13 Noise and vibration

This chapter provides a summary of the noise and vibration assessment undertaken for the Project. A full copy of the assessment report is provided as **Technical report 4 – Noise and vibration** of this EIS.

13.1 Introduction

This chapter responds to the SEARs relevant to noise and vibration. **Table 13-1** sets out the relevant SEARs and identifies where they have been addressed in this Chapter.

Table 13-1 SEARs

SEARs	Where addressed in this EIS
Noise and vibration - Amenity	
Assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must consider cumulative impacts from nearby key infrastructure projects. The assessment must justify impacts to receivers including consideration of sleep disturbance (including the number of noise-awakening events), and, as relevant, the characteristics of noise and vibration (for example, low frequency noise).	**Section 13.4.1** **Section 13.4.2** Cumulative noise impacts are addressed in **Chapter 23** of this EIS.
Construction noise and vibration including:	
a. the nature of construction activities (including transport, tonal or impulsive noise-generating works, as relevant)	**Section 13.4.1**
b. the intensity and duration of noise (both air and ground borne) and vibration impacts	**Section 13.4.1**
c. identification of receivers, existing and known future, during construction	**Section 13.3** and **Section 13.4.1**
d. the sensitivity of receivers to the level of impact	**Section 13.2.3** **Section 13.3**
e. the need to balance: i. timely conclusion of noise and vibration-generating works with periods of receiver respite; ii. the need to work at night and during planned rail possessions; and iii. other factors that may influence the timing and duration of construction activities	**Section 13.4.1** **Section 13.5**
f. noise impacts of out of hours works (including utility works), the activities to be undertaken, their estimated duration and justification in terms of the *Interim Construction Noise Guideline* (DECC, 2009)	**Section 13.4.1**
g. cumulative noise and vibration including project impacts and concurrent construction activities within the proposal and the construction of other relevant development in the vicinity	**Section 13.4.1** Cumulative noise impacts are addressed in **Chapter 23** of this EIS
h. details and analysis of the predicted effectiveness of mitigation measures to adequately manage identified impacts, including impacts as identified in (g), and any potential residual noise and vibration impacts following application of mitigation measures	**Section 13.5.3**

SEARs	Where addressed in this EIS
i. a description of how feedback received during preparation of the Environmental Impact Statement has been taken into account (and would be taken into account following exhibition of the EIS) in the design of mitigation measures, including any tailored mitigation, management and communication strategies for sensitive receivers.	**Section 13.5**
Noise and vibration - Structural	
Operational noise and vibration impacts resulting from use of the infrastructure on the amenity of local residents.	**Section 13.4.2**
Construction and operation noise and vibration impacts to the structural integrity and heritage significance of items (including Aboriginal places and items of environmental heritage) in accordance with relevant guidelines.	**Section 13.3.2** **Section 13.4.1**

13.2 Method of assessment

13.2.1 Approach and methodology

The approach for the noise and vibration assessment was to:

- establish the existing background noise levels in the vicinity of the Project
- establish construction noise management levels and vibration limits that would apply to the Project
- predict noise and vibration levels at nearby residential and other sensitive receivers due to the construction of the Project
- predict environmental noise and vibration levels at nearby residential and other sensitive receivers due to operation of the Project
- predict noise levels from additional off-site construction traffic generated by the Project
- recommend mitigation measures, where necessary, to reduce and manage noise and vibration impacts from the Project to comply with established noise management levels and vibration limits.

13.2.2 Policies and guidelines

Relevant policies and guidelines for the assessment of noise and vibration in NSW have been considered during the preparation of the assessment. It is noted that blasting is not a part of the Project, and so the following guideline referenced in the SEARs in not relevant: *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*, Australian and New Zealand Environment Council (ANZEC) 1990.

The policies and guidelines considered include:

- *Interim Construction Noise Guideline* (ICNG), Department of Environment and Climate Change, 2009
- *Assessing Vibration: A Technical Guideline* (AVATG), Department of Environment and Conservation, 2006
- *NSW Road Noise Policy* (RNP), Department of Environment, Climate Change and Water, 2011
- *Noise Policy for Industry*, Environment Protection Authority, 2017
- *Noise Guide for Local Government*, Environmental Protection Authority, 2013
- *Rail Infrastructure Noise Guideline*, Environment Protection Authority, 2013
- *Development Near Rail Corridors and Busy Roads – Interim Guideline*, Department of Planning, 2008

- *Construction Noise and Vibration Strategy* (CNVS), Transport for NSW, 2019a
- DIN Standard 4150: Part 3 2016 *Vibration in Buildings - Effects on Structures*, 1999
- British Standard 7385: Part 2 1993 *Evaluation and Measurement of Vibration in Buildings*, 1993
- British Standard 6472: *Evaluation of human exposure to vibration in buildings (1-80 Hz)*, 1992
- Bavarian State Office for the Environment's (Bayerishes Landesamt für Umwelt/BayLfU) *Parking Area Noise,* 2007
- other relevant Australian and British Standards
- *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration,* Australian and New Zealand Environment Council (ANZEC), 1990.

13.2.3 Study area

To assist in determining noise criteria for noise sensitive receivers surrounding the Project, five Noise Catchment Areas (NCAs) were identified, which are shown in **Figure 13-1**. The noise environment throughout a NCA is considered to be similar, considering proximity to major noise sources. These NCAs form the study area for this assessment. The locations of noise logging undertaken for the Project are also shown on **Figure 13-1**. A description of noise logging undertaken and how it is utilised in the assessment is provided in **Section 13.2.4**.

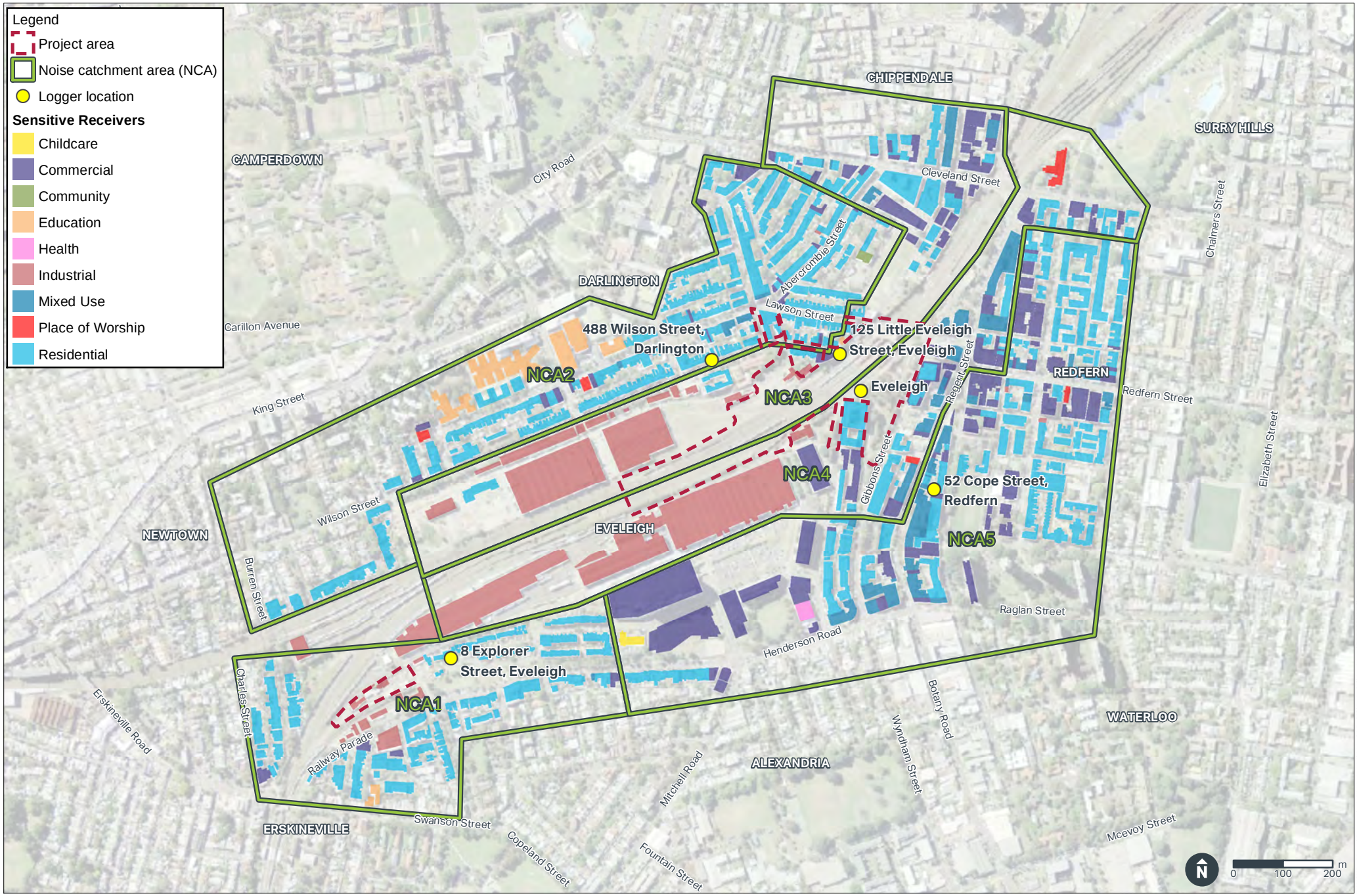

FIGURE 13-1: NOISE CATCHMENT AREAS

13.2.4 Construction noise and vibration criteria

Interim Construction Noise Guideline

The ICNG is a NSW Government document that identifies ways to manage impacts of construction noise on residences and other noise sensitive land uses. It is the principal guideline for the assessment and management of construction noise in NSW. In accordance with the ICNG, a quantitative assessment using representative construction scenarios has been carried out for the construction of the Project.

Noise levels from construction activities are predicted at nearby noise sensitive receivers using environmental noise modelling software and compared to the noise management levels (NML), derived in accordance with the ICNG. NMLs are based on the rating background level (RBL), which is the overall background noise level measured (refer to **Section 13.3.3**). The ICNG's guidance on how to determine and apply NMLs is provided in **Table 13-2**.

Where an exceedance of the NML is predicted, the ICNG advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially impacted residents of the nature of the works to be carried out, the expected noise level and duration, as well as provide contact details to facilitate feedback from affected residents during construction.

Where construction noise levels at the receiver reach 75 A Weighted decibel (dB(A)), residential receivers are considered to be 'highly noise affected' and the proponent should, in consultation with the community, consider restrictions to the hours of construction to provide respite periods.

The ICNG defines what is considered to be feasible and reasonable as follows:

- *feasible: a work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements*
- *reasonable: selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.*

Table 13-2 ICNG Residential noise management levels

Time of day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to apply
Recommended standard hours: Monday to Friday 7:00 am to 6:00 pm; Saturday 8:00 am to 1:00 pm; No work on Sundays or public holidays	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. 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.

Time of day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to apply
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. 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: • 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 • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements refer section 7.2.2 of the ICNG.

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

The construction NMLs for nearby residential receivers and other sensitive land uses are provided in **Table 13-3** and **Table 13-4**. As discussed above, these NMLs are based on the rating background level (RBL), which is the overall background noise level measured (refer to **Section 13.3.3**). Residential receivers are grouped into the NCAs identified for the Project (refer **Section 13.2.3**).

Table 13-3 Construction noise management levels – Residential receivers

NCA	Period	RBL, L_{A90} dB(A)	Standard hours NMLs, $L_{Aeq,15min}$, dB(A)	Out of hours NMLs, $L_{Aeq,15min}$, dB(A)
1	Day	42	52 (75 – highly noise affected level)	47
	Evening	37	-	42
	Night	32	-	37
2	Day	41	51 (75 – highly noise affected level)	46
	Evening	39	-	44
	Night	35	-	40
3	Day	53	63 (75 – highly noise affected level)	58
	Evening	51	-	56
	Night	39	-	44

NCA	Period	RBL, L_{A90} dB(A)	Standard hours NMLs, $L_{Aeq,15min}$, dB(A)	Out of hours NMLs, $L_{Aeq,15min}$, dB(A)
4	Day	53	63 (75 – highly noise affected level)	58
	Evening	51	-	56
	Night	39	-	44
5	Day	44	54 (75 – highly noise affected level)	49
	Evening	44	-	49
	Night	37	-	42

Table 13-4 Construction noise management levels – Other receivers

Land use	NMLs, $L_{Aeq,15min}$ (applies when properties are in use) (external)
Commercial premises (including offices, retail outlets)	70dB(A)
Industrial receivers	75dB(A)
School classrooms	55dB(A)[1]
Places of worship	55dB(A)[1]
Childcare centre	55dB(A)[1]

Notes:
1. This external noise management level is based upon a 45 dB(A) internal noise management level and a 10 dB(A) reduction from outside to inside through an open window.

Sleep disturbance guidelines

The ICNG requires a sleep disturbance analysis where construction works are planned to extend over more than two consecutive nights. The NSW EPA recommends that to minimise the risk of sleep disturbance during the night-time period (i.e. 10:00 pm to 7:00 am), the $L_{A1(1\ min),}$ noise level outside a bedroom window should not exceed the $L_{A90(15\ minute)}$ background noise level by more than 15dB(A). If this screening criterion is found to be exceeded, then a more detailed analysis must be undertaken and include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period. Sleep disturbance research presented in the *NSW Road Noise Policy* (RNP) (DECCW, 2011) concludes that "*Maximum internal noise levels below 50-55dB(A) are unlikely to cause awakening reactions"*. Therefore, given that an open window provides approximately 10dB(A) in noise attenuation from outside to inside, external noise levels of 60-65dB(A) are unlikely to result in awakening reactions.

A sleep disturbance assessment has been undertaken for the Project in accordance with the ICNG. Sleep disturbance criteria has been developed for the nearest noise sensitive residential receivers, which is presented in **Table 13-5**. The criteria is based on background noise levels measured during the night time (refer **Section 13.3** for measurement of background noise levels).

Table 13-5 Sleep disturbance criteria

NCA	Background noise level	Sleep disturbance criteria (external) L_{Amax}, dB(A)	
	(L_{A90}), dB(A)	Screening level	Awakening reaction
1	32	47	65
2	35	50	65
3	39	54	65
4	39	54	65
5	37	52	65

Construction traffic noise criteria

Noise from construction traffic on public roads is assessed under the *Road Noise Policy* (RNP) (DECCW, 2011). Where the predicted noise increase from construction traffic is 2dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2dB(A), and the predicted road traffic noise level exceeds the road category specific criterion, then noise mitigation should be considered for those receivers affected. The RNP does not require assessment of noise impact to commercial or industrial receivers.

Construction vibration criteria

Vibration criteria are set primarily according to whether the particular project activities are continuous in nature or intermittent, whether they occur during the daytime or night-time and the type of receiver to be assessed (e.g. industrial, commercial or residential). The effects of vibration in buildings can be divided into the following categories:

- those in which building damage may occur (i.e. structural damage)
- those in which the occupants or users of the building are inconvenienced or possibly disturbed, (i.e. human disturbance or discomfort).

Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities
- impulsive vibration is a rapid build-up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving and jack hammers.

Therefore, vibration levels at sensitive receiver locations must be controlled so as to prevent discomfort and regenerated noise, and in some extreme cases, structural damage. The relevant standards and guidelines utilised for the assessment of construction vibration for the Project are:

- structural damage: German Standard DIN 4150 – *Part 3 – Structural Vibration in Buildings – Effects on Structures* (DIN 4150)
- human comfort (tactile vibration): *Assessing Vibration: A Technical Guideline* (AVATG) (Department of Environment and Conservation, 2006).

Table 13-6 provides the maximum levels of vibration that reduce the likelihood of building damage (structural damage) caused by vibration, as recommended by German Standard (DIN 4150) (noting that DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage).

Table 13-6 DIN 4150: Structural damage safe limits for building vibration

Group	Type of structure	At foundation – Less than 10 Hz	At foundation – 10 Hz to 50 Hz	At foundation – 50 Hz to 100 Hz[1]	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Groups 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Notes:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values.

Table 13-7 provides maximum and preferred Vibration Dose Values (VDVs) for intermittent vibration arising from construction activities (representing the human comfort levels), in accordance with the *Assessing Vibration: A Technical Guideline*. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 13-7 Preferred and maximum vibration dose values for intermittent vibration (m/s$^{1.75}$)

Location	Daytime[1] Preferred	Daytime Max	Night time Preferred	Night time Max
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions, commercial premises and places of worship	0.4	0.8	0.4	0.8
Workshops or factory environments	0.8	1.6	0.8	1.6

Notes:

1. Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am.

13.2.5 Operational noise criteria

The noise and vibration assessment included an assessment of industrial noise and non-industrial noise from operation of the Project. The *Noise Policy for Industry* (EPA, 2017) provides guidance in relation to acceptable noise limits for industrial noise emissions (e.g. mechanical plant). Noise from the car park activities, mechanical services and Opal card readers are considered to be industrial noise and are therefore assessed using the *Noise Policy for Industry* (EPA, 2017). It is noted that car park activity noise has been determined in accordance with the guideline *Parking Area Noise* (Bavarian State Office for the Environment, 2007).

Operation of the Project would also result in an increase in additional commuters/pedestrians walking through the new shared zone areas. Noise from additional commuters walking through shared zones is considered non-industrial noise and has been considered using the *Noise Guide for Local*

Government's checklist for 'offensive noise', under the *Protection of the Environment Operations Act 1997*. Criteria for industrial and non-industrial noise is explained further below.

Industrial noise

The assessment procedure in the *Noise Policy for Industry* has two components for industrial noise:

- controlling **intrusive** noise impacts in the short term for residences
- maintaining noise level **amenity** for residences and other land uses.

Both components are assessed at the boundary of the noise sensitive receiver site. These criteria apply to environmental noise emissions from any plant installed as part of the Project, and for residential receivers represent the lower of the intrusive and amenity criteria.

Intrusive noise impacts

The *Noise Policy for Industry* states that the noise from any single noise source should not be greatly above the prevailing background noise level. Industrial noise sources are generally considered acceptable if the A-weighted equivalent continuous sound pressure level of noise from the source, measured over a 15 minute period ($L_{Aeq,15\ min}$) does not exceed the RBL by more than 5dB(A) for the period under consideration. This is termed the intrusiveness criterion.

The RBL is the background noise level to be used for assessment purposes and is determined by the methods given in the *Noise Policy for Industry*. Measurement of the RBLs for the Project is described in **Section 13.3**, and the RBL and the respective intrusiveness criteria for the day, evening and night periods are provided in **Table 13-8**.

Table 13-8 Intrusiveness criteria

Location	Period	RBL (L_{A90}), dB(A)	Intrusiveness criteria (RBL+5), dB(A)
NCA 1 Residential receivers	Day	42	47
	Evening	37	42
	Night	32	37
NCA 2 Residential receivers	Day	41	46
	Evening	39	44
	Night	35	40
NCA 3 Residential receivers	Day	53	58
	Evening	51	56
	Night	39	44
NCA 4 Residential receivers	Day	53	58
	Evening	51	56
	Night	39	44
NCA 5 Residential receivers	Day	44	49
	Evening	44	49
	Night	37	42
Commercial premises	When in use	-	-
School classroom[3]	When in use	-	-
Place of worship[3]	When in use	-	-
Childcare[3]	When in use	-	-

Protecting amenity

To limit continuing increase in noise levels, the maximum ambient noise level within an area from all industrial noise sources should not normally exceed the recommended amenity noise levels specified in the *Noise Policy for Industry*. That is the noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the background creep or amenity criterion. The amenity criteria for the Project is presented in **Table 13-9**.

Table 13-9 Amenity criteria

Type of receiver	Indicative noise amenity area	Time of day	Recommended amenity noise level[1], dB(A)	Project amenity noise level[2], dB(A)	
			$L_{Aeq\ (period)}$	$L_{Aeq\ (period)}$	$L_{Aeq\ (15\ minute)}$
NCA 1 Residential receivers	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	40	43
NCA 2 Residential receivers	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	40	43

Type of receiver	Indicative noise amenity area	Time of day	Recommended amenity noise level[1], dB(A)	Project amenity noise level[2], dB(A)	
			$L_{Aeq\ (period)}$	$L_{Aeq\ (period)}$	$L_{Aeq\ (15\ minute)}$
NCA 3 Residential receivers	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	42[4]	45
NCA 4 Residential receivers	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	42[4]	45
NCA 5 Residential receivers	Urban	Day	60	55	58
		Evening	50	45	43
		Night	45	40	38
Commercial premises	All	When in use	65	65	68
School classroom[3]	All	When in use	45	45	48
Place of worship[3]	All	When in use	50	50	53
Childcare[3]	All	When in use	45	45	48

Notes:
1. Specified in Table 2.2 of the *Noise Policy for Industry*
2. The project amenity level is equal to the recommended amenity noise level minus 5dB(A). The Project amenity level is then converted to a 15 minute period by adding 3dB(A).
3. External noise levels are based on internal criteria with a 10dB(A) reduction from outside to inside through an open window
4. Area dominated by high levels of rail traffic noise, therefore in accordance with the *Noise Policy for Industry* the Project amenity level = existing $L_{Aeq(period,\ traffic)}$ minus 15dB(A).

Environmental noise emission criteria

A summary of the Project specific noise level criteria for operation of the Project is presented in **Table 13-10**. These criteria have been developed in accordance with the *Noise Policy for Industry* and apply to environmental noise emissions from operation of the Project (e.g. use of mechanical services, Opal card readers and car park activities), and for residential receivers these criteria represent the lower of the intrusive and amenity criteria.

Table 13-10 Summary of environmental noise emission criteria for operation of the Project

Location	Time of day	Project specific noise levels criteria L_{Aeq}, dB(A)
NCA 1	Day	47
	Evening	42
	Night	37
NCA 2	Day	46
	Evening	43
	Night	38
NCA 3	Day	58
	Evening	48
	Night	44

Location	Time of day	Project specific noise levels criteria L_{Aeq}, dB(A)
NCA 4	Day	58
	Evening	48
	Night	44
NCA 5	Day	49
	Evening	43
	Night	38
Commercial premises	When in use	68
Community hall	When in use	58
School classroom	When in use	48

Maximum noise level for sleep disturbance

The *Noise Policy for Industry* requires the potential for sleep disturbance to be assessed by considering maximum noise levels events during the night-time period. Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in **Table 13-11**.

Table 13-11 Night-time sleep disturbance screening levels

Location	Measured night-time RBL, $L_{A90, 15\ mins}$ dB(A)	Sleep disturbance screening levels, dB(A)	
		$L_{Aeq,15min}$	L_{AFmax}
NCA 1 Residential receivers	32	40	55
NCA 2 Residential receivers	35	40	55
NCA 3 Residential receivers	39	44	59
NCA 4 Residential receivers	39	44	59
NCA 5 Residential receivers	37	42	57

Non-industrial noise

Noise from the additional commuters using the station, i.e. non-industrial noise, does not fall under the *Noise Policy for Industry*. The EPA's *Noise Guide for Local Government* (EPA, 2013) provides the following checklist of considerations to determine whether noise is offensive:

1. Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?
2. Does the noise include characteristics that make it particularly irritating?
3. Does the noise occur at times when people expect to enjoy peace and quiet?
4. Is the noise atypical for the area?
5. Does the noise occur often?
6. Are a number of people affected by the noise?

13.3 Existing environment

The Project is directly surrounded by a mix of residential, commercial and industrial receivers. The closest residential receivers are located adjacent to the railway station, and adjacent to the Project area on Little Eveleigh Street and on Marian Street.

13.3.1 Noise sensitive receivers

Noise sensitive receivers for the Project are identified in **Figure 13-1**, which fall within the five NCAs identified. Non-residential noise sensitive receivers surrounding the Project are listed in **Table 13-12**.

Table 13-12 Notable non-residential sensitive receivers surrounding the Project area

NCA	Receiver	Receiver type
NCA 1	South Sydney Rotary Park	Passive recreation
NCA 1	Solander Park	Passive recreation
NCA 1	St Marys Catholic Primary School	Educational facility
NCA 1	Ethel Street Playground	Passive recreation
NCA 2	Hollis Park	Passive recreation
NCA 2	Darlington Public School	Education
NCA 2	Saint Michael the Archangel Melkite Cathedral	Place of worship
NCA 2	University of Sydney	Educational facility
NCA 2	Church of the Assumption of Our Lady	Place of worship
NCA 2	TAFE NSW - Eora	Educational facility
NCA 2	Charles Kernan Reserve	Passive recreation
NCA 2	Hugo Street Reserve	Passive recreation
NCA 2	Redfern community centre/playground	Passive recreation
NCA 3	Key College	Educational facility
NCA 4	Cathedral of the Annunciation of Our Lady	Place of worship
NCA 4	Prince Alfred Park	Passive recreation
NCA 4	Gibbons Street Reserve[1]	Passive recreation
NCA 4	Carriage works	Passive recreation
NCA 5	Reconciliation Park	Passive recreation
NCA 5	St Vincent de Paul's Catholic Church Redfern	Place of worship
NCA 5	South Eveleigh Playground	Passive recreation
NCA 5	Redfern Park	Passive recreation
NCA 5	Alexandria Park	Passive recreation
NCA 5	Alexandria Childcare Centre	Childcare centre

Notes:
1. Gibbons Street Reserve would be used as a construction compound for the Project.

Known future developments that have the potential to become new noise sensitive receivers for the Project (due their timing) include:

- Sydney Metro City & Southwest: Waterloo Over Station Development
- Pemulwuy Student Accommodation (Located at Eveleigh Street/Vine Street/Louis Street/Caroline Street and Lawson Street, Redfern)
- 1 Lawson Square Redfern (alterations and additions to existing commercial towers)
- Social housing development at 11 Gibbons Street, Redfern
- 90-102 Regent Street, Redfern - Student Accommodation
- The Regent Hotel, 56-58 Regent Street, Redfern (proposed redevelopment)
- Mixed use development (including retail and residential) at No. 48 Regent Street, Redfern.

Due to their timing for completion, it is not expected that they would become new noise sensitive receivers during construction of the Project. Once completed and occupied, these would become new residential and non-residential receivers for operation of the Project. Further information on these developments is provided in **Chapter 23** of this EIS.

13.3.2 Heritage items

There are a number of heritage listed buildings located within or adjacent to the Project area. These heritage items are a mix of local and state heritage significance. Most notably, they include the Eveleigh Chief Mechanical Engineers Office, Eveleigh Railway Workshops and Machinery and the Redfern Railway Station group. Refer to **Chapter 14** of this EIS for further information on heritage listed items.

13.3.3 Existing background noise levels

Long term unattended and short term attended noise measurements were undertaken to establish the existing ambient and background noise environment at potentially affected receivers around the Project.

Unattended noise measurements

Noise measurements were undertaken using a noise logger at a representative location within each NCA (refer **Technical report 4 – Noise and vibration** for specific locations and measurement periods). Noise monitoring affected by adverse weather conditions or extraneous noise events is excluded from the monitoring data.

The noise environment at each of the residential receivers within a NCA is considered to have a similar noise environment to the unattended monitoring location within that NCA. As such, each of the residential receivers is assigned the same background noise level and construction noise management level (NML) (refer to **Section 13.2.4**).

The logger measured noise levels over the sample period then determined L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels of the noise environment (i.e. noise levels exceeded for 1%, 10% and 90% of the measurement period respectively). The L_{A90} is taken as the background level. The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels.

Table 13-13 presents individual RBLs and the existing L_{Aeq} ambient noise levels selected for each day, evening and night-time period for the NCAs, determined in accordance with the *Noise Policy for Industry*.

Table 13-13 Unattended noise measurement results in dB(A) for all NCAs

NCA	Logger	RBL L_{A90} dB(A)			Log Average L_{Aeq} dB(A)		
		Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
1	1	42	37	32	54	53	46
2	2	41	39	35	57	53	48

NCA	Logger	RBL L_{A90} dB(A)			Log Average L_{Aeq} dB(A)		
		Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
-	3	54	49	41	64	62	59
3/4	4[3]	53	51	39	61	58	57
5	5	44	44[2]	37	53	54	48

Notes:
1. Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays and Public Holidays. Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday and Public Holidays. Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays and Public Holidays.
2. The evening level was higher than the daytime level, and so it has been set to the daytime level as recommended by the Noise Policy for Industry.
3. The logging results of Logger 4 were used for both NCA 3 and NCA 4 to better interface with the other NCAs i.e. minimise differences in criteria for adjacent NCAs.

Attended noise measurements

Attended noise measurements were conducted at the five unattended noise monitoring locations described above. An additional location was also used to take attended measurements at a receiver on Little Eveleigh Street, close to the station and near to where the new station entrance on Little Eveleigh Street would be located. The measurements were conducted over 15 minute periods. **Table 13-14** provides the results of the attended noise measurements undertaken.

Table 13-14 Attended noise measurement results

Location	L_{Aeq} dB(A)	L_{A90} dB(A)
1	56	45
2	56	42
3	58	50
4	59	53
5	51	46
Additional location on Little Eveleigh Street	54	46

The noise measurements undertaken found that the acoustic environment in NCA 1, 2 and 5 are generally dominated by local vehicle traffic with receivers also affected by rail depending on proximity. The acoustic environment within NCA 3 and 4 are generally dominated by rail noise as well as noise associated with the operation of Redfern Station. Natural sounds are also audible throughout all NCAs. These characteristics are typical of an urban environment.

13.4 Impact assessment

13.4.1 Construction

The identified residential and non-residential receivers have been assessed against the standard hours and the out of hours NMLs as appropriate. Noise was assessed across the construction stages described below.

There may be differences between predicted and actual noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement, and also the location and orientation of the plant equipment. The acoustic shielding calculated in the model due to fixed building structures would also vary as the construction equipment moves around the Project area.

Construction stages and work hours

Seven distinct construction stages have been considered for the Project, which are described in **Table 13-16**. These would be confirmed by the construction contractor prior to construction commencing and further assessment would be undertaken if required. Construction stages 6 and 7 would not generate construction noise levels higher than the other stages, and therefore have not been modelled (note

however that mitigation measures identified for other stages in the assessment would be implemented for Stage 6 and 7). Further information on the specific activities to be undertaken during each construction stage is provided in **Section 5.3** of **Chapter 5**. A full list of construction machinery and equipment and respective sound power levels are provided in **Table 13-15**.

Table 13-15 Equipment sound power levels per construction work package

Construction stage	Equipment	Sound Power Level, dB(A)	
		L_{Aeq}	L_{max}
Stage 1: Site establishment and enabling works[1] (two months)	Bobcat	104	112
	Crane trucks (semi-trailer and tipper)	108	116
	Excavator (20 tonne)	98	106
	Generator	101	104
	Hand tools	94	102
	Lighting tower	95	98
	Power tools	97	105
	Bored piling rig[2]	103	111
Stage 2: Building modification works (six months)	Bored piling rig	103	111
	Concrete pump	106	109
	Concrete truck	106	114
	Crane trucks (semi-trailer and tipper)	108	116
	Demolition saw[3]	115	123
	Excavator (20 tonne)	98	106
	Grinder[2]	113	121
	Hand tools	94	102
	Impact drill[2]	112	120
	Jack hammer[3]	113	121
	Nail gun	90	98
	Power tools	97	105

Construction stage	Equipment	Sound Power Level, dB(A)	
		L_{Aeq}	L_{max}
Stage 3: Utility and overhead wiring relocations/ adjustments (ten months)	Bored piling rig	103	111
	Concrete pump	106	109
	Concrete truck	106	114
	Crane trucks (semi-trailer and tipper)	108	116
	Demolition saw[3]	115	123
	Excavator (20 tonne)	98	106
	Hand tools	94	102
	Lighting tower	95	98
	Power tools	97	105
Stage 4.1: Main construction works – Station entrances (eight months over an 18 month period)[2] Stage 4.2: Main construction works – Installation of concourse (18 months)[2]	Bobcat	104	112
	Bored piling rig	103	111
	Concrete pump	106	109
	Concrete truck	106	114
	Crane (450 tonne)	106	114
	Crane trucks (semi-trailer and tipper)	108	116
	Demolition saw[3]	115	123
	Excavator (20 tonne)	98	106
	Excavator (with auger)	103	111
	Franna crane	93	101
	Generator	101	104
	Grinder[3]	113	121
	Hand tools	94	102
	Hydreama/hirail	94	102
	Impact drill[2]	112	120
	Jack hammer[2]	113	121
	Lighting tower	95	98
	Manitou (forklift)	92	100
	Mini excavator	94	102
	Mobile crane	104	112
	Nail gun	90	98
	Power tools	97	105

Construction stage	Equipment	Sound Power Level, dB(A)	
		L_{Aeq}	L_{max}
Stage 5: Roadworks (Little Eveleigh Street/Ivy Street, and Marian Street/ Cornwallis Street/Rosehill Street, Lawson Street and Gibbons Street) (nine months)	Bobcat	104	112
	Concrete pump	106	109
	Concrete truck	106	114
	Coring machine[3]	115	123
	Crane trucks (semi-trailer and tipper)	108	116
	Excavator (20 tonne)	98	106
	Hand tools	94	102
	Jack hammer[3]	113	121
	Lighting tower	95	98
	Line marking truck	102	110
	Mobile crane	104	112
	Plate compactor	108	116
	Power tools	97	105
Stage 6: Demobilisation	Excavator (20 tonne)	98	106
	Generator	101	104
	Crane trucks (semi-trailer and tipper)	108	116
	Hand tools	94	102
	Lighting tower	95	98
	Power tools	97	105
Stage 7: Testing and Commissioning	Hand tools	94	102
	Lighting tower	95	98
	Power tools	97	105

Notes:

1. A chainsaw and mulcher may also be used at this stage however they have not been included in the 'Site establishment and enabling works' modelling as their use is not typical of this construction stage and would be for limited duration at certain locations during daytime only
2. Assumes that the piling rig would not be located adjacent to the other equipment listed in Stage 1. i.e. the same noise sensitive receivers would not be equally affected by the piling rig and the other equipment at any one time
3. A +5 dB(A) correction has been added in accordance with the Construction Noise and Vibration Strategy (TfNSW, 2019a) to account for noise with special audible characteristics.

The majority of works would be undertaken during standard daytime construction hours where reasonable and feasible to do so. Standard construction hours are:

- Monday to Friday 7:00 am to 6:00 pm
- Saturday 8:00 am to 1:00 pm
- No work on Sundays and public holidays.

However, work outside standard hours (out of hours work (OOHW)) would be required for some construction stages to minimise disruptions to traffic, pedestrians, nearby residents and businesses, and also for constructability, safety (particularly working within a live rail environment), continuity of rail services reasons or to meet approval requirements (e.g. Road Occupancy Licence).

Section 2.3 of the ICNG describes five categories of works that might be undertaken outside of standard hours, as follows:

1. *the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads*
2. *emergency work to avoid the loss of life or damage to property, or to prevent environmental harm*
3. *maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours*
4. *public infrastructure works that shorten the length of the project and are supported by the affected community*
5. *works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.*

Some OOHW for the Project would fall within categories 1 to 3. Most OOHW for the Project would also fall into Category 5, as some activities by their nature and location, including concourse and lift installation and some work on platforms, would be required to be undertaken during a standard rail shutdown (i.e. rail possession). It is anticipated that the works requiring rail shutdown would be undertaken over approximately 20 scheduled rail possession periods with continual work from Friday to early on Monday mornings. Approximately two additional (non-standard) rail possession periods are proposed including a possession across the 2020 and 2021 Christmas periods. During these possessions, existing standard protocols would be implemented to minimise impacts to the community, including providing alternative transport arrangements and notifications.

There is also the potential for mid-week night work to be required throughout various stages of the Project depending on the activity required. Certain construction activities, such as overnight concrete pours, would also out of necessity be undertaken outside of the standard construction hours so as to facilitate design and construction quality requirements (i.e. performing the concrete pour continuously). Other works that can be undertaken so as to be inaudible at the nearest residential receivers may also be performed during out of hours periods.

Table 13-16 Construction stages and scheduling

Construction stage and duration	Scheduling[1]
Stage 1: Site establishment and enabling works (two months)	Standard hours which may extend to Period 2 Out of Hours Works (OOHW)
Stage 2: Building modification works (six months)	Standard hours which may extend to Period 1 OOHW
Stage 3: Utility and overhead wiring relocations/ adjustments (ten months)	Standard hours, Period 1 OOHW and during a possession (Period 2 OOHW)
Stage 4.1: Main construction works – Station entrances (eight months of work over 18 months)[2]	Standard hours which may extend to Period 1 OOHW
Stage 4.2: Main construction works – Installation of concourse (18 months)[2]	Standard hours, Period 1 OOHW and during a possession (Period 2 OOHW)
Stage 5: Roadworks (Little Eveleigh Street/Ivy Street, and Marian Street/Cornwallis Street/Rosehill Street, Lawson Street and Gibbons Street) (nine months)	Standard hours which may extend to Period 2 OOHW
Stage 6: Demobilisation	Standard hours

Construction stage and duration	Scheduling[1]
Stage 7: Testing and commissioning	Standard hours, Period 1 OOHW and during a possession (Period 2 OOHW) (however no noisy work that is audible at sensitive receivers would be undertaken during OOHW)

Notes:

1. Construction hours are as follows:
   a. Standard hours - Weekdays 7:00 am to 6:00 pm and Saturday 8:00 am to 1:00 pm
   b. Period 1 OOHW are Weekdays 6:00 pm to 10:00 pm, Saturday 7:00 am to 8:00 am and 1:00 pm to 10:00 pm and Sunday/Public holiday 8:00 am to 6:00 pm
   c. Period 2 OOHW are Weekdays 10:00 pm to 7:00 am, Saturday 10:00 pm to 8:00 am and Sunday/Public holiday 6:00 pm to 7:00 am.
2. For the purpose of noise modelling, Stage 4.1 and Stage 4.2 have been represented by a single scenario Stage 4.

Three construction ancillary facilities are proposed for the construction of the Project as described in **Section 5.3.10** of **Chapter 5**. The assessment for Stage 1: Site establishment and enabling works includes the ancillary facility areas (i.e. noise sources have been modelled from within the ancillary facility areas). Based on the anticipated plant and equipment to be used, it is expected that noise levels from ongoing construction activities within the construction ancillary facility areas would be consistent with or less than the noise levels assessed for the Stage 1 works. However, as the construction ancillary facility areas would be used for the entire Project construction period there may be some cumulative noise impact from the noise generated from the construction ancillary facilities and works from other Project stages. Potential cumulative noise impacts are addressed further below.

Impacts to residential receivers

A comparison of the modelled noise levels against the NMLs for residential receivers is presented in **Table 13-5**. Note that the identified receivers are based on residential buildings impacted, and each receiver/building may contain more than one resident.

Table 13-17 Number of residential buildings where noise levels may exceed NMLs for each construction stage

Stage	Number of residential buildings where noise levels may exceed NML[1]											
	Standard Hours			Out of hours – Daytime				Out of hours – Night-time				Highly Noise Affected level (75 dB(A))[2]
	1-10 dB(A)	11-20 dB(A)	> 20 dB(A)	1-5 dB(A)	6-15 dB(A)	16-25 dB(A)	> 25 dB(A)	1-5 dB(A)	6-15 dB(A)	16-25 dB(A)	> 25 dB(A)	
NCA 1												
Stage 1	27	1	0	44	27	1	0	62	120	27	1	0
Stage 2	0	0	0	0	0	0	0	-	-	-	-	0
Stage 3	0	0	0	0	0	0	0	5	3	0	0	0
Stage 4.1/4.2	0	0	0	0	0	0	0	11	2	0	0	0
Stage 5	0	0	0	5	0	0	0	3	18	0	0	0
NCA 2												
Stage 1	6	0	0	10	6	0	0	70	26	1	0	0
Stage 2	9	14	11	42	9	14	11	-	-	-	-	7
Stage 3	89	0	0	63	89	0	0	149	154	25	0	0
Stage 4.1/4.2	35	12	5	70	35	12	5	208	130	24	9	4
Stage 5	220	84	101	125	220	84	101	140	248	174	141	74
NCA 3												
Stage 1	0	0	0	0	0	0	0	4	20	0	0	0
Stage 2	11	2	3	1	11	2	3	-	-	-	-	5
Stage 3	6	6	0	20	6	6	0	12	13	20	9	5
Stage 4.1/4.2	10	3	0	5	10	3	0	14	29	13	5	3
Stage 5	2	4	20	9	2	4	20	7	30	8	24	24

Stage	Number of residential buildings where noise levels may exceed NML[1]											
	Standard Hours			Out of hours – Daytime				Out of hours – Night-time				Highly Noise Affected level (75 dB(A))[2]
	1-10 dB(A)	11-20 dB(A)	> 20 dB(A)	1-5 dB(A)	6-15 dB(A)	16-25 dB(A)	> 25 dB(A)	1-5 dB(A)	6-15 dB(A)	16-25 dB(A)	> 25 dB(A)	
NCA 4 [2]												
Stage 1	5	0	0	6	5	0	0	12	9	9	2	0
Stage 2	0	0	0	2	0	0	0	-	-	-	-	0
Stage 3	4	0	0	8	4	0	0	9	26	9	0	0
Stage 4.1/4.2	1	0	0	8	1	0	0	15	18	4	1	0
Stage 5	14	1	1	11	14	1	1	34	14	24	3	2
NCA 5												
Stage 1	0	0	0	7	0	0	0	15	10	0	0	0
Stage 2	0	0	0	6	0	0	0	-	-	-	-	0
Stage 3	0	0	0	7	0	0	0	18	8	0	0	0
Stage 4.1/4.2	0	0	0	5	0	0	0	21	7	0	0	0
Stage 5	24	0	0	35	24	0	0	82	64	12	0	0

Notes:

1. These numbers are not cumulative through the ranges of noise emissions shown
2. The highly noise affected level specifies the exceedances of 75dB(A) or more shown in the upper ranges in the table (i.e. in the > 20dB(A) and > 25dB(A) columns)

Construction noise levels are predicted to exceed noise management levels during standard hours and out of hours across all construction stages with varying levels of exceedances.

During the daytime, the largest number of predicted exceedances occur during Stage 5 – Roadworks, due to works occurring on Little Eveleigh Street, Marian Street, Cornwallis Street, and Rosehill Street. The greatest number of exceedances of the noise management levels would occur at receivers in NCA 2. Across all NCAs, up to 100 residential buildings are predicted to be 'highly affected' at times from Stage 5 – Roadworks, due to the close proximity of the works.

During the night-time out of hours works, the largest number of exceedances occur during Stage 5 – roadworks. The greatest number of exceedances of the NMLs would occur at receivers in NCA 2.

Stage 5 – Roadworks is considered to have the greatest number of exceedances of the NMLs due to the close proximity of the works and the progressive nature of the works which would move through the Project area. It should be noted that the overall noise impact on residents would vary depending on location of the works, and residents would not be impacted for the full duration of Stage 5 – Roadworks. The modelled levels on certain receivers is shown graphically in Appendix B of **Technical report 4 – Noise and vibration**.

Impacts to non-residential receivers

The assessment found that construction noise levels are predicted to exceed the NMLs at non-residential receivers across all construction stages at varying levels. **Table 13-18** outlines the number of non-residential sensitive receivers where noise levels may exceed the NMLs. These non-residential sensitive receivers include a number of Sydney Trains' properties, and some commercial offices/shops/cafes.

The greatest number of exceedances of the NMLs for non-residential receivers is during Stage 5 – Roadworks, due to the close proximity and progressive nature of the works (i.e. the works would move throughout the area, affecting a large number of receivers). Key noisy activities of Stage 5 include the use of concrete saws, breakers and jack hammers. It should be noted that the overall noise impact would vary depending on location of the works and receivers would not be impacted for the full duration of the Stage 5 – Roadworks.

Table 13-18 Number of non-residential sensitive receivers where noise levels exceed the NMLs

Stage	Number of other buildings where noise levels may exceed NML		
	1-10 dB	11-20 dB	> 20 dB
Stage 1	5	0	0
Stage 2	0	3	2
Stage 3	2	0	0
Stage 4.1/4.2	2	1	2
Stage 5	6	0	5

Sleep disturbance

Sleep disturbance was assessed for construction Stage 3 and Stage 4.2, which are proposed to be undertaken during Period 2 OOHW (refer **Table 13-16** for information on construction stages and work hours). Based on the sleep disturbance screening level criteria as outlined in **Section 13.3.3**, the assessment found that a number of residential buildings would be affected by potential sleep disturbance impacts. This is detailed further below and shown in **Table 13-19**.

During Stage 1, noise levels at 399 residential buildings within all NCAs are predicted to exceed the sleep disturbance screening level criteria, and noise levels at approximately 57 residential buildings within NCAs 1, 2, 3 and 4 are predicted to exceed the awakening reaction criteria during this stage. The highest impacts are expected during truck movements involving crane trucks entering and leaving the Project area. During Stage 3, noise levels at 361 residential buildings located across all NCAs are predicted to exceed the sleep disturbance screening level criteria, and noise levels at approximately 68 residential buildings within NCAs 2, 3 and 4 are predicted to exceed the awakening reaction criteria during this stage. The highest impacts are expected during steel works (e.g. steel cutting, construction

using power tools). As works for Stage 3 would progress throughout the Project area, it is expected that this is a reasonable indication of the number of exceedances of the awakening reaction at any one time. However, any one building is not likely to be affected for the whole duration of this stage, due to the movement of the works.

During Stage 4.1/4.2, noise levels at approximately 127 residential buildings within NCAs 1, 2, 3 and 4 are predicted to exceed the sleep disturbance screening level criteria, and noise levels at 15 residential buildings within NCAs 2, 3 and 4 are predicted to exceed the awakening reaction criteria during this stage. The highest impacts are expected during hammering and excavation for the concourse support structures.

During Stage 5 - Roadworks, noise levels at 559 residential buildings within all NCAs are predicted to exceed the sleep disturbance screening level criteria (i.e. the screening criteria that then requires further detailed assessment to be undertaken), and subsequently it was found that noise levels at approximately 178 residential buildings within NCAs 2, 3 and 4 are predicted to exceed the awakening reaction criteria during this stage. The highest impacts are expected during hammering and coring for the construction of the shared zones on Marian Street and Little Eveleigh Street. As the roadworks would progress throughout the Project area, it is expected that this is a good indication of the number of exceedances of the awakening reaction at any one time. However any one building is not likely to be affected for the whole duration of this stage, due to the progressive movement of the works through the area.

It is noted that as the works are planned to occur during the night-time for both rail possessions and non-rail possession nights, cumulative noise impacts may occur where the possessions overlap with planned rail maintenance. This may result in an increase of up to 3 dB(A) of the highest noise level predicted for any construction stage and potentially increase the number of impacted receivers. This is discussed further in the cumulative construction noise section below.

Table 13-19 Number of residential buildings where noise levels may exceed sleep disturbance criteria

Stage	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level L_{Amax}, dB(A)	Awakening reaction level L_{Amax}, dB(A)
NCA 1		
Stage 1: Site establishment and enabling works	219	23
Stage 3: Utility and overhead wiring relocations/adjustments	12	0
Stage 4.2: Main construction works – Installation of concourse	3	0
Stage 5: Roadworks	5	0
NCA 2		
Stage 1: Site establishment and enabling works	90	4
Stage 3: Utility and overhead wiring relocations/adjustments	243	16
Stage 4.2: Main construction works – Installation of concourse	72	2
Stage 5: Roadworks	422	141
NCA 3		
Stage 1: Site establishment and enabling works	29	13
Stage 3: Utility and overhead wiring relocations/adjustments	45	35

Stage	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level L_{Amax}, dB(A)	Awakening reaction level L_{Amax}, dB(A)
Stage 4.2: Main construction works – Installation of concourse	37	10
Stage 5: Roadworks	51	26
NCA 4		
Stage 1: Site establishment and enabling works	31	17
Stage 3: Utility and overhead wiring relocations/adjustments	43	17
Stage 4.2: Main construction works – Installation of concourse	15	3
Stage 5: Roadworks	40	11
NCA 5		
Stage 1: Site establishment and enabling works	30	0
Stage 3: Utility and overhead wiring relocations/adjustments	18	0
Stage 4.2: Main construction works – Installation of concourse	0	0
Stage 5: Roadworks	41	0

Construction traffic noise

Construction traffic would generally not exceed 20 heavy vehicle movements and 40 light vehicles movements per day at peak construction periods (not including worker transport to and from site). On average, approximately only five heavy vehicles and 20 light vehicles would be expected on an average day.

The assessment found that road traffic noise levels during construction are unlikely to increase by more than 2dB(A) on Cleveland Street, Regent Street, Wyndham Street/Gibbons Street, Lawson Street, Botany Road, McEvoy Street, Fountain Street, Mitchell Road and Copeland Street/Swanson Street. This is due to the existing high volumes of traffic on these roads and the small percentage increase due to construction traffic.

Whilst the existing annual average daily traffic volumes on Little Eveleigh Street and the Marian Street/Cornwallis Street/Rosehill Street are estimated to be around 300 and 150 vehicles respectively, road traffic levels are also unlikely to increase by more than 2dB(A) due to the low volumes of the construction traffic generated. It is also noted that traffic speeds during the construction period may be reduced, which would generally lessen the level of noise generated.

As noise levels are not expected to increase by more than 2dB, further assessment is not required in accordance with the *Road Noise Policy* (DECCW, 2011).

To minimise the construction traffic noise levels and reduce the risk of negative impacts occurring, construction traffic management (including vehicle movements generated under the Project) would be considered as part of a Construction Noise and Vibration Management Plan (CNVMP), which would be developed for the Project (refer to **Section 13.5**).

Construction vibration

Vibration intensive works for the construction of the Project may include the use of jackhammer/s, bored piling rig/s and plate compactor/s. The minimum working distances of these items of equipment from receivers are provided in **Table 13-20**, which is based on recommendations of the *Construction Noise and Vibration Strategy* (TfNSW, 2019a). If these minimum working distances are complied with,

no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage.

However, a number of heritage-listed items within the Project area may be within the minimum working distances for vibration intensive works, including the following:

- Platform 1 and 10 Retaining walls
- Platform 1 Store and Office Building
- Engine Dive and Ventilation Shafts
- Telecommunications Equipment Centre
- Interlocking Store, Southern Store, Northern Store and Brick Toilet
- Platform 1 to 10 facings
- Platform 4 to 10 Buildings
- Platform 11 and 12 below ground structures.

Where vibration intensive works are required within the minimum working distances, mitigation measures to control excessive vibration would be implemented, as outlined in **Section 13.5**. Specific vibration mitigation measures would be determined during detailed design. This should include as a minimum, building condition surveys and vibration monitoring during construction which would be documented within the CNVMP. If the construction methodology changes during detailed design, then a reassessment of the minimum working distances would be required.

Table 13-20 Minimum working distances of vibration intensive equipment to be used during the Project

Plant	Rating/ description	Cosmetic damage		Human response
		Heritage	Residential/ commercial	
Jackhammer	Handheld	1 metre (nominal)	1 metre (nominal)	Avoid contact with structure
Plate compactor[1]	Handheld	8 metres	5 metres	15 to 20 metres
Pile boring	Less than or equal to 800 mm	4 metres	2 metres (nominal)	4 metres

Notes:

1. No recommendations provided in the Construction Noise and Vibration Strategy for a plate compactor (assumed to be the same as a small roller).

Cumulative construction noise

While most construction activities are expected to occur at distinct scheduled times and at different locations, it is possible that noisy construction activities for the Project may occur at the same time in close proximity to each other. An indicative program for the construction stages is provided in refer **Section 5.3** of **Chapter 5**. Overlap between stages may occur for works at the new station entrances on Marian Street and Little Eveleigh Street (Stage 2) in conjunction with utility and overhead wiring relocations/adjustments (Stage 3) and the Main Construction works (Stage 4). In these cases, it is possible that an increase of up to 3dB(A) of the highest noise level predicted for any construction stage may occur (assuming that at any one location equal noise levels from two stages of works are experienced). This may increase the number of receivers where noise levels would be greater than 20dB(A) above the NMLs.

Similarly, there is an overlap of the program of construction works between Stage 3, Stage 4 and Stage 5 (refer **Section 5.3** of **Chapter 5**). Noise from use of the construction ancillary facility areas may also contribute to construction noise at receivers. However, it is likely that the other construction stages would dominate cumulative noise levels, and any increase in the overall noise level from the Project would be less than 3dB(A). Any overlapping construction stages and identification of any receivers subject to increased noise levels would be determined during detailed design. Additional

mitigation measures subsequently required would also be identified during detailed design (as described in **Section 13.5** and **Table 13-22**).

There is also potential for construction noise from the Project to combine with noise generated by potential other projects in the area (as identified in S**ection 13.3.1**) to create cumulative noise impacts on receivers. Potential cumulative noise impacts with other projects in the area is assessed in **Chapter 23** of this EIS (and also addressed in Section 5.6.2 of **Technical Report 4 – Noise and Vibration**). In summary, it was found that if the noisiest stages of other construction projects were to coincide with the construction of this Project, the greatest increase in noise levels from either project would be a maximum of 3 dB(A). In the case of construction traffic, a maximum noise level increase of 3 dB(A) is also predicted. For context, an increase in noise levels of around 3dB(A) is low (barely noticeable). The decibel scale is explained further in the Definitions section of **Technical Report 4 – Noise and Vibration**. Mitigations measures are provided in **Chapter 23** of this EIS in regards to managing potential cumulative noise impacts with other projects.

13.4.2 Operation

Operation of the Project would introduce a number of mechanical plant and infrastructure (e.g. lifts, new services building, Opal card readers) and a new car park which would generate noise. It is also noted that additional commuters would access the upgraded station from streets close to the new station entrances.

As noted in **Section 13.2.5**, noise from the car park activities, mechanical services and Opal card readers are assessed in this section using the *Noise Policy for Industry*. The receivers mostly likely to be affected by car park activities would not be affected by the mechanical services and Opal card readers, therefore these sources have been considered separately. Receivers affected by noise from Opal card readers could also be affected by noise from mechanical services, however in this case the mechanical services would be designed so that cumulative noise impacts would comply with the relevant criteria. Noise from commuters walking through shared zones has been assessed using the *Noise Guide for Local Government's* checklist for 'offensive noise'.

During operation the Project is not anticipated to significantly generate additional vehicular traffic, and therefore negligible impacts to traffic noise around Redfern Station are expected. The only considerable change the Project would bring is the reduction in the speed limit to 10 kilometres per hour within the new shared zone areas along Little Eveleigh Street and Marian Street/Cornwallis Street/Rosehill Street. This would generally reduce the noise levels from vehicles, however given that the current traffic flow in these roads is already characterised by slow operating speeds of vehicles, this impact is expected to be negligible.

The operation of the Project would also not include any sources of vibration likely to exceed the relevant criteria, and would not give rise to significant vibration. Therefore no further consideration of operational vibration has been undertaken.

Industrial noise

Car park noise

The car park is proposed to have 20 car parking spaces, which would replace the current on-street parking spaces which would be removed as part of the shared zone improvement. Car park activity noise was calculated in accordance with the Bavarian State Office for the Environment's *Parking Area Noise*. For the purposes of assessment, it was assumed that there would be up to four vehicle movements during the daytime and one vehicle movement during the night-time in a 15 minute period.

Predicted noise levels at the most affected residential receivers (157 Little Eveleigh Street (within NCA 3) and 160-166 Little Eveleigh Street (within NCA 2)) indicate that the operational noise levels comply with the relevant criteria at all receivers during the daytime, however there may be small, temporary exceedances (up to 2dB(A)) during the night-time period at the rear/western side of 157 Little Eveleigh Street which is the closest residential receiver. For most receivers along Little Eveleigh Street, the use of the new car park would reduce current parking noise levels, which currently extend along Little Eveleigh Street. However although noise sources such as car engines starting and car doors/car boots closing would be removed from along Little Eveleigh Street when the parking spaces are relocated, there would be additional noise from pedestrians walking through the new shared zone along Little Eveleigh Street. Mitigation measures are described in **Section 13.5**.

Sleep disturbance

A sleep disturbance assessment was undertaken to assess the potential noise impacts from car parking activities (e.g. car door/boot slam, car starting and car accelerating) on nearby sensitive receivers during operation. Results show that the predicted noise levels are expected to exceed the sleep disturbance screening criteria at 157 Little Eveleigh Street and 160-166 Little Eveleigh Street by up to 20dB(A) L_{AFmax} and 12dB(A) L_{AFmax} respectively (sleep disturbance criteria is provided in **Table 13-11**) However due to the nature of the noise sources (e.g. car door/boot slam, cars moving) the noise is likely to be of short duration (i.e. not continuous). The exceedances are due to the close proximity of the nearest car parking space to these receivers.

At other locations, the noise level from the car park would likely be less, due to the acoustic shielding provided by 157 Little Eveleigh Street and distance loss.

To provide context, the existing high background noise levels as measured at 125 Little Eveleigh Street (which currently range between 65 and 75dB(A) from 10:00 pm to 2:00 am, and is reduced from 2:00 am before beginning to rise again after 4:00 am), means the acoustic environment is unlikely to significantly change as a result of the new car park, when the current frequency of cars parking in the existing street parking along Little Eveleigh Street is considered. The car park would be used infrequently between 2:00 am and 5:00 am, and similarly it is also unlikely that the acoustic environment during this time would change significantly from the current frequency of cars parking along Little Eveleigh Street.

Notwithstanding, and noting the exceedance of criteria above, a new solid fence would be constructed between the boundary of the car park and 157 Little Eveleigh Street as part of the Project (and also the boundary with 155 Little Eveleigh Street), which would reduce noise levels by around 5dB(A). Depending on the specific acoustic performance of the proposed fence, consideration would be given to at-receiver treatments such as the provision of mechanical ventilation to allow windows to be closed and/or upgraded glazing at 157 Little Eveleigh Street. The installation of at-receiver treatments would address any residual exceedances. Mitigation measures are described in **Section 13.5**.

Mechanical service noise

Noise sources from mechanical services associated with the operation of the Project are expected to include lift motors, lift air conditioning plant, building air conditioning plant and toilet exhaust fans.

This equipment would be selected during detailed design. However, based on the nature of the mechanical services to be installed, standard noise controls such as appropriate selection and placement of mechanical plant and the inclusion of attenuation measures such as duct lining/attenuators, would be adequate to reduce the noise levels so that they meet the *Noise Policy for Industry* criteria. This would be confirmed once equipment selection is finalised.

Public address system noise

New public address system speakers would be installed at the southern ends of the platforms for regular announcements. Speakers would also be installed in the concourse and within the new station entrances. These speakers would be used for train delay or special event announcements only.

A public address system has not yet been selected, therefore operational noise levels cannot be predicted definitively at this stage of the design. However given the nature of these systems and mitigation measures successfully applied to other projects, it is expected that potential impacts can be readily mitigated during the detailed design stage, and noise levels would be design so at to not be intrusive for nearby residential receivers.

Opal card reader noise

Opal card readers would be installed at the new station entrances. The closest noise receivers for Opal card readers include 124 Little Eveleigh Street (approximately 10 metres from the Opal card readers), and 1 Marian Street (approximately 20 metres from the Opal card readers).

Based on a pedestrian modelling study undertaken for the Project, it is likely that around 825 passengers would be ‘tapping on/off’ in a 15 minute period in the AM peak commuter hour at the Little Eveleigh Street entrance, and around 1,695 passengers at the Marian Street entrance. Conservatively, it is then assumed that during the night-time period (10:00 pm until trains finish

running) this would be reduced to around 10% of the PM peak commuter hour 'tapping on/off' in a 15 minute period at the Little Eveleigh Street and Marian Street entrances (82 people and 170 people respectively).

Based on the above, the predicted noise levels at these two locations comply with the applicable Project specific noise level criteria (described in **Table 13-10**) during both the daytime and night-time periods. It should be noted that noise from Opal card readers would not be tonal over a 15 minute period at receiver locations, therefore a correction to account for annoying characteristics under the *Noise Policy for Industry* is not required.

Non-industrial noise

Commuters

During operation of the Project, a noticeable increase in pedestrian movements would be experienced on Little Eveleigh Street and Marian Street. The investigations undertaken to inform the design of the Project estimated that approximately 3,300 and 6,770 people would be walking down Little Eveleigh Street and Marian Street respectively during a typical AM peak hour. These pedestrians are expected to exhibit typical behaviour of people entering and leaving train stations, in that the majority of people would be constantly moving toward their destination and not loitering, with minimal conversation, with use of mobile phones being a notable exception.

However there are no specific noise criteria or limits that would apply to this activity. The 'offensive noise' checklist from the *Noise Guide for Local Government* (refer to **Section 13.2.4**) is therefore considered below to determine if nearby noise sensitive receivers are likely to be adversely affected by the Project. The questions in the checklist are as follows:

Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?

The noise generated by commuters/pedestrians walking through the shared zones to and from the new station entrances and other local areas would not be loud in an absolute sense (e.g. in the context of the overall existing noise environment) at nearby residential receivers. Ambient L_{Aeq} noise levels at the nearby residential receivers on Little Eveleigh Street are around 61 to 67 dB(A) during the daytime, 60 to 63 dB(A) during the evening, and 58 to 60 dB(A) during the night-time period when Sydney Trains are in operation. It can also be seen that the ambient L_{Aeq} noise levels at the nearby residential receivers on Marian Street are around 59 to 63 dB(A) during the daytime, 55 to 60 dB(A) during the evening, and 50 to 60 dB(A) during the night-time period when Sydney Trains are in operation (refer Appendix A of **Technical Report 4 – Noise and Vibration**). Noise from commuters walking along these roads would not be considered loud relative to these existing ambient noise levels.

Does the noise include characteristics that make it particularly irritating? Is the noise atypical for the area?

The noise generated by pedestrians would likely comprise footfall noise and conversations, and would not be considered atypical for an urban area. It would not include any characteristics that typically irritate such as low frequency or tonal components. This type of noise would not be considered atypical for an urban area.

Does the noise occur at times when people expect to enjoy peace and quiet? Does the noise occur often?

It is considered that local residential receivers would notice a difference in ambient noise levels due to the large number of commuters utilising the new station entrances and concourse. The noise levels from commuters would be highest during commuter peak periods which would coincide with the noisier parts of the day, and therefore have less of an effect on the overall noise level. The noise is likely to occur on most days.

Based on the above considerations, noise associated with the commuter use of the new station entrances and surrounding shared zones would be noticeable to the closest residential receivers, however is unlikely to be considered 'offensive' as defined in the *Protection of the Environment Operations Act 1997* (refer also **Technical Report 4 – Noise and Vibration** of this EIS). The Project would investigate further opportunities to minimise noise impacts to residents through the ongoing design development of the Little Eveleigh Street and Marian Street shared zones.

Noise from commuters and other pedestrians, including anti-social behaviour, is addressed further in the **Chapter 11** and **Technical report 2 - Social** of this EIS.

13.5 Management and mitigation measures

13.5.1 Overview

A CEMF (refer **Appendix D** of this EIS) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor in developing the CEMP, sub-plans, and other supporting documentation for each specific environmental aspect.

A Construction Noise and Vibration Management Sub-Plan would be developed for the Project as identified in Section 6.2 of the CEMF, and well as the Construction Noise and Vibration Strategy (CNVS) (refer **Appendix E** of this EIS).

The chapter includes a compilation of the performance outcomes as well as mitigation measures, including those that would be included in the Construction Noise and Vibration Management Sub-Plan.

Mitigation measures have been developed with consideration to some feedback provided by the community during early project-engagement stages. Feedback received during the public exhibition of this EIS in regard to mitigation of noise would be considered and documented in the Response to Submissions report to be prepared. Refer **Chapter 6** and **Chapter 11** of this EIS for further information.

13.5.2 Performance outcomes

The following performance outcomes have been established for this Project:

- construction airborne and ground-borne noise and vibration is effectively managed to minimise adverse impacts on acoustic amenity
- construction vibration is effectively managed to minimise adverse impacts on the structural integrity of buildings and items
- increases in noise emissions and vibration during operation of the Project affecting nearby properties and other sensitive receivers are effectively managed to protect the amenity and well-being of the community
- appropriate mitigation measures outlined in the TfNSW CNVS are identified and implemented to minimise noise and vibration impacts
- specific notifications to the community are issued no later than seven days prior to construction works.

The Project would be designed, constructed and operated to achieve these performance outcomes.

13.5.3 Mitigation measures

A list of mitigation measures which would be implemented during the Project are provided in **Table 13-21**.

Table 13-21 Mitigation measures

ID	Mitigation measure	Applicable location (s)
Construction		
N1	A Construction Noise and Vibration Management Sub-Plan (CNVMP) would be prepared as part of the CEMP. The CNVMP would include all feasible and reasonable safeguards to manage noise emissions from the Project. The CNVMP would include, as a minimum, the following: • identification of nearby residences and other sensitive land uses • description of approved hours of work and an Out of Hours Protocol	All

ID	Mitigation measure	Applicable location (s)
	• description and identification of all construction activities, including work areas, equipment and duration (and provision for re-assessment of noise and vibration impacts if required due to changes) • description of the work practices (generic and specific) that would be applied to minimise noise and vibration • works scheduling to minimise the noise impact on sensitive receivers, with consideration given to cumulative noise impacts (and provision for re-assessment of noise and vibration impacts if required due to changes to work stages or other surrounding projects) • a complaints handling process • noise and vibration monitoring procedures, including for heritage-listed items/structures • overview of community consultation required for identified noise intensive works. The CNVMP and CEMP must be updated as required to account for any changes in noise and vibration management issues and strategies, to ensure these documents remain adequate for their purposes.	
N2	All employees, contractors and subcontractors would receive an environmental induction. As a minimum the induction must include: • all relevant Project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on noise generating activities with special audible characteristics (noise with characteristics that can cause annoyance and disturbance, containing noticeable factors such as tonality, low frequency noise, impulsive or intermittent noise events) • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures and complaint handling procedures.	All
N3	All nearby residents and sensitive receivers impacted by noise levels from the Project which are expected to exceed the NML would be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works. The information provided to the receivers will include: • programmed times and locations of construction work • the hours of proposed works • construction noise and vibration impact predictions • construction noise and vibration mitigation measures being implemented on site. Community consultation regarding construction noise and vibration would be detailed in a Community Liaison Plan for the construction of the Project and would include a 24 hour hotline and complaints management process.	All

ID	Mitigation measure	Applicable location (s)
N4	If vibration intensive equipment is to be used within the minimum working distances for cosmetic damage described in this EIS (**Technical report 4 – Noise and vibration**), then attended vibration measurements would be undertaken when work commences, to determine "site specific minimum working distances" and confirm appropriate vibration limits for that structure. The Construction Contractor would be informed of the minimum working distances.	All
N5	For heritage items where the screening criteria are predicted to be exceeded, the more detailed assessment would include condition assessment and specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Heritage items
N6	The CNVMP would be implemented with the aim of meeting the construction noise management levels where feasible and reasonable. The following mitigation measures would be included in the CNVMP: • use of at-source noise attenuation around equipment where possible • where feasible and reasonable structures such as site sheds, earth bunds and fencing shall be used to shield residential receivers from noise (e.g. including along appropriate sections of the rail corridor fence line of Little Eveleigh Street and Marian Street, and through the use of 1.8 m high fencing around ancillary facility 3). Site topography shall be considered when situating plant • traffic flow (i.e. vehicle movements, including deliveries), parking and loading/unloading areas would be planned to minimise reversing movements within construction sites • loading and unloading of materials/deliveries would occur as far as possible from sensitive receivers • if site access points and roads are altered during detailed design, they would be selected to be as far as possible away from sensitive receivers within rail corridor access constraints • dedicated loading/unloading areas would be shielded if close to sensitive receivers wherever feasible and reasonable • delivery vehicles would be fitted with straps rather than chains for unloading, wherever possible • non-tonal reversing beepers would be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles • on-site storage capacity would be maximised to reduce the need for truck movements during sensitive times • the offset distance between noisy plant and adjacent sensitive receivers would be maximised • plant used intermittently would be throttled down or shut down • noise-emitting plant would be directed away from sensitive receivers where feasible and reasonable • the noise levels of plant and equipment must have operating sound power or sound pressure levels as presented in this EIS (**Technical report 4 – Noise and vibration**) that would meet the predicted noise levels • quieter and less vibration emitting construction methods would be used where feasible and reasonable (e.g. rubber wheeled instead of steel tracked plant) • where practicable, materials would be pre-fabricated and/or prepared off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.	All

ID	Mitigation measure	Applicable location (s)
N7	Work generating noise with special audible characteristics (such as jack hammers, rock breakers, piling rigs and diamond saws) and/or vibration levels would be scheduled during less sensitive time periods for receivers (for example, before 10:00 pm or as determined during community consultation) where feasible and reasonable.	All
N8	Vehicle movements would be routed away from sensitive receivers and scheduled during less sensitive times where feasible and reasonable. The speed of vehicles would be limited, and the use of engine compression brakes avoided.	All
N9	A noise and vibration monitoring program would be carried out for the duration of works in accordance with the CNVS, CNVMP and any approval and licence conditions. Monitoring of noise would be undertaken at appropriate intervals and in response to complaints during construction. In addition, vibration intensive work would not proceed within the site specific minimum working distances unless a permanent vibration monitoring system is installed approximately one metre from the building footprint, to warn operators (e.g. via flashing light, audible alarm, SMS) when vibration levels are approaching the peak particle velocity objective.	All
N10	In accordance with the CNVS, additional mitigation measures should be implemented according to **Table 13-22** and **Table 13-23** (and Appendix B of **Technical report 4 – Noise and vibration**) of this EIS for sensitive receivers where noise levels are predicted to exceed applicable criteria.	As per **Table 13-22** and **Table 13-23** (and Appendix B of **Technical report 4 – Noise and vibration**)
Operation		
N11	Mechanical plant selections should be reviewed during the detailed design phase to ensure compliance with the operational noise criteria detailed in this EIS (**Technical report 4 – Noise and vibration**) is achieved. Standard noise controls such as appropriate selection and placement of mechanical plant and the inclusion of attenuation measures such as duct lining/attenuators are recommended to achieve operational noise criteria.	Redfern Station
N12	Public address system selection should be reviewed during detailed design to ensure that compliance is achieved with the operational noise criteria detailed in **Section 13.2.5**.	Redfern Station
N13	The type and design of the new solid fence proposed to be constructed at the boundary of the proposed car park should be developed to optimise the level of acoustic shielding provided. Depending on the acoustic performance of the proposed fence, consideration would be given to at-receiver treatments for 157 Little Eveleigh Street such as the provision of mechanical ventilation to allow windows to be closed and/or upgraded glazing.	Car park boundary and 157 Little Eveleigh Street
N14	The Project would investigate further opportunities to minimise noise impacts to residents through the ongoing design development of the shared zones at Little Eveleigh Street and Marian Street.	Little Eveleigh Street and Marian Street shared zones

The CNVS provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during construction of TfNSW projects. This is managed through the application of all feasible and reasonable

mitigation measures. However, predicted exceedances after the application of standard noise-reducing mitigation measures may still occur for the Project, which represents residual noise impacts.

The CNVS recommends the implementation of additional mitigation measures where there are predicted exceedances resulting in residual noise impacts. These additional measures are presented in **Table 13-22**. The provision of additional mitigation measure/s is based on the degree of a predicted exceedance above the RBL, and when the exceedance is predicted to occur, which is related to a receiver's perception of the noise. The RBLs can be found in **Section 13.3**, and Appendix B of **Technical Report 4 – Noise and vibration** shows the location of impacted receivers and degree of noise exceedance predicted (to determine which mitigation measure/s should be applied to which receiver).

In addition to these predicted exceedances there may also be cumulative noise impacts from concurrent construction stages of the Project, as well as from other projects in the surrounding area, as presented in **Section 13.4.1**. Cumulative noise impacts may result in an increase in the overall noise level by up to 3dB(A). Potential cumulative noise impacts from the Project in conjunction with other projects in the area are further addressed in **Chapter 23** of this EIS.

Table 13-22 Additional mitigation measures matrix

Construction hours		Action level[1] (mitigation measures)[2]			
		0 – 10 dB(A) Noticeable	>10 – 20 dB(A) Clearly audible	>20 – 30 dB(A) Moderately intrusive	>30 dB(A) Highly intrusive
Standard	Weekday (7:00 am–6:00 pm) Saturday (8:00 am–1:00 pm) Sunday/Public Holiday (Nil)	-	-	PN, V	PN, V
Out of Hours Work Period 1	Weekday (6:00 pm–10:00 pm)	-	PN, RP[3], DR[3]	PN, V, SN, RO, RP[3], DR[3]	PN, V, SN, RO, RP[3], DR[3]
	Saturday (7:00 am–8:00 am) and (1:00 pm–10:00 pm)				
	Sunday/Public Holiday (8:00 am–6:00 pm)				
Out of Hours Work Period 2	Weekday (10:00 pm–7:00 am)	PN	PN, V, SN, RO[4], RP[3], DR[3]	PN, V, SN, RO[4], RP[3], DR[3]	PN, V, SN, RO[4], RP[3], DR[3], AA
	Saturday (10:00 pm–8:00 am)				
	Sunday/Public Holiday (6:00 pm–7:00 am)				

Notes:

1. Action level is) the noise level ($L_{Aeq(15\ minute)}$) above background (RBL) - qualitative assessment of noise levels.
2. The following abbreviations have been used (refer to **Table 13-23** for further details):
   PN: Project notification; V: Verification monitoring; SN: Specific notification; RP: Respite period; DR: Duration reduction; RO: Project specific respite offer; AA: Alternative accommodation.
3. Respite periods and duration reduction are not applicable when works are carried out during OOHW Period 1 Day only (i.e. Saturday 6:00 am-7:00 am and 1:00 pm-6:00 pm, Sundays/Public Holidays 8:00 am-6:00 pm).
4. *Respite offers during OOHW Period 2 are only applicable for evening periods (i.e. Sundays/Public Holidays 6:00 pm-10:00 pm),and may not be required if a respite offer has already been made for the immediately preceding OOHW Period 1.*

Table 13-23 provides an explanation of each additional mitigation measure, as outlined in the CNVS.

Table 13-23 Description of additional mitigation measures

Abbreviation	Mitigation measure	Explanation
PN	Periodic notification	A notification entitled 'Project Update', 'Construction Update' or 'Community Update' or similar is produced and distributed to stakeholders via letterbox drop and distributed to the Project postal and/or email mailing lists. The same information will be published on the TfNSW website. Periodic notifications provide an overview of current and upcoming works across the Project and other topics of interest. The objective is to engage, inform and provide project-specific messages. Advanced warning of potential disruptions can assist in reducing the impact on stakeholders. The approval conditions for projects specify requirements for notification to sensitive receivers where works may impact on them. Content and length is determined on a project-by-project basis and must be approved by TfNSW prior to distribution. Most projects distribute notifications on a monthly basis.
V	Verification	Verification monitoring of noise and/or vibration during construction may be conducted at the affected receiver or a nominated representative location. Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to confirm that: Attended noise monitoring is to be undertaken as follows: construction noise and vibration from the Project are consistent with the predictions in the noise assessment mitigation and management of construction noise and vibration is appropriate for receivers affected by the works. Where noise monitoring finds that the actual noise levels exceed those predicted in the noise assessment then immediate refinement of mitigation measures may be required.
SN	Specific notifications	Specific notifications are in the form of a personalised letter, or phone call to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. Letters may be letterbox dropped or hand distributed. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and their specific needs. Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing. Individual briefings are used to inform stakeholders about the impacts of noisy activities and mitigation measures that would be implemented. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the Project. Specific notifications are used to support periodic notifications, or to advertise unscheduled works and must be approved by TfNSW prior to implementation/distribution.

Abbreviation	Mitigation measure	Explanation
RO	Respite offers	The purpose of a respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact. The offer could comprise pre-purchased tickets for activities, restaurants or similar.
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts. Alternative accommodation would be determined on a case-by-case basis and should provide a like-for-life replacement for permanent residents, including provisions for pets, where reasonable and feasible.
RP	Respite period	OOHW during evening and night periods would be restricted so that receivers are impacted for no more than three consecutive evenings and no more than two consecutive nights in the same NCA in any one week, except where this is a Duration Reduction. A minimum respite period of four evenings/five nights shall be implemented between periods of evening and/or night works. Strong justification must be provided where it is not feasible and reasonable to implement these period restrictions (e.g. to minimise impacts to rail operations), and approval must be given by TfNSW through the OOHW Approval Protocol.
DR	Duration Reduction	Where Respite Periods are considered to be counterproductive to reducing noise and vibration impacts to the community it may be beneficial to increase the number of consecutive evenings and/or nights through an overall Duration Reduction to minimise the duration of the activity. Impacted receivers must be consulted and evidence of community support for the Duration Reduction must be provided as justification for the Duration Reduction. A community engagement strategy must be agreed with and implemented in consultation with Project Community Engagement Representatives.