NMLs are predicted at several non-residential properties. These exceedances are greatest during asbestos removal and demolition and progressively decrease after this scenario. This is particularly the case once site hoardings are installed after scenario 5. The noise levels above NMLs are largely confined to industrial and commercial locations, with exceedances at child care, educational and medical receivers only expected during scenario 4 and 5.

Construction noise levels are predicted to satisfy NMLs at all non-residential receivers during OOH periods.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.

**Table 7.5 Parramatta Road East and West assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML (when in use)					
		Total other	Commercial	Childcare centre	Education	Medical	Passive recreation
1	Total exceedances	3	3	0	0	0	0
Site setup	1-10dB	3	3	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
	2	Total exceedances	4	4	0	0	0
Geotech investigations	1-10dB	2	2	0	0	0	0
	11-20dB	2	2	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0

**Table 7.5 Parramatta Road East and West assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML (when in use)					
		Total other	Commercial	Childcare centre	Education	Medical	Passive recreation
3 Deliveries	Total exceedances	2	2	0	0	0	0
	1-10dB	2	2	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
4 Asbestos removal and demolition	Total exceedances	19	10	3	4	1	1
	1-10dB	16	7	3	4	1	1
	11-20dB	2	2	0	0	0	0
	21-25dB	1	1	0	0	0	0
	>25dB	0	0	0	0	0	0
5 Install plywood hoardings/noise barriers, set-up environmental controls	Total exceedances	17	10	3	3	0	1
	1-10dB	14	7	3	3	0	1
	11-20dB	2	3	0	0	0	0
	21-25dB	1	1	0	0	0	0
	>25dB	0	0	0	0	0	0
6 Pedestrian bridge construction	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
7 Installation of site facilities and services	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0

**iii Cumulative noise**

The NMLs for the project are based on background noise levels measured at the EIS in the absence of construction noise from each stage of the WestConnex project. Therefore, adhering to NMLs as far as practicable would also assist in minimising cumulative noise impacts from the project.

Other construction activity from the project is unlikely to occur at the same time as site establishment. Therefore, cumulative noise impacts from multiple project work sites are considered unlikely.

## 7.3.2 Pymont Bridge Road

### i Residential

A summary of predicted noise levels which exceed NMLs due to proposed works at the Pymont Bridge Road site are provided in Table 7.6 for standard and OOH periods. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above the noise affected NMLs are predicted at a number of residential properties surrounding the site which are greatest during scenario 3. Noise levels decrease after scenario 3, which is further assisted by the installation of site hoardings after scenario 6.

Some sections of site hoarding construction (during Scenario 6) will require a ROL and therefore construction must be undertaken during OOH evening and night periods. Noise levels during this time are predicted to be above noise affected NMLs at up to 22 receiver locations. The majority of these receivers fall into the 1 to 10 dB category. There is relatively greater scope to reduce noise levels of this magnitude to below the noise affected NMLs. For example, localised noise barriers around a static noise source can provide 5 to 10 dB of noise reduction.

Construction noise levels above the sleep disturbance screening criterion are also predicted at up to eight receivers during OOH works. Again, these are in the 1 to 10 dB category with greater scope to mitigate closer or to below the screening criteria.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.

**Table 7.6 Pymont Bridge Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75 dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
1 Site setup	Total exceedances	7	0	n/a	n/a	n/a
	1-10dB	7	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
2 Geotech investigations	Total exceedances	18	1	n/a	n/a	n/a
	1-10dB	15	0	n/a	n/a	n/a
	11-20dB	3	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
3 Asbestos removal and demolition	Total exceedances	57	3	n/a	n/a	n/a
	1-10dB	51	0	n/a	n/a	n/a
	11-20dB	6	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
4 Deliveries	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a



**Table 7.6 Pyrmont Bridge Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75 dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
	Total exceedances	3	0	n/a	n/a	n/a
5 Installation of site facilities and services	1-10dB	3	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
6 Earthworks, protect utilities, install plywood hoardings	Total exceedances	12	0	5	22	8
	1-10dB	12	0	5	19	8
	11-20dB	0	0	0	3	0
	21-25dB	0	0	0	0	0
	>25dB	0	0	0	0	0
7 Foundations and pavements	Total exceedances	11	0	n/a	n/a	n/a
	1-10dB	11	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
8 Bored piling for shed and cut and cover	Total exceedances	5	0	n/a	n/a	n/a
	1-10dB	5	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
9 Build acoustic shed	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
10 Decline cut and cover earthworks and shaft excavation	Total exceedances	17	0	n/a	n/a	n/a
	1-10dB	17	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a

**Table 7.6 Pyrmont Bridge Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75 dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
11	Total exceedances	3	0	n/a	n/a	n/a
Shotcrete trials and complete site set-up	1-10dB	3	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a

**ii Non-residential**

A summary of predicted noise levels which exceed NMLs at Pyrmont Bridge Road are provided in Table 7.7. A summary is provided for standard hours and OOH periods. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above noise affected NMLs are predicted at a number of non-residential receivers which are greatest during scenario 3. Construction noise levels decrease after these scenarios which is further assisted by the installation of site hoarding after scenario 6.

The majority of buildings with predicted noise levels above the NMLs are classified as commercial or retail.

Noise levels above NMLs are predicted at two education institutions, situated on the south side of Parramatta Road. These exceedances would only transpire in practice when construction is in relative close proximity, close to the south site boundary.

Noise levels above the NMLs are predicted at two recording studios situated on Church Street during asbestos removal and demolition. The predicted noise levels for the recording studios are based on a 30 dB outdoor to indoor noise reduction. In our experience this is likely to be conservative for a studio which would typically have a much higher level of sound insulation, especially given the locality in a noisy urban environment. This however should be reviewed in more detail in consultation with the users.

Noise levels above NMLs are predicted at one passive recreation receiver (Camperdown Park) during scenario 3 only. Noise levels above the NML would expected to be of short duration and only when construction is near the southern site boundary.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.1.

**Table 7.7** Pyrmont Bridge Road assessment of noise predictions – non-residential

Scenario	Assessment category	Predicted number of receivers above noise affected NML					
		Total	Commercial	Cafe/bar	Educational	Passive recreation	Recording studio
1 Site setup	Total exceedances	5	5	0	0	0	0
	1-10dB	4	4	0	0	0	0
	11-20dB	1	1	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
2 Geotech investigations	Total exceedances	11	9	0	2	0	0
	1-10dB	7	5	0	2	0	0
	11-20dB	4	4	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
3 Asbestos removal and demolition	Total exceedances	23	17	1	2	1	2
	1-10dB	20	15	1	1	1	2
	11-20dB	3	2	0	1	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
4 Deliveries	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
5 Installation of site facilities and services	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
6 Earthworks, protect utilities, install plywood hoardings	Total exceedances	8	6	0	2	0	0
	1-10dB	8	6	0	2	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
7 Foundations and pavements	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0

**Table 7.7 Pyrmont Bridge Road assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML					
		Total	Commercial	Cafe/bar	Educational	Passive recreation	Recording studio
8 Bored piling for shed and cut and cover	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
9 Build acoustic shed	Total exceedances	0	0	0	0	0	0
	1-10dB	0	0	0	0	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
10 Decline cut and cover earthworks and shaft excavation	Total exceedances	8	6	0	2	0	0
	1-10dB	8	6	0	2	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0
11 Shotcrete trials and complete site set-up	Total exceedances	2	0	0	2	0	0
	1-10dB	2	0	0	2	0	0
	11-20dB	0	0	0	0	0	0
	21-25dB	0	0	0	0	0	0
	>25dB	0	0	0	0	0	0

### iii Cumulative noise

The NMLs for the project are based on background noise levels measured at the EIS stage of M4 East, New M5 and M4-M5 Link projects in the absence of construction noise from each stage of the WestConnex project. Therefore, adhering to NMLs as far as practicable would therefore also assist in minimising cumulative noise impacts from the project.

Other construction activity from the project is unlikely to occur at the same time as site establishment. Therefore, cumulative noise impacts from multiple project work sites are considered unlikely.

## 7.3.3 Campbell Road

### i Residential

A summary of predicted noise levels which exceed NMLs at the Campbell Road are provided in Table 7.8. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above the noise affected NMLs are predicted at three residential properties surrounding the site during scenario 3 only. Predicted noise levels are in the 1 to 10 dB range and therefore there is relatively greater scope to manage and mitigation to or close to noise affected NMLs using conventional methods such as localised noise barriers and quieter work practices, where feasible and reasonable.

Limited activities such as deliveries (scenario 5) and site installation works (scenario 6) may be undertaken during OOH evening and night periods. Noise levels during this time are predicted to be above noise affected NMLs at up to nine receiver locations during scenario 6 and at one receiver during scenario 5. All of these receivers fall into the 1 to 10 dB category.

There is relatively greater scope to reduce noise levels of this magnitude to below the noise affected NMLs. For example, localised noise barriers around a static noise source can provide 5 to 10 dB of noise reduction. Increasing the distance between the activity and receiver locations could also be utilised for this site given the overall size. For example, every doubling of distance between the activity and receiver location will achieve 6dB of noise reduction. It is therefore expected that these potential impacts can be actively mitigated and managed at the time to satisfy NMLs.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.1.

**Table 7.8 Campbell Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
1 Site setup	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
2 Geotech Investigation	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
3 Earthworks, drainage, install plywood hoardings	Total exceedances	1	0	n/a	n/a	n/a
	1-10dB	1	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a

**Table 7.8 Campbell Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
4 Foundations and pavements	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
5 Deliveries	Total exceedances	0	0	0	1	0
	1-10dB	0	0	0	1	0
	11-20dB	0	0	0	0	0
	21-25dB	0	0	0	0	0
	>25dB	0	0	0	0	0
6 Install of site facilities	Total exceedances	0	0	0	9	0
	1-10dB	0	0	0	9	0
	11-20dB	0	0	0	0	0
	21-25dB	0	0	0	0	0
	>25dB	0	0	0	0	0
7 Bored piling for shed and cut and cover	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
8 Build acoustic shed	Total exceedances	0	0	n/a	n/a	n/a
	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a

**Table 7.8 Campbell Road assessment of noise predictions - residential**

Scenario	Assessment category	Predicted number of receivers above NML				
		Day noise affected NML (RBL + 10dB)	Day highly noise affected NML (>75dB)	Evening noise affected NML (RBL + 5dB)	Night noise affected NML (RBL + 5dB)	Night sleep disturbance screen criteria (RBL + 15dB)
9	Total exceedances	1	0	n/a	n/a	n/a
Decline cut and cover earthworks, and shaft excavation	1-10dB	1	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
	Total exceedances	0	0	n/a	n/a	n/a
10	Total exceedances	0	0	n/a	n/a	n/a
Shotcrete trials, complete site set-up and deliveries	1-10dB	0	0	n/a	n/a	n/a
	11-20dB	0	0	n/a	n/a	n/a
	21-25dB	0	0	n/a	n/a	n/a
	>25dB	0	0	n/a	n/a	n/a
	Total exceedances	0	0	n/a	n/a	n/a

ii **Non-residential**

A summary of predicted noise levels which exceed noise affected NMLs due to proposed works at Campbell Road are provided in Table 7.9 for standard hours. Single point predictions for all receivers within the immediate NCAs are provided in Appendix B.

Construction noise levels above noise affected NMLs are predicted at Sydney Park (passive recreation) during scenario three and nine. Construction noise levels decrease over time which is assisted by the installation of site hoarding, site buildings and the acoustics shed.

Mitigation and management measures to improve this environmental outcome are presented in Section 10.

**Table 7.9 Campbell Road assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML		
		Total	Commercial	Passive recreation
1	Total exceedances	0	0	0
Site setup	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
	Total exceedances	0	0	0
2	Total exceedances	0	0	0
Geotech Investigation	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
	Total exceedances	0	0	0

**Table 7.9 Campbell Road assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML		
		Total	Commercial	Passive recreation
3 Earthworks, drainage, install plywood hoardings	Total exceedances	1	0	1
	1-10dB	1	0	1
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
4 Foundations and pavements	Total exceedances	0	0	0
	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
5 Deliveries	Total exceedances	0	0	0
	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
6 Install of site facilities	Total exceedances	0	0	0
	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
7 Bored piling for shed and cut and cover	Total exceedances	0	0	0
	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
8 Build acoustic shed	Total exceedances	0	0	0
	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0



**Table 7.9 Campbell Road assessment of noise predictions – non-residential**

Scenario	Assessment category	Predicted number of receivers above noise affected NML		
		Total	Commercial	Passive recreation
9	Total exceedances	1	0	1
Decline cut and cover earthworks, and shaft excavation	1-10dB	1	0	1
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0
10	Total exceedances	0	0	0
Shotcrete trials, complete site set-up and deliveries	1-10dB	0	0	0
	11-20dB	0	0	0
	21-25dB	0	0	0
	>25dB	0	0	0

iii Cumulative noise

The NMLs for the project are based on background noise levels measured at the EIS in the absence of construction noise from each stage of the WestConnex project. Therefore, adhering to NMLs as far as practicable would therefore also assist in minimising cumulative noise impacts from the project.

Other construction activity from the project is unlikely to occur at the same time as site establishment. Therefore, cumulative noise impacts from multiple project work sites is considered unlikely.

# 8 Construction vibration assessment

## 8.1 Safe working distances and assessment methodology

Table 8.1 provides an indication of potential offset distances required from sensitive receivers in order to comply with DIN4150-3 vibration criteria. This information should be used by relevant personnel when planning their work to identify when other forms of construction methodology or vibration mitigation and/or management measures may need to be investigated or implemented. This data is based on information provided in the noise and vibration assessment prepared for the EIS as well as publicly available data for other large infrastructure projects in Sydney.

The safe working distances provided are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

**Table 8.1 Vibration levels and safe working distance guidance – transient vibration**

Source	Estimated safe working distance			
	Human comfort	Commercial, Industrial or similar structures	Dwellings and similar structures	Heritage and other sensitive structures
Large Vibratory Roller (20t)	100m	5m	33m	50m
Medium Vibratory Roller (10t)	100m	5m	20m	31m
Compactor (7t)	50m	5m	20m	20m
Hand operated wacka packer on backfill	10m	5m	5m	5m
Hand operated wacka packer on asphalt	10m	5m	5m	5m
Heavy Hydraulic Hammer (1500kg hammer on 30t excavator)	73m	5m	22m	44m
Medium Hydraulic Hammer (900kg hammer on 18t excavator)	23m	5m	10m	15m
Light Hydraulic Hammer (300kg on 5t excavator)	10m	5m	5m	5m
Jack Hammer	Avoid contact with structure	5m	5m	5m
Air Track Drill	20m	5m	5m	10m
Small rock drill (estimate)	10m	5m	5m	5m
Down the Hole Hammer	10m	5m	5m	5m
Ripping (measured in Sydney sandstone)	10m	5m	5m	5m
Impact Piling	30m	5m	10m	20m
Vibratory Piling	30m	5m	26m	100m
Rock Sawing	10m	5m	5m	5m
Bored Piling	N/A	5m	10m	10m

Notes: 1. Based on information provided in the NorthConnex Construction Noise and Vibration Management Sub Plan prepared by Lend Lease Bouygues Joint Venture dated 1 May 2017.

Proposed site establishment construction plant and equipment has been utilised to determine where, if at all, the safe working distances are likely to be encroached and, if so, likely areas of impact. Recommendations regarding appropriate vibration mitigation and management measures have been provided in Section 10.2.

Construction scenarios considered are consistent with those presented for the construction noise assessment. Proposed works with the potential to cause vibration impact at nearby vibration-sensitive receptors include the use of drills, vibratory rollers or excavations including the use of a rock hammer and bored piling rig for the shed at the Pyrmont Bridge Road and Campbell Road site.

The number of receptors with potential to exceed relevant vibration criteria at each site is summarised in Table 8.2. Vibration contour plots are provided in the NVMP.

**Table 8.2 Potential vibration impacts**

Equipment item	Construction scenario	Number of receptors with potential to exceed vibration criteria <sup>1</sup>			
		Human comfort (residences)	Cosmetic damage		
			Dwellings, garages	Commercial, industrial or similar	Heritage and other sensitive structures
<b>Parramatta Road East and West</b>					
Drill	2 and 5	10	7	3	0
Heavy hydraulic hammer <sup>2</sup>	4	47	16	4	0
Large vibratory roller (20t)	5	72	27	4	0
<b>Pyrmont Bridge Road</b>					
Drill	2 and 8	0	0	1	0
Heavy hydraulic hammer <sup>2</sup>	3 and 10	21	2	3	2
Large vibratory roller (20t)	7, 8 and 10	49	8	3	2
<b>Campbell Road</b>					
Heavy hydraulic hammer <sup>2</sup>	9	0	0	0	2
Large vibratory roller (20t)	4, 7 and 9	0	0	0	2

Notes: 1. The number of potentially affected receptors have been calculated based on the most conservative safe distances provided in Table 8.1 for the relevant task.

2. 1500kg hammer on 30t excavator.

3. Based on the air track drill in Table 8.1.

In addition to heritage items identified in Table 8.2, a feasibility study will be undertaken which will review the possibility of retaining the bank facade at the Pyrmont Bridge Road site which also has heritage significance. This CNVIS will be updated accordingly should it be decided that the bank facade will be retained. In the interim, vibration intensive activity will be managed when in the vicinity of the bank facade where safe working distance referenced in Table 8.1 are encroached.

Vibration mitigation and management measures are detailed in Section 10.2.

## 9 Offsite traffic noise

The road traffic noise generated by site establishment related to the Parramatta Road, Campbell Road and Pyrmont Bridge Road sites has been assessed in accordance with the NSW RNP. This document provides the principle guidance to assess the impact of road traffic noise on noise sensitive receivers, such as residences which are in close proximity to the sites.

### 9.1 Parramatta Road East and West

Construction hours at Parramatta Road East and West are generally between 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 6:00 pm Saturday for the majority of the site establishment phase. Limited construction during out of standard construction hours is also proposed. As an assumed worst case, additional traffic movements associated with the site in any given 15 minute period are as follows:

- four additional light vehicles; and
- one additional heavy vehicle.

Over the course of defined RNP periods, this equates to:

- 240 additional light vehicle and 60 additional heavy vehicle movements during the day; and
- 144 additional light vehicle and 36 additional heavy vehicle movements during the night.

These movements are based on construction scenarios which occur over a worst case 15 minutes developed for construction noise modelling. They will not be sustained over a full day and/or night period and are therefore conservative.

Existing traffic movements in this assessment are based on weekday 2018 data as found in the Roads and Maritime Services (Roads and Maritime) traffic volume viewer on the Roads and Maritime website.

The relative increase in noise levels which incorporate the additional traffic movements were calculated using the UK's Calculation of Road Traffic Noise (CoRTN) algorithm, adjusted for Australian conditions, and are presented in Table 9.1. It was assumed that half of the additional traffic movements occurred on each of the site access roads; namely Parramatta Road or Wattle Street.

**Table 9.1 Assessment of increased traffic noise levels – Parramatta Road East and West**

Road	Period	Existing traffic		Additional traffic		Noise criteria LAeq (15 hour), dB(A)	Relative LAeq,period noise increase (dB)
		Light	Heavy	Light	Heavy		
Parramatta Road	Day	53700	4670	120	30	60 LAeq (15 hour),	≈ 0
	Night	14645	1274	72	18	55 LAeq (9 hour)	≈ 0
Wattle Street	Day	18837	1638	120	30	60 LAeq (15 hour),	≈ 0
	Night	4404	383	72	18	55 LAeq (9 hour)	≈ 0

Notes: 1. Daytime is defined as 7am to 10pm and night-time is defined as 10pm to 7am as per the RNP.

The results indicate that increased traffic movements from the site establishment phase on Parramatta Road and Wattle Street are negligible and will result in no changes to the existing traffic noise levels.

There will be a requirement during site establishment for occasional heavy vehicle deliveries to use the Alt Street site access (north and south). Alt Street is classified as a local road where an  $L_{Aeq,1hour}$  criteria applies

A comparison of predicted noise levels from a single heavy vehicle delivery per hour and the existing  $L_{Aeq,1hour}$  noise levels recorded at logger H.03 indicate a potential increase of greater than 2 dB during the night period at residents on Alt Street which are near site access gates. A relative increase of road traffic noise levels of greater than 2 dB exceeds CNVG assessment requirements. Truck movements at night will therefore be managed to avoid the use of the Alt Street site access. This will include prioritising the Parramatta Road access gate during the night-time period.

Notwithstanding the above, night work proposed at Parramatta Road East and West is due to the requirement for an ROL over Parramatta Road. It is most likely that the Parramatta Road site access would be used for deliveries associated with this activity which would avoid the need to utilise Alt Street.

If the Alt Street site access must be used during the night, the activity will be assessed under the out-of-hours works protocol as nominated in the project's Environmental Protection License (EPL) where activity specific noise management and mitigation measures will be developed.

## 9.2 Pyrmont Bridge Road

Construction hours at Parramatta Road East and West are generally between 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 6:00 pm Saturday for the majority of the site establishment phase. Limited construction during out of standard construction hours is also proposed. As an assumed worst case, additional traffic movements associated with the site in any given 15 minute period are as follows:

- four additional light vehicles; and
- one additional heavy vehicle.

Over the course of the defined RNP periods, this equates to:

- 240 additional light vehicle and 60 additional heavy vehicle movements during the day; and
- 144 additional light vehicle and 36 additional heavy vehicle movements during the night.

These movements are based on construction scenarios which occur over a worst case 15 minutes developed for construction noise modelling. They will not be sustained over a full day and/or night period and are therefore conservative.

Existing traffic movements in this assessment are based on weekday data as found in the Roads and Maritime traffic volume viewer on Roads and Maritime website.

The relative increase in noise levels which incorporate the additional traffic movements were calculated using the UK's Calculation of Road Traffic Noise (CoRTN) algorithm, adjusted for Australian conditions, and are presented in Table 9.2. It was assumed that all additional traffic movements would utilise Pyrmont Bridge Road where nearest residential receivers are located. This provides a conservative assessment, as the relative increase in road traffic noise on Parramatta Road where other residential receivers are located would be less given higher existing volumes.

There are no land uses sensitive to road traffic noise (as defined in the NSW RNP) on Mallet Street and Bignell Lane which will also be utilised during site establishment. The single residential receiver on the corner of Pymont Bridge Road and the future extended Bignell Lane would be predominantly exposed to road traffic noise from Pymont Bridge Road which has been assessed in Table 9.2.

Further, the resident on the corner of Bignell Lane and Pymont Bridge Road (including adjoining terrace residences) will be exposed to construction noise from most of the site as assessed in Section 7.3.2. Therefore, with respect to noise, trucks which use Bignell Lane will be likely perceived by these residents as a part of overall construction activity, rather than a separate road traffic noise source. Truck activity on Bignell Lane will therefore be appropriately managed under the sites NVMP where it is found to exceed NMLs. This will include adopting site speed limits for trucks which use Bignell Lane.

**Table 9.2 Assessment of increased traffic noise levels – Pymont Bridge Road**

Road	Period	Existing traffic		Additional traffic		Noise criteria dB(A)	Relative L <sub>Aeq,period</sub> noise increase (dB)
		Light	Heavy	Light	Heavy		
Pymont Bridge Road	Day	31686	2755	240	60	60 L <sub>Aeq</sub> (15 hour),	≈ 0
	Night	5001	435	144	36	55 L <sub>Aeq</sub> (9 hour)	≈ 0

Notes: 1. Daytime is defined as 7am to 10pm and night-time is defined as 10pm to 7am as per the RNP.  
2. The most recent RMS volume data for Pymont Bridge Road is from 2009. The 2018 volume has been estimated using a standard 2.5 % per year increase.

The results indicate that increased traffic movements from the site establishment phase are negligible and will result in no changes to the existing traffic noise levels.

### 9.3 Campbell Road

Construction hours at Parramatta Road East and West are generally between 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 6:00 pm Saturday for the majority of the site establishment phase. Limited construction during out of standard construction hours is also proposed. As an assumed worst case, additional traffic movements associated with the site in any given 15 minute period are as follows:

- four additional light vehicles; and
- one additional heavy vehicles.

Over the course of the defined RNP periods, this equates to:

- 240 additional light vehicle and 60 additional heavy vehicle movements during the day; and
- 144 additional light vehicle and 36 additional heavy vehicle movements during the night.

These volumes are based on construction scenarios which occur over a worst case 15 minutes developed for construction noise modelling. They will not be sustained over a full day or night period and are therefore conservative.

Existing traffic movements in this assessment are based on average weekly traffic data from Table 8-32 of the M4-M5 Link EIS.

The relative increase in noise levels which incorporate the additional traffic movements were calculated using the UK's Calculation of Road Traffic Noise (CoRTN) algorithm, adjusted for Australian conditions, and are presented in

Table 9.3. It was assumed that all additional traffic movements occurred on the site’s only access road; namely Campbell Road.

**Table 9.3 Assessment of increased traffic noise levels – Campbell Road**

Road	Period	Existing traffic		Additional traffic		Noise criteria, dB(A)	Relative L <sub>Aeq,period</sub> noise increase (dB)
		Light	Heavy	Light	Heavy		
Campbell Road	Day	8232	1118	176	44	60 L <sub>Aeq</sub> (15 hour)	≈ 0
	Night	1453	197	144	36	55 L <sub>Aeq</sub> (9 hour)	≈ 0

Notes: 1. Daytime is defined as 7am to 10pm as per the RNP.

The results indicate that increased traffic movements from the site establishment phase are negligible and will result in no changes to the existing traffic noise levels.

# 10 Noise and vibration mitigation and management

## 10.1 Noise

### 10.1.1 General

The EPA's NSW ICNG requires that construction noise levels are assessed against NMLs. It is not uncommon for construction projects to exceed NMLs. For this reason, they are not considered as noise criteria, but as a trigger for all feasible and reasonable noise mitigation and management to be considered, once exceeded.

Noise levels above NMLs have been predicted for some construction phases of the Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road sites, primarily prior to the installation of site hoarding and noise barriers (where applicable). This triggers the need for feasible and reasonable noise mitigation and management.

The following site specific feasible and reasonable noise mitigation and management will be employed on each site to reduce construction noise levels with the aim of satisfying NMLs:

- noise barriers/site hoardings as presented in Figures 4.1, 4.2 and 4.3 will be implemented at each site;
- trucks which use Bignell Lane during site establishment will adopt site speed limits;
- the use of noise intensive equipment including rock hammers, road saws, vibratory rollers, grinders or other equipment as defined in the CoA as applicable to site establishment will be carried out in accordance with CoA E72. This includes limiting these activities to times of permitted use and applying respite requirements as outlined in CoA E72;
- in accordance with CoA E80, activities described in scenarios 5 and 6 (Table 7.1) which are predicted to exceed the NMLs at the educational and child care facilities at Parramatta Road East and West will be scheduled as to avoid noise impacts during sensitive time periods, unless other reasonable arrangements are made with these affected institutions. These properties are identified in Appendix B.
- in accordance with CoA E80, activities described in scenarios 2, 3 and 10 (Table 7.2) which are predicted to exceed the NMLs at the educational facilities and the recording studios surrounding Pyrmont Bridge Road will be scheduled as to avoid noise impacts during sensitive time periods, unless other reasonable arrangements are made with these affected institutions. These properties are identified in Appendix B.
- notwithstanding the above, actual noise levels will be verified by measurement throughout the site establishment phase. This CNVIS will be refined as required to capture differences between noise predictions and actual noise measurement results for respective activities to assist with ongoing management of site noise and to determine compliance with CoA; and
- the community will be consulted throughout the construction Project in accordance with the Projects' Community Communication Strategy.

In addition, general measures presented in AS 2436-2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* will be adopted by the project. Examples of these measures are listed in the following sections.



### 10.1.2 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks and site specific Project induction) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- develop routes for the delivery of materials and parking of vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise;
- when loading trucks, excavators should avoid ‘dropping’ material into the waiting truck, but rather place the material which would be less noise intrusive;
- excavator operators should avoid ‘bucket shaking’ between passes or banging the bucket against the ground to remove loose material;
- minimise the movement of materials and plant and unnecessary metal-on-metal contact;
- where feasible, all plant should be fitted with reversing or movement ‘quackers/squawkers’ instead of the high pitch tonal reverse/movement beepers;
- workers should refrain from shouting or talking ‘loudly’ when arriving/leaving site, especially during OOH works;
- minimise truck movements where feasible; and
- schedule respite periods for intensive works as determined through consultation with potentially affected neighbours (e.g. a daily respite period for a minimum of one hour at midday).

### 10.1.3 Plant and equipment

Additional measures for plant and equipment include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- shut down plant or equipment which isn’t being used (e.g. don’t leave plant/vehicles idling or don’t turn on plant/equipment to ‘warm up’);
- where feasible install a noise ‘shroud’ around equipment when in use;
- positioning plant as far away from affected receivers as feasible and reasonable;
- operate plant and equipment in the quietest and most efficient manner; and

- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

#### 10.1.4 Work scheduling

Work scheduling measures include:

- where possible, schedule activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events;
- where possible, scheduling work to coincide with non-sensitive periods;
- where possible, scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive;
- where possible, planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers;
- optimise the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours;
- where possible, designating, designing and maintaining access routes to the site to minimise impacts; and
- high vibration generating activities should only be carried out in continuous blocks, with appropriate respite periods as determined through consultation with potentially affected neighbours.

#### 10.1.5 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 10.1.

**Table 10.1 Relative effectiveness of various forms of noise control**

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level, dB
Increase source to receiver distance <sup>1</sup>	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery <sup>2</sup>	approximately 3 dB per halving of operating time
Operating training on quiet operation <sup>2</sup>	Up to 3 to 5 dB
Screening (eg noise barrier) <sup>1</sup>	normally 5dB to 10 dB, maximum 15 dB
Enclosure (eg shed/building) <sup>1</sup>	normally 15 dB to 25 dB, maximum 50 dB
Silencing (eg exhaust mufflers) <sup>1</sup>	normally 5 dB to 10 dB, maximum 20 dB

Notes: 1. Sourced from AS2436-2010.

2. Based on EMM's measurement experience at construction and mining sites.

#### 10.1.6 Additional noise mitigation measures – Construction Noise and Vibration Guideline

In many instances, impacts from construction noise and vibration are unavoidable where works are undertaken in relatively close proximity to surrounding receivers. The Roads and Maritime CNVG includes a list of additional mitigation measures which aim to manage the potential noise impacts. Additional mitigation measures from the CNVG that have been adopted for the project are summarised in Table 10.2.

**Table 10.2 CNVG additional noise mitigation measures**

ID	Name	Description
N	Notification (letterbox drop or equivalent)	Advanced warning of works and potential disruptions can assist in reducing the impact to the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of seven calendar days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.
SN	Specific notifications	Specific notifications are letterbox drops (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification should provide additional information to that covered in the general notifications and be targeted at highly affected receivers.
RO	Respite offers	Respite Offers should be considered and or adopted where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.
R1	Respite period 1	Out of hours construction conducted during the OOHW period 1 (Monday to Friday 6:00 pm to 10:00 pm, Saturday 7:00 am to 8:00 am and 1:00 pm – 10:00 pm, Sunday/Public Holiday 8:00 am to 6:00 pm) shall be limited to no more than three consecutive evenings per week except where there is a duration respite. For night work these periods of work should be separated by not less than one week and no more than six evenings per month.
R2	Respite period 2	Night time construction in OOHW period 2 (Monday to Friday 10:00 pm to 7:00 am, Saturday 10:00 pm to 8:00 am, Sunday/Public Holiday 6:00 pm to 7:00 am) shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and six nights per month. Where possible, high noise generating works shall be completed before 11 pm.
AA	Alternative accommodation	Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels (refer to Tables C1-C3 of the CNVG). The specifics of the offer will be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.
DR	Duration respite	Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified that it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly The project team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.
V	Verification	Refer to Appendix F of the CNVG for more details about verification of noise and vibration levels as part of routine checks of noise levels or following reasonable complaints. This verification should include measurement of the background noise level and construction noise. Note this is not required for projects less than three weeks unless to assist in managing complaints.

The level of additional mitigation is then assigned based on the impact classification (ie predicted noise level above NML) and the list of measures in Table 10.3.

**Table 10.3 Additional mitigation measures matrix – airborne construction noise**

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

Note: 1. The following abbreviations are used: Alternative Accommodation (AA), Respite Period 1 (R1), Verification (V), Specific Notifications (SN), Notification drops (N), Respite Period 2 (R2), Negotiated Respite (NR), Highly Affected (HA), Respite Offer (RO).

Additional noise mitigation measure for Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road based on Table 10.3 are presented in Appendix C.

It is noted that the CNVG defines highly noise affected as levels of greater than or equal to 75 dBA. However, the ICNG talks about receivers being highly noise affected once levels are above 75 dBA. The additional noise mitigation measures assigned in Appendix C follow the CNVG approach and therefore the total number of receivers which are highly noise affected may be greater than those presented in Section 7.

## 10.2 Vibration

The primary form of mitigation of vibration would be ensuring vibration intensive works do not occur within the safe working distances. Further mitigation of vibration would not be required where the safe working distances are adhered to.

If vibration intensive works are planned within the safe working distances identified, monitoring will be adopted to verify actual vibration levels generated and compared against the DIN-4150 criteria. Where compliance with the DIN-4150 criteria is confirmed, works will continue as planned.

For vibration intensive activities that occur within the safe working distances and it has been confirmed that the DIN-4150 cannot be complied with, the following management methods will be adopted:

- Equipment selection and maintenance

Equipment size would be selected taking into account the safe working distances/DIN-4150 criteria. The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable when working in proximity to existing structures. Equipment would be maintained and operated in an efficient manner, in accordance with manufacturer’s specifications, to reduce the potential for adverse vibration impacts.

- Construction scheduling

Wherever feasible and reasonable, vibration intensive works should be limited to the least sensitive times of the day. These times would be determined based on the outcomes of consultation with relevant sensitive receivers.

If ongoing works are required, where monitoring has confirmed actual vibration levels are nearing the DIN-4150 criteria, a temporary relocatable vibration monitoring system may be considered to warn operators (via flashing light, audible alarm etc) when vibration levels are approaching the cosmetic damage objective.

Additional noise mitigation measures with respect to human response to vibration will be applied in accordance with the CNVG as presented in Table 10.4.

**Table 10.4 Additional mitigation measures matrix – construction vibration**

Predicted human response vibration levels <sup>3</sup>	Additional mitigation measures	
	Type <sup>1</sup>	Apply to <sup>2</sup>
<b>Standard hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Hol (Nil)</b>		
Predicted vibration exceeds maximum human comfort levels	V, N, RP	All
<b>OOHW Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am &amp; 1pm – 10pm), Sun/Pub Hol (8am – 6pm)</b>		
Predicted vibration exceeds maximum human comfort levels	V, N, RO, RP, SN	All
<b>OOHW period 2: Mon - Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)</b>		
Predicted vibration exceeds maximum human comfort levels	AA, V, N, RP, SN	All

Notes: 1. The following abbreviations are used: Alternative Accommodation (AA), Respite Period 1 (R1), Validation of predicted noise levels (V), Specific Notifications (SN), Notification drops (N), Respite Period 2 (R2), Duration respite (DR)  
 2. All affected receivers  
 3. This text has been amended from what is displayed in the CVNG which references an LAeq(15min) noise level

### 10.3 Community consultation and complaints handling

Community consultation and complaints handling will be undertaken in accordance with the Project’s Community Communication Strategy (CCS).

# 11 Conclusions

EMM has prepared a CNVIS for site establishment proposed at the Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road sites from the Project.

Construction noise and vibration levels from the project components have been assessed in accordance with relevant policies, standards, guidelines and the instrument of approval conditions.

The primary document in NSW for assessing construction noise is the EPA's ICNG. It is inherent for most metropolitan based construction projects to exceed noise management levels provided in the ICNG. However, where this is the case, all feasible and reasonable noise mitigation and management measures must be implemented with the aim of achieving NMLs.

Noise levels above NMLs have been predicted for some site establishment phases for the proposed Parramatta Road East and West, Pyrmont Bridge Road and Campbell Road sites. This triggers the need for feasible and reasonable noise mitigation and management. This includes works during standard and OOH periods.

The scenarios presented in this report are considered representative of typical or worst case, and it is likely that construction methods will evolve from the CNVIS stage. Methods on how noise can be managed and mitigated are provided in Section 10.

The NMLs for the project are based on measured background noise levels as described in the EIS in the absence of construction noise from each stage of the WestConnex project. Therefore, adhering to NMLs as far as practicable would also assist in minimising cumulative noise impacts from the project.

Project traffic on public roads has been assessed against the NSW RNP and RMS CNVG. Traffic volumes during site establishment phases are negligible relative to existing movements and movements expected during tunnel excavation. The relative increase in road traffic noise levels due to site establishment is less than 2 dB which satisfies the RNP and CNVG guidelines.

The potential for vibration impacts have been assessed. This involved identifying vibration intensive construction activity and assigning safe working distances to these activities outside of which structural vibration and human response criteria would be expected to be met. The output of this assessment is a series of safe working distances. Where these safe working distances are encroached, alternate work practices would be considered, as will real time monitoring systems to monitor live vibration levels whilst construction is happening.

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Appendix A

# Plant and equipment modelling assumptions

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Parramatta Road East and West														
ID	Description	Equipment	Quantity	Periods			Equipment Sound Power Levels, dB							
				Day	OOH day	OOH evening	OOH night	Item LAeq, 15min	Typical runtime per 15min	Modifying factor	Item LAeq, 15min - adjusted	Group LAeq, 15min - day	Group LAeq, 15min - OOH	Group Lmax - night
1	Site setup	Heavy vehicle	2	Yes				105	100%		108	109	n/a	n/a
		Hand tools	2	Yes				94	100%		97			
		Backhoe	1	Yes				102	100%		102			
2	Geotech investigations	Rubber tyred drill rig	1	Yes				114	100%		114	115	n/a	n/a
		Vacuum truck	1	Yes				110	100%		110			
3	Deliveries	Heavy vehicle	1	Yes				105	100%		105	106	n/a	n/a
		Forklift	2	Yes				94	100%		97			
4	Asbestos removal and demolition	Excavator with hammer	1	Yes				117	100%	5	122	123	n/a	n/a
		Excavator with nibbler	1	Yes				104	100%	5	109			
		Bogie tippers	3	Yes				107	100%		112			
		Watercart	1	Yes				98	100%		98			
		Crusher	1	Yes				110	100%	5	115			
		966 Loader	1	Yes				102	100%		102			
		Heavy vehicle	1	Yes				105	100%		105			
		Backhoe	1	Yes				102	100%		102			
5	Set-up environmental controls, install plywood hoardings	Heavy vehicle	1	Yes				105	100%		105	122	n/a	n/a
		Elevated work platform	1	Yes				97	100%		97			
		18T Franna crane	1	Yes				104	100%		104			
		Backhoe	1	Yes				102	100%		102			
		Bogie tippers	1	Yes				107	100%		107			
		30T excavators	2	Yes				104	100%		107			
		Vibratory roller	2	Yes				109	100%		112			
		966 Loader	1	Yes				102	100%		102			
		Concrete road saw	1	Yes				115	100%	5	120			
		Rubber tyred drill rig	1	Yes				114	100%		114			
6	Pedestrian bridge construction	30T mobile crane	1	Yes		Yes	Yes	98	100%		98	112	112	112
		Heavy vehicle	1	Yes		Yes	Yes	105	100%		105			
		Concrete trucks	1	Yes		Yes	Yes	106	100%		106			
		Concrete boom pump	1	Yes		Yes	Yes	106	100%		106			
		Generator	1	Yes		Yes	Yes	101	100%		101			
		Elevated work platform	1	Yes		Yes	Yes	97	100%		97			
		Hand tools	3	Yes		Yes	Yes	94	100%		99			
7	Installation of site facilities and services	Heavy vehicle	1	Yes				105	100%		105	115	n/a	n/a
		Backhoe	1	Yes				102	100%		102			
		30T mobile crane	2	Yes				98	100%		101			
		Hand tools	1	Yes				94	100%		94			
		20T excavator	1	Yes				99	100%		99			
		Bogie tippers	4	Yes				107	100%		113			
		Loader	1	Yes				102	100%		102			

Notes:

Day Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
Day OOH Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
Evening Evening 6:00 pm to 10:00 pm Monday to Sunday  
Night Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays



Pymont Bridge Road																			
ID	Description	Equipment	Quantity	Periods			Equipment Sound Power Levels, dB												
				Day	OOH day	OOH evening	OOH night	Item LAeq, 15min	Typical runtime per 15min	Modifying factor	Item LAeq, 15min - adjusted	Group LAeq, 15min - day	Group LAeq, 15min - OOH	Group Lmax - night					
1	Site setup	Heavy vehicle	1	Yes				105	100%		105	108	n/a	n/a					
		Generator	1	Yes				101	100%		101								
		Hand tools	2	Yes				94	100%		97								
		Backhoe	1	Yes				102	100%		102								
2	Geotech investigations	Rubber tyred drill rig	1	Yes				114	100%		114	115	n/a	n/a					
		Vacuum truck	1	Yes				110	100%		110								
3	Asbestos removal and demolition	Excavator with hammer	1	Yes				117	100%	5	122	124	n/a	n/a					
		Excavator with nibbler	1	Yes				104	100%	5	109								
		Dozer	1	Yes				111	100%		111								
		Watercart	1	Yes				98	100%		98								
		Crusher	1	Yes				110	100%	5	115								
		Loader	1	Yes				102	100%		102								
		Bogie tippers	3	Yes				107	100%		112								
		Backhoe	1	Yes				102	100%		102								
4	Deliveries	Heavy vehicle	1	Yes				105	100%		105	105	n/a	n/a					
		Forklift	1	Yes				94	100%		94								
5	Installation of site facilities and services	Backhoe	1	Yes				102	100%		102	115	n/a	n/a					
		Heavy vehicle	1	Yes				105	100%		105								
		30T mobile crane	2	Yes				98	100%		101								
		Hand tools	1	Yes				94	100%		94								
		20T excavator	1	Yes				99	100%		99								
		Bogie tippers	4	Yes				107	100%		113								
		Loader	1	Yes				102	100%		102								
6	Earthworks, protect utilities, install plywood hoardings	Heavy vehicle	1	Yes		Yes	Yes	105	100%		105	118	107	110					
		Backhoe	1	Yes				102	100%		102								
		Rubber tyred drill rig	1	Yes				114	100%		114								
		30T mobile crane	2	Yes		Yes	Yes	98	100%		101								
		Grader	1	Yes				105	100%		105								
		Watercart	1	Yes				98	100%		98								
		996 loader	1	Yes				102	100%		102								
		Bogie tippers	3	Yes				107	100%		112								
		30T excavator	2	Yes				104	100%		107								
		Hand tools	1	Yes		Yes	Yes	94	100%		94								
		7	Foundations and pavements	Heavy vehicle	1	Yes				105	100%					105	119	n/a	n/a
Backhoe	1			Yes				102	100%		102								
Concrete agitator	1			Yes				106	100%		106								
Concrete vibrator	1			Yes				102	100%		102								
Bogie tippers	3			Yes				107	100%		112								
Concrete boom pump	1			Yes				106	100%		106								
30T excavator	2			Yes				104	100%		107								
20T vibrating roller	2			Yes				109	100%		112								
996 loader	1			Yes				102	100%		102								
Ashpalt paver	1			Yes				105	100%		105								
8	Bored piling for shed and cut and cover			Bored piling rig	2	Yes				108	100%		111	117	n/a	n/a			
				Backhoe	1	Yes				102	100%		102						
		Concrete agitator	1	Yes				106	100%		106								
		30T crane	2	Yes				98	100%		101								
		Bogie tippers	3	Yes				107	100%		112								
		20T vibrating roller	1	Yes				109	100%		109								
		Heavy vehicle	1	Yes				105	100%		105								
		Excavator	1	Yes				106	100%		106								
9	Build acoustic shed	Elevated work platform	1	Yes				97	100%		97	112	n/a	n/a					
		30T crane	1	Yes				98	100%		98								
		Power tools	1	Yes				108	100%		108								
		Heavy vehicle	2	Yes				105	100%		108								
		Excavator	1	Yes				106	100%		106								
10	Decline cut and cover earthworks and shaft excavation	30T excavator	1	Yes				104	100%		104	123	n/a	n/a					
		Concrete boom pump	1	Yes				106	100%		106								
		Concrete agitator	1	Yes				106	100%		106								
		20T vibrating roller	1	Yes				109	100%		109								
		30T excavator with hammer	1	Yes				117	100%	5	122								
		Loader	1	Yes				102	100%		102								
11	Shotcrete trials and complete site set-up	Grader	2	Yes				105	100%		108	115	n/a	n/a					
		30T crane	1	Yes				98	100%		98								
		Shotcrete machine	1	Yes				106	100%		106								
		Shotcrete agitator	2	Yes				106	100%		109								
		Heavy vehicle	1	Yes				105	100%		105								
		Elevated work platform	2	Yes				97	100%		100								
Power tools	2	Yes				108	100%		111										

Notes:  
Day Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
Day OOH Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
Evening Evening 6:00 pm to 10:00 pm Monday to Sunday  
Night Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays

Campbell Road														
ID	Description	Equipment	Quantity	Periods			Equipment Sound Power Levels, dB							
				Day	OOH day	OOH evening	OOH night	Item LAeq, 15min	Typical runtime per 15min	Modifying factor	Item LAeq, 15min - adjusted	Group LAeq, 15min - day	Group LAeq, 15min - OOH	Group Lmax - night
1	Site setup	Heavy vehicle	1	Yes				105	100%		105	108		
		Generator	1	Yes				101	100%		101			
		Hand tools	2	Yes				94	100%		97			
		Backhoe	1	Yes				102	100%		102			
2	Geotech Investigations	Rubber tyred drill rig	1	Yes				114	100%		114	115		
		Vacuum truck	1	Yes				110	100%		110			
3	Earthworks, drainage and install plywood hoardings	Heavy vehicle	1	Yes				105	100%		105	118		
		Backhoe	1	Yes				102	100%		102			
		Mobile crane	1	Yes				104	100%		104			
		Rubber tyred drill rig	1	Yes				114	100%		114			
		Grader	1	Yes				105	100%		105			
		Watercart	1	Yes				98	100%		98			
		996 loader	1	Yes				102	100%		102			
		Bogie tippers	3	Yes				107	100%		112			
		30T excavator	2	Yes				104	100%		107			
		Hand tools	1	Yes				94	100%		94			
4	Foundations and pavements	Heavy vehicle	1	Yes				105	100%		105	117		
		Backhoe	1	Yes				102	100%		102			
		Concrete agitator	1	Yes				106	100%		106			
		Concrete vibrator	1	Yes				102	100%		102			
		Bogie tippers	3	Yes				107	100%		112			
		30T excavator	2	Yes				104	100%		107			
		20T vibrating roller	2	Yes				109	100%		112			
		996 loader	1	Yes				102	100%		102			
		Asphalt paver	1	Yes				105	100%		105			
		Forklift	1	Yes		Yes	Yes	94	100%		94			
5	Deliveries	Heavy vehicle	1	Yes		Yes	Yes	105	100%		105	105	105	110
		Forklift	1	Yes		Yes	Yes	94	100%		94			
		Backhoe	1	Yes		Yes	Yes	102	100%		102			
6	Install of site facilities	18T Franna crane	1	Yes		Yes	Yes	104	100%		104	107	107	111
		Hand tools	2	Yes		Yes	Yes	94	100%		97			
		Bored piling rig	2	Yes				108	100%		111			
7	Bored piling for shed and cut and cover	Backhoe	1	Yes				102	100%		102	117		
		Concrete agitator	1	Yes				106	100%		106			
		30T crane	2	Yes				98	100%		101			
		Bogie tippers	3	Yes				107	100%		112			
		20T vibrating roller	1	Yes				109	100%		109			
		Heavy vehicle	1	Yes				105	100%		105			
		Excavator	1	Yes				106	100%		106			
8	Build acoustic shed	Elevated work platform	1	Yes				97	100%		97	113		
		30T crane	1	Yes				98	100%		98			
		Power tools	1	Yes				108	100%		108			
		Watercart	1	Yes				98	100%		98			
		Heavy vehicle	2	Yes				105	100%		108			
		30T excavator	1	Yes				104	100%		104			
9	Decline cut and cover earthworks, and shaft excavation	Concrete boom pump	1	Yes				106	100%		106	123		
		Concrete agitator	1	Yes				106	100%		106			
		20T vibrating roller	1	Yes				109	100%		109			
		30T excavator with hamm	1	Yes				117	100%	5	122			
		Loader	1	Yes				102	100%		102			
		Grader	2	Yes				105	100%		108			
10	Shotcrete trials, complete site set-up and deliveries	30T crane	1	Yes				98	100%		98	115		
		Shotcrete machine	1	Yes				106	100%		106			
		Shotcrete agitator	2	Yes				106	100%		109			
		Heavy vehicle	1	Yes				105	100%		105			
		Elevated work platform	2	Yes				97	100%		100			
		Power tools	2	Yes				108	100%		111			

Notes:

Day Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday  
Day OOH Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm  
Evening Evening 6:00 pm to 10:00 pm Monday to Sunday  
Night Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays

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Appendix B

## Single point noise predictions, $L_{Aeq,15minutes}$

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Summary of single point noise predictions, dB LAeq,15minute

Table with columns for NCA, Latitude, Longitude, Address, Type, Day (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7), Evening (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7), and Night (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7). Rows list various residential addresses in Parramatta, NSW, with their corresponding noise prediction values for different time periods.





Summary of single point noise predictions, dB LAeq,15Minute

Table with columns: NCA, Latitude, Longitude, Address, Type, Day (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7), Evening (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7), Night (NML, Sc1, Sc2, Sc3, Sc4, Sc5, Sc6, Sc7). Rows contain noise prediction data for various locations.

Summary of single point noise predictions, dB LAeq,15minute

Table with columns: NCA, Latitude, Longitude, Address, Type, Day (NML, Sc 1-7), Evening (NML, Sc 1-7), Night (NML, Sc 1-7). Rows contain noise prediction data for various locations in Parramatta.



























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Appendix C

# Additional CNVG noise mitigation measures

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Summary of additional noise mitigation measures

NCA	Latitude	Longitude	Address	Type	Day	Day	Day	Day	Day	Day	Evening	Night	Day	Day	Day	Day	Day
					Sc 1	Sc 2	Sc 3	Sc 4	Sc 5	Sc 6	Sc 6	Sc 7	Sc 8	Sc 9	Sc 10	Sc 11	
41	331272	331272	58 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								V, N, R2, DR					
41	331277	331277	56 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								V, N, R2, DR					
41	331253	331253	68 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES			N, V					V, N, R2, DR					
41	331201	331201	99-101 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	COM	N, V	N, V	N, V										
41	331265	331265	60 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES			N, V					V, N, R2, DR					
41	331259	331259	64 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES			N, V					V, N, R2, DR					
42	331226	331226	14 AUSTRALIA STREET, CAMPERDOWN NSW 2050	RES								N					
42	331376	331376	31 MALLETT STREET, CAMPERDOWN NSW 2050	RES								N					
42	331375	331375	29 MALLETT STREET, CAMPERDOWN NSW 2050	RES								N					
41	331247	331247	72A PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES		N, V	N, V					V, N, R2, DR					
42	331374	331374	27 MALLETT STREET, CAMPERDOWN NSW 2050	RES								N					
41	331288	331288	75 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES		N, V	N, V					V, N, R2, DR					
41	331297	331297	71 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								V, N, R2, DR					
41	331293	331293	73 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								V, N, R2, DR					
42	331263	331263	127 PARRAMATTA ROAD, CAMPERDOWN NSW 2050	OED			N, V										
42	331390	331390	44 PIDCOCK STREET, CAMPERDOWN NSW 2050	RES								N					
41	331300	331300	69 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								N					
41	331283	331283	77 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES		N, V, RO	N, V, RO			N, V	N, R1, DR	V, N, R2, DR			N, V		
42	331359	331359	28 PIDCOCK STREET, CAMPERDOWN NSW 2050	RES								N					
41	331302	331302	79 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	COM		N, V	N, V										
41	331304	331304	67 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	RES								N					
41	331196	331196	97 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	COM		N, V											
44	331380	331380	156-158 PARRAMATTA ROAD, CAMPERDOWN NSW 2050	RES		N, V	N, V, RO										
41	331207	331207	190-192 PARRAMATTA ROAD, ANNANDALE NSW 2038	COM	N, V	N, V	N, V										
44	331400	331400	8 ISABELLA STREET, CAMPERDOWN NSW 2050	RES								N					
41	331324	331324	63-65 PYRMONT BRIDGE ROAD, ANNANDALE NSW 2038	COM		N, V	N, V										
42	331301	331301	119-125 PARRAMATTA ROAD, CAMPERDOWN NSW 2050	RES		N, V	N, V, RO			N, V	N, R1, DR	V, N, R2, DR					
44	331410	331410	13 LAYTON STREET, CAMPERDOWN NSW 2050	RES								N					
42	331146	331146	3-5 GANTRY LANE, CAMPERDOWN NSW 2050	RES								N					

Campbell Road ancillary facility

Summary of additional noise mitigation measures						
NCA	Latitude	Longitude	Address	Type	Night	Night
					Sc 5	Sc 6
49	331840	331840	51 BARWON PARK ROAD, ST PETERS NSW 2044	RES		N
48	332041	332041	4 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332046	332046	6 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332050	332050	8 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332051	332051	10 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332056	332056	12 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332059	332059	14 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
48	332061	332061	16 CAMPBELL ROAD, ALEXANDRIA NSW 2015	RES		N
49	331832	331832	17 CAMPBELL STREET, ST PETERS NSW 2044	RES	N	N



