Pyrmont Over Station Development

Appendix E
Noise and Vibration Assessment

August 2024

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Glossary

Term	Definition
'A'-Weighted	Frequency adjustment to account for the relative loudness perceived by the human ear. Indicated by the units dB(A).
'C'-Weighted	Frequency adjustment for noise measurements to account for loudness or bass noise. Indicated by the units dB(C).
ABL	Assessment Background Level, the lowest 10th percentile of the background noise (the L_{A90}) over the defined period for each day.
AS 2187.2	Australian Standard AS 2187.2-2006 Explosive-Storage and use Part 2: Use of explosives
AS 2436	Australian Standard AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites
AS/NZS 2107	Australian / New Zealand Standard AS/NZS 2107:2016 "Acoustics – Recommended design sound levels and reverberation times for building interiors"
AVATG	Assessing Vibration: A technical guideline, NSW Department of Environment and Conservation, February 2006.
BS 7385.2	British Standard BS 7385.2-1993 Evaluation and measurement for vibration in Buildings Part 2
CBD	Central business district
CNVG	Construction Noise and Vibration Guideline, NSW Department of Road and Maritime Services, August 2016
CNVS	Sydney Metro Construction Noise and Vibration Standard
CNVMP	Construction Noise and Vibration Management Plan
Concept and Stage 1 CSSI Application	Application SSI-10038 including all major civil construction works between Westmead and The Bays, including station excavation and tunnelling, associated with the Sydney Metro West line, approved 11 March 2021
Concept SSDA	A concept development application as defined in Section 4.22 the EP&A Act, as a development application that sets out concept proposals for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications.
Council	City of Sydney
CSSI	Critical State Significant Infrastructure
dB	decibel, unit used to measure the loudness of sound
dB(A)	'A'-weighted decibel
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
FSR	Floor space ratio

Term	Definition
GFA	Gross floor area
ICNG	Interim Construction Noise Guideline, NSW Department of Environment and Climate Change, July 2009
IGU	Insulated glass unit
Infrastructure SEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
L_{A90}	The noise level which is exceeded for 90% of the measurement period, commonly used to indicate the background noise level.
$L_{Aeq,T}$	The energy average noise level over the measurement period, T
L_{AFmax}	The maximum noise level over the measurement period. This level is the maximum noise level due to an individual noise event.
LEP	Local Environmental Plan
LGA	Local Government Area
NML	Noise Management Level
NPfI	Noise Policy for Industry, NSW EPA, October 2017
OSD	Over Station Development
POEO Act	*Protection of the Environment Operations Act 1997*
RBL	Rating Background Level, the median ABL over an entire noise monitoring period
RL	Reduced level
RNP	NSW *Road Noise Policy*, Department of Climate Change, Environment and Water 2011
SEARs	Secretary's Environmental Assessment Requirements
SSDA	State Significant Development Application
SSI	State Significant Infrastructure
Stage 2 CSSI Approval	Application SSI-19238057, including major civil construction works between The Bays and Hunter Street Station, approved 24 August 2022
Stage 3 CSSI Application	Application SSI-22765520, including rail infrastructure, stations, precincts and operation of the Sydney Metro West line, approved 25 January 2023
Sydney Metro West	Construction and operation of a metro rail line and associated stations between Westmead and the Sydney CBD as described in section 1.1
TfNSW	Transport for New South Wales
VDV	Vibration Dose Value

Executive summary

This Noise and Vibration Impact Assessment report supports a Concept State Significant Development Application (Concept SSDA) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Concept SSDA is made under section 4.22 of the EP&A Act.

Sydney Metro is seeking concept approval for an over station development above the Pyrmont Station located at 37-69 Pyrmont Bridge Road, Pyrmont. The proposed development would comprise a mixed use building comprising a predominantly commercial podium and residential tower above.

The Concept SSDA seeks consent for a mixed use building envelope, a maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking. In addition, it also seeks consent for strategies and design parameters for the future detailed design of the development.

This Noise and Vibration Impact Assessment report responds specifically to the Secretary's Environmental Assessment Requirements (SEARs) and provides an assessment of noise and vibration effects associated with the construction and operation of the proposed development. The report considers the different types of noise and vibration impacts and establishes objective criteria based on relevant standards and guidelines.

A preliminary assessment of construction noise from the proposed development was undertaken. Applying a worst-case scenario (all anticipated construction equipment operating at the same time), the assessment indicated that significant noise impacts could be expected at nearby sensitive uses, which included residential dwellings, hotels and specialised spaces including music recording studios and theatres. Minor impacts on nearby commercial business were also predicted. These impacts would need to be managed throughout the construction of the proposed development in accordance with the contractors' Construction Noise and Vibration Management Plan (CNVMP), to be prepared as part of the subsequent Detailed SSDA.

Cumulative construction noise impacts are anticipated to be dominated by works associated with the construction of the proposed development, with minimal contribution from overlapping construction activities associated with Stage 3 CSSI Application. Cumulative impacts with other nearby future developments (such as the Sydney Fish Market and Harbourside Shopping Centre Redevelopment) have been considered and where required would be managed through consultation and implementation of the CNVMP.

Construction vibration impacts are not anticipated given the type of construction equipment that is likely to be used for this development. Impacts from construction traffic will be assessed as the design develops.

Operational noise and vibration impacts from mechanical plant will be assessed at a later stage when the design is developed as part of the subsequent Detailed SSDA. At this stage, examples of typical acoustic treatments have been provided. To address traffic noise intrusion, indicative glazing construction has been provided for the proposed development which can be refined as the design develops. Road traffic, loading dock and car parking emissions associated with the development will be considered as the design develops.

Based on outcomes of the preliminary assessments, construction and operational noise and vibration from the proposed development are expected to meet all relevant requirements with the implementation of reasonable and feasible mitigation measures, which are typical for developments of this nature.

1. Introduction

1.1. Sydney Metro West

Sydney Metro West will double rail capacity between Greater Parramatta and the Sydney Central Business District (CBD), transforming Sydney for generations to come. The once in a century infrastructure investment will provide fast, reliable turn-up-and-go metro services with fully accessible stations, link new communities to rail services and support employment growth and housing supply.

Stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street, and two potential station locations at Rosehill and west of Sydney Olympic Park that could support a significant increase in housing.

Sydney Metro West station locations are shown in Figure 1-1 below.

Figure 1-1 Sydney Metro West alignment map

1.2. Background and planning context

Sydney Metro is seeking to deliver Pyrmont Station under a two-part planning approval process. The station fit out infrastructure is to be delivered under a Critical State Significant Infrastructure (CSSI) application subject to provisions under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The over station development is to be delivered under a State Significant Development (SSD) subject to the provisions of Part 4 of the EP&A Act.

1.2.1. Critical state significant infrastructure

The state significant infrastructure (SSI) planning approval process for the Sydney Metro West metro line, including delivery of station infrastructure, has been broken down into a number of planning application stages, comprising the following:

- Concept and Stage 1 CSSI Approval (SSI-10038) – All major civil construction works between Westmead and The Bays including station excavation, tunnelling and demolition of existing buildings (approved 11 March 2021).
- Stage 2 CSSI Approval (SSI-19238057) – All major civil construction works between The Bays and Hunter Street Station (approved 24 August 2022).
- Stage 3 CSSI Application (SSI-22765520) – Tunnel fit-out, construction of stations, ancillary facilities and station precincts between Westmead and Hunter Street Station, and operation and maintenance of the Sydney Metro West line (approved 25 January 2023).

1.2.2. State Significant Development application

The SSD will be undertaken as a staged development with the subject Concept State Significant Development Application (Concept SSDA) being consistent with the meaning under section 4.22 of the EP&A Act and seeking conceptual approval for a mixed use building envelope, a maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking. In addition, it would also seek consent for strategies and design parameters for the future detailed design of the development.

If the concept DA is approved, a subsequent Detailed SSDA is to be prepared by a future development partner which will seek consent for detailed design and construction of the development.

1.3. Purpose of the report

This Noise and Vibration Impact Assessment report supports a Concept SSDA submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the EP&A Act. The Concept SSDA is made under section 4.22 of the EP&A Act.

This report has been prepared to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the Concept SSDA on 18 November 2022 which states that the environmental impact statement is to address the requirements in Table 1-1.

Table 1-1 SEARs and where this is addressed in this report

SEARs requirement	Addressed in
1. Statutory and Strategic Context Address all relevant legislation, environmental planning instruments (EPIs) (including drafts), plans, policies and guidelines. Identify compliance with applicable development standards and provide a detailed justification of any non-compliances.	Sections 5, 6 and 7.
11. Noise and Vibration Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail	Throughout this report

construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	
20. Construction, Operation and Staging If staging is proposed, provide any details of how construction and operation would be managed and any impacts mitigated.	Sections 6.1, 6.2 and 6.3.

The Noise and Vibration Impact Assessment report assesses the noise and vibration impacts from the proposed development at the nearest sensitive receivers. It also assesses the impact from environmental factors such as road traffic on the proposed development. Criteria are established based on suitable guidelines and legislation, predicted impacts are then assessed against these criteria. Feasible and reasonable mitigation measures are identified to reduce any impacts and to contain any adverse noise and vibration effects of the proposed development. These measures will be further developed as the design progresses as part of the subsequent Detailed SSD for the proposed development.

2. The site and proposal

2.1. Site location and description

The proposed development is located at 37-69 Union Street, Pyrmont and is within the Sydney Local Government Area (LGA).

The site has a generally triangular configuration, bounded by Union Street (to the north), Pyrmont Bridge Road (to the southeast), and Edward Street (to the west). The site has a total area of approximately 2,607m^2 and currently accommodates several multi-storey commercial buildings occupied by a range of retail, health, and business premises. All existing buildings will be demolished to facilitate construction of the new Pyrmont Station and the proposed development.

The site is on the Pyrmont Peninsula which is approximately 1km to the west of Sydney CBD and is characterised by a diversity of residential, commercial, tourism, higher education, and entertainment land uses. The Peninsula contains a network of public spaces including, open space, plazas, forecourts, parks, civic squares, and waterfront promenades.

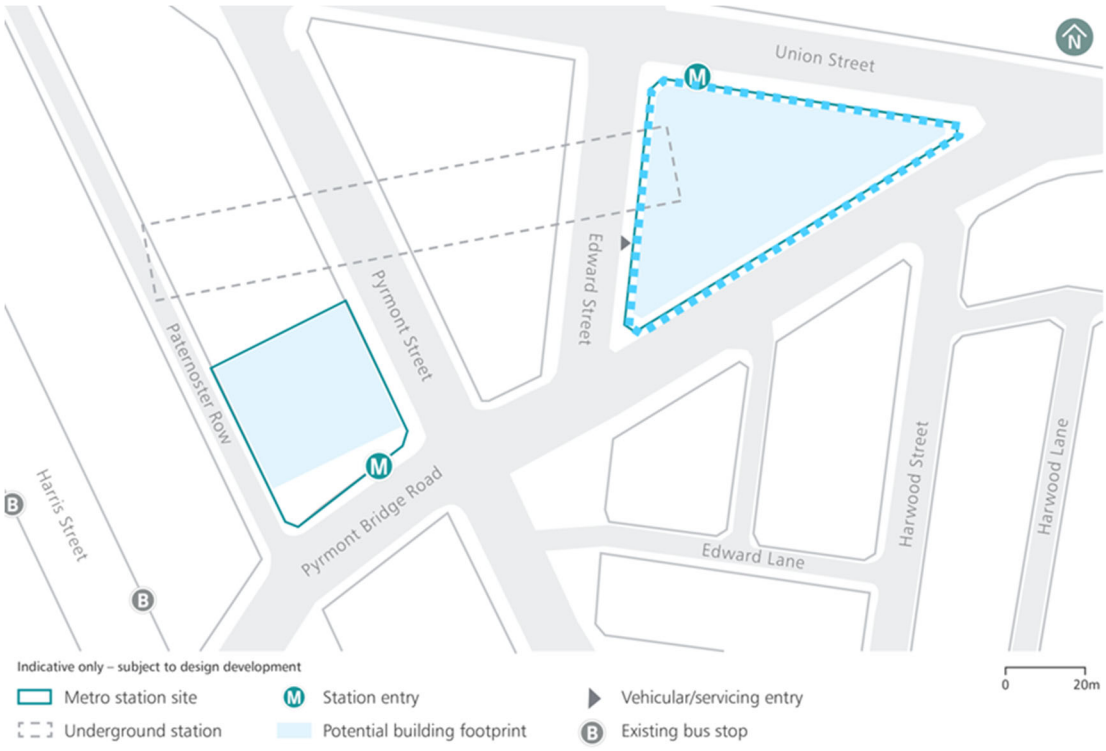


Figure 2-1 Location of the site (OSD site location shown in dashed to the east)

Table 2-1 sets out the address and legal description of the parcels of land that comprise the site.

Table 2-1 Site legal description

Address	Lot and DP
37-69 Union Street, Pyrmont	Lot 1 DP620352 and 1 DP657429
	Total = 2,607m^2

2.2. Overview of the proposal

The Concept SSDA will seek consent for a building envelope above the Pyrmont Station (the proposed development) as detailed in Table 2-2, Figure 2-2**Error! Reference source not found.** and Figure 2-3.

Table 2-2 Proposed development overview

Concept Plan	Indicative Numerical Overview
Total GFA	23,463m^2 The total GFA excludes any GFA associated with the rail infrastructure facilities sought under the Stage 3 CSSI Application.
Height	Podium: Maximum RL 34.9 metres Tower: RL120 metres
Site area	2,607m^2
Floor space ratio	9:1 (excluding GFA associated with rail infrastructure facilities)
Land use(s)	Commercial premises and residential accommodation

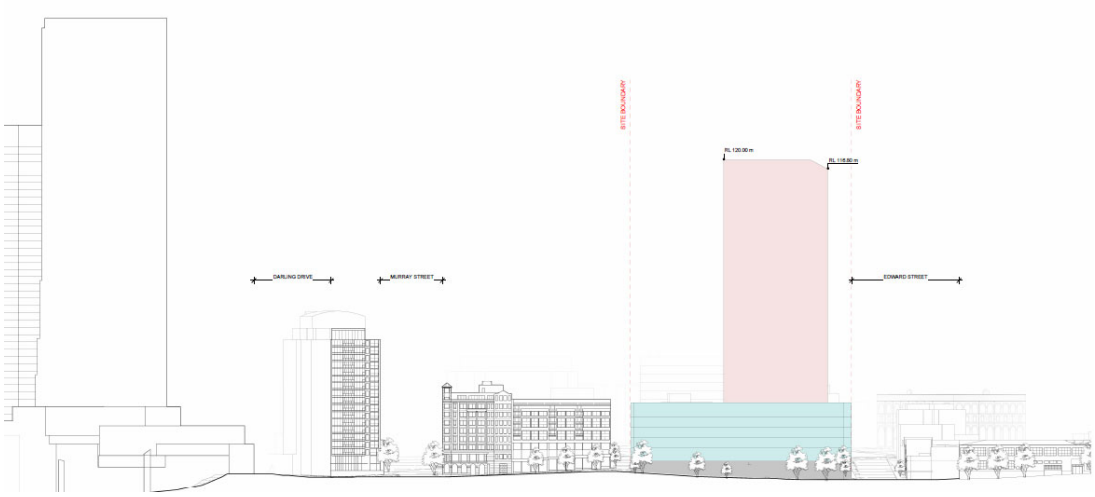


Figure 2-2 Proposed OSD shown in blue and pink with station infrastructure shown in grey as viewed from Union Street

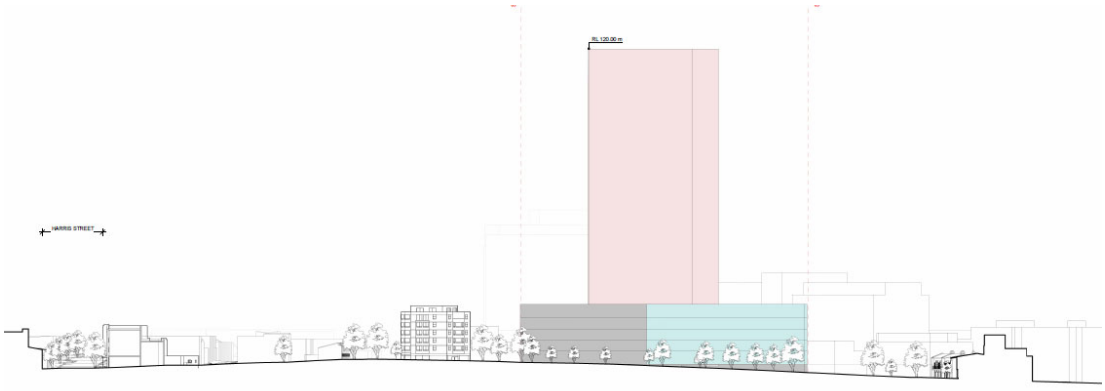


Figure 2-3 Proposed OSD shown in blue and pink with station infrastructure shown in grey as viewed from Pyrmont Bridge Road

3. Scope of assessment

A noise and vibration impact assessment has been undertaken to determine the likely impacts on nearby sensitive receivers. The assessment includes:

- reviewing the existing environment and identifying noise and vibration sensitive receivers throughout the project area
- determining the existing background noise levels based on previously undertaken baseline noise monitoring
- establishing appropriate environmental noise criteria for operation and construction based on the local noise environment and the available noise monitoring data
- establishing vibration levels within the proposed development due to impacts from existing underground rail operations
- establishing representative construction scenarios, locations, working times and duration of activities that would apply to construction of the proposal
- predicting noise levels at receivers within the assessment area due to the proposed construction activities using a noise prediction model
- assessing potential construction noise impacts with reference to the Interim Construction Noise Guideline (ICNG) and the Sydney Metro Construction Noise and Vibration Standard (CNVS)
- assessing potential cumulative construction noise impacts from Sydney Metro project construction and other nearby projects
- assessing road noise impacts from construction activities in accordance with the NSW Road Noise Policy (RNP)
- assessing potential construction vibration impacts from the project in accordance with the EPA's Assessing vibration: a technical guideline (AVATG)
- assessing potential operational noise impacts with reference to the NSW Noise Policy for Industry (NPfI) and the RNP, where applicable. The assessment considers cumulative operational noise impacts from other developments
- identifying suitable management and mitigation measures to minimise the predicted noise and vibration impacts generated by the project. A detailed noise and vibration assessment report will form part of the Detailed SSDA.

4. Existing environment

4.1. Existing acoustic environment

The existing noise environment in the surrounding area is dominated by road traffic noise, particularly from Pyrmont Bridge Road and to some extent the Western Distributor.

The proposed development is located on a triangular site bounded by Union Street, Edward Street and Pyrmont Bridge Road. The surrounding area is primarily commercial and retail land uses mixed with residential and hotels. There are also nearby recording studios as well as the Sydney Lyric Theatre.

Figure 4-1 shows the building uses surrounding the proposed development site and identifies the nearest noise sensitive receivers. The nearest noise sensitive receivers are also listed in Table 4-1. The planning zoning of the noise sensitive receivers within the Sydney Local Environmental Plan 2012 is indicated on the map in Appendix A.

The closest noise sensitive receivers to the proposed development are located approximately 20 metres from the site boundary, across the road along all three sides of the site boundary.

Table 4-1 Noise sensitive receivers

ID	Address	Receiver type
R-1	Sydney Lyric Theatre, 55 Pirrama Road	Drama theatre
R-2	The Darling Hotel, 80 Pyrmont Street	Hotel
R-3	80 Pyrmont Street	Commercial
R-4	Sandcastle Studios, 33 Union Street	Video production studio
R-5	35 Union Street	Mixed commercial/residential
R-6	29 Union Street	Residential
R-7	Dodgy Sound, 100 Pyrmont Street	Music recording studio
R-8	69-71 Edward Street	Commercial
R-9	Electric Avenue Studios, 102 Pyrmont Street	Music Recording Studio
R-10	The Sebel, 104 Pyrmont Street	Hotel
R-11	50 Union Street	Commercial
R-12	84 Union Street	Mixed commercial/residential
R-13	Pyrmont Bridge Hotel, 96 Union Street	Hotel
R-14	1 Pyrmont Bridge Road	Residential
R-15	9 Pyrmont Bridge Road	Residential
R-16	21 Pyrmont Bridge Road	Commercial
R-17	One Darling Harbour, 50 Murray Street	Mixed commercial/ residential

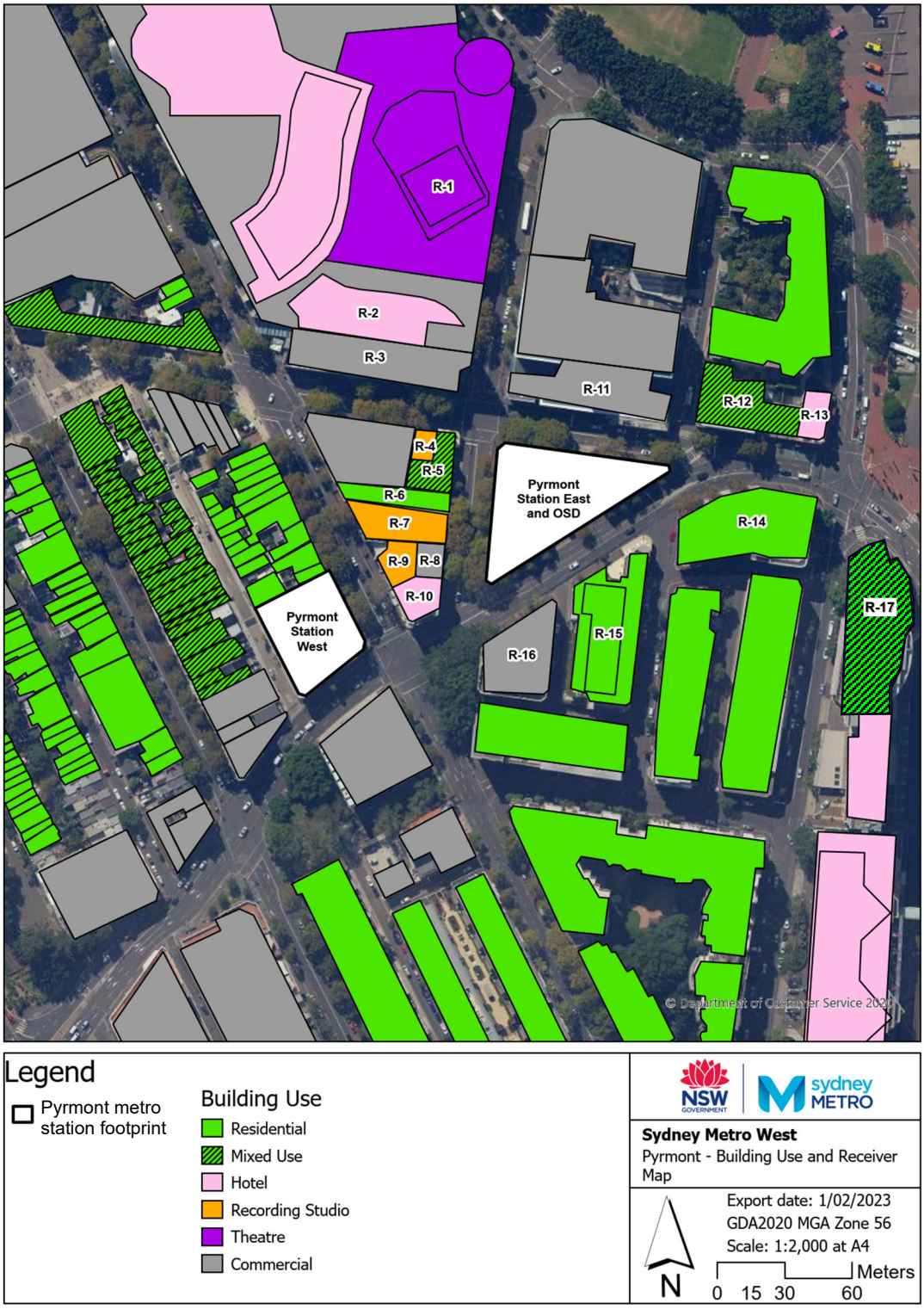


Figure 4-1 Site map identifying the nearest noise sensitive receivers

4.2. Baseline noise monitoring

Baseline noise monitoring was undertaken as part of the Concept and Stage 1 CSSI Approval. The monitoring was carried out at L.01 which is adjacent to the development site to the southeast, as shown in Figure 4-2.

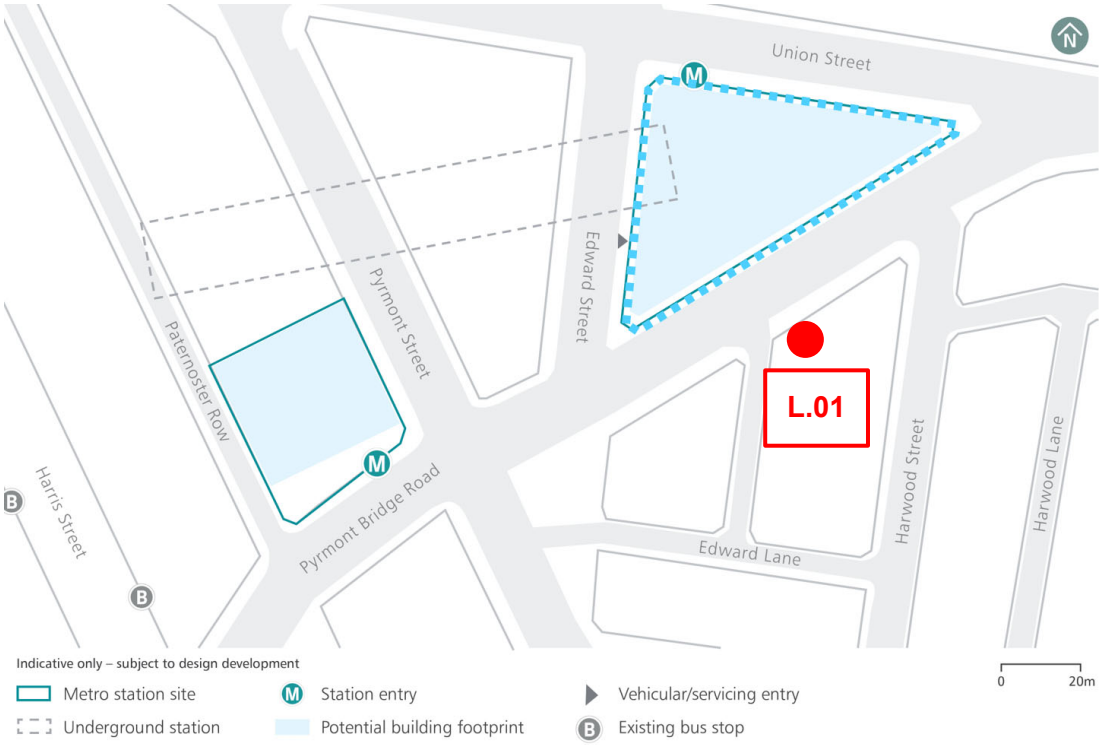


Figure 4-2 Representative noise monitoring location (indicated by red dot)

Unattended noise measurements at L.01 were undertaken continuously over a minimum one-week period between February and March 2019. The measurements at this location were used to inform the existing background noise levels in the area. The measured noise levels were found to be controlled by traffic noise from Pyrmont Bridge Road.

A noise logger measures the local noise environment and records noise statistics about the measurement period. For this project the noise logger was setup to measure 15-minute intervals and record:

- L_{A90} – the noise level which is exceeded for 90 per cent of the measurement period. This is considered to be the background noise level over the measurement period
- L_{Aeq} – the energy average noise level over the measurement period
- L_{AFmax} – the maximum noise level over the measurement period. This level is the maximum noise due to an individual noise event.

All measured noise levels are A-weighted, which is used across Australian and international standards to account for the relative loudness perceived by the human ear.

Further details of the weather and data processing can be found in the Sydney Metro West Environmental Impact Statement Westmead to The Bays and Sydney CBD Technical Paper 2 - Noise and Vibration.

Table 4-2 presents the summary of the baseline noise monitoring results for location L.01 according to the day (7am to 6pm), evening (6pm to 10pm) and night (10pm to 7am) periods, as defined in the NPfI. For each time-period the assessment

background level (ABL) has been established by determining the lowest 10th percentile of the background noise (the L_{A90}) over the defined period for each day. The rating background level (RBL) is the median ABL over the entire monitoring period.

Table 4-2 Summary of noise monitoring

ID	Address	Rating Background Level (RBL), dB(A)			Average Noise Level (L_{Aeq}), dB(A)		
		Day	Evening	Night	Day	Evening	Night
L.01	1-5 Harwood Street, Pyrmont	52	49	46	61	59	56

Source: Sydney Metro West Environmental Impact Statement The Bays to Sydney CBD Technical Paper 2 - Noise and Vibration.

5. Assessment criteria

5.1. Construction noise

Table 5-1 summarises the potential construction noise impacts and the corresponding relevant guidelines or documents which have been used to establish the criteria.

Table 5-1 Construction noise - impacts and relevant guidelines

Impact type	Sub-category	Relevant guideline or document
Construction noise	Airborne noise emissions	Interim Construction Noise Guideline, Department of Environmental and Climate Change NSW, July 2009 (ICNG) Sydney Metro Construction Noise and Vibration Standard, July 2022 (CNVS)
	Sleep disturbance	Interim Construction Noise Guideline, Department of Environmental and Climate Change NSW, July 2009 (ICNG) Noise Policy for Industry, NSW EPA, October 2017 (NPfI)
	Ground-borne noise	Interim Construction Noise Guidelines, Department of Environmental and Climate Change NSW, July 2009 (ICNG)
	Construction road traffic noise	Sydney Metro Construction Noise and Vibration Standard, July 2022 (CNVS) Road Noise Policy, Department of Environmental and Climate Change NSW, March 2011 (RNP)

Note: The NSW EPA have released Draft Construction Noise Guideline which will replace the ICNG when the draft guideline is finalised. The public consultation for the Draft Construction Noise Guideline closed in April 2021 with feedback currently under review. At the time of writing the ICNG is still applicable.

5.1.1. Airborne noise emissions

The Interim Construction Noise Guideline (ICNG) provides guidance on the appropriate construction noise goals, in addition to identifying appropriate noise management and mitigation strategies. The Sydney Metro Construction Noise and Vibration Standard (CNVS) provides further, more detailed information on management and mitigation structures.

The ICNG and CNVS also provide guidance on reasonable and feasible noise mitigation and management measures:

- feasible – a mitigation or management measure is feasible if it is practical to build or capable of being put into practice given project constraints
- reasonable – a mitigation or management measure is reasonable if the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

The ICNG and CNVS both establish noise management levels (NMLs) based on existing background noise levels which trigger the requirement for certain management measures. The NMLs for residential and non-residential uses are outlined below.

Residential land uses

Table 5-2 summarises the construction NMLs for residential receivers.

Table 5-2 Construction noise management level criteria – residential receivers

Time of day	Construction noise management level, $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ 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.
	Highly noise affected 75 dB(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.

Time of day	Construction noise management level, $L_{Aeq,15min}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

The applicable noise criteria for this area have been derived based on measured background noise levels at location L.01 (refer section 4.2), which is directly adjacent to the development site.

Table 5-3 provides a summary of the project resultant construction NMLs.

Table 5-3 Construction noise management levels – residential receivers

RBL, L_{A90}, dB(A)			Noise management level, $L_{Aeq,15min}$ dB(A)		
Day	**Evening**	**Night**	**Day**	**Evening**	**Night**
52	49	46	62	54	51

Notes:

1. Daytime is assumed to fall within recommended standard construction hours and therefore RBL + 10 dB(A) has been applied.
2. Evening and night-time fall outside of standard construction hours therefore RBL + 5 dB(A) has been applied.

Non-residential land uses

Table 5-4 provides the construction NMLs for non-residential land uses. The levels for commercial premises are sourced from ICNG, and the studio and theatre levels are sourced from AS/NZS 2107:2016.

Table 5-4 Construction noise management levels – non-residential receivers

Land use	Noise management level, $L_{Aeq,15min}$
Commercial premises (offices, retail outlets)	External noise level 70 dB(A)
Music recording studios	Internal noise level 25 dB(A)
Film or television studios	Internal noise level 30 dB(A)

Land use	Noise management level, $L_{Aeq,15min}$
Theatres for operetta and musical plays	AS/NZS 2107:2016 recommends specialist advice is sought for these places. For this assessment an internal noise level of 30 dB(A) was applied.

5.1.2. Sleep disturbance

The ICNG requires a sleep disturbance noise assessment to be completed for construction works which are proposed for more than two consecutive nights.

The CNVS provides an approach to assessing sleep disturbance events that is consistent with the NPfI. That is, where night-time noise levels at a residential location exceed:

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

a detailed maximum noise level event assessment is to be undertaken.

The detailed assessment is required to 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.

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under 'fast' time response. The detailed assessment as part of the Detailed SSDA will consider all feasible and reasonable noise mitigation measures with the goal of achieving the above trigger levels for night-time activities. Table 5-5 summarises the sleep disturbance criteria for construction noise.

Table 5-5 Construction noise – sleep disturbance criteria

Night time RBL, L_{A90} dB(A)	Construction noise sleep disturbance criteria, dB(A)	
	$L_{Aeq,15min}$	L_{AFmax}
46	51	61

5.1.3. Ground-borne noise

Ground-borne noise levels for residents are nominated in the ICNG and indicate where management actions would be implemented. These levels are only applicable when ground-borne noise levels are higher than airborne noise levels. Any levels exceeding objectives should be considered in the context of any existing exposure to ground-borne noise.

The ground-borne noise management levels (residential receivers only) are:

- evening (6pm to 10pm) internal $L_{Aeq,15min}$ 40 dB(A)
- night-time (10pm to 7am) internal $L_{Aeq,15min}$ 35 dB(A).

These levels are assessed at the centre of the most affected habitable room.

5.1.4. Construction road traffic noise

Road traffic noise impacts generated during project construction is not explicitly covered under the ICNG nor the RNP. However, the CNVS references the RNP for a suitable assessment approach to address construction road traffic noise impact.

An initial assessment has been completed to determine the increase in traffic noise due to the project construction. Where this increase is 2 dB(A) or less, no further assessment is required. Where the increase is greater than 2 dB(A) and exceeds the road category specific criterion, a more detailed assessment is completed.

Further detail about applying the RNP is included in section 5.3.4.

5.2. Construction vibration

Table 5-6 summarises the potential construction vibration impacts and the corresponding relevant guidelines or documents which have been used to establish the criteria.

Table 5-6 Construction vibration - impacts and relevant guidelines

Impact type	Sub-category	Relevant guideline or document
Construction vibration	Human comfort	Department of Environment and Conservation, Assessing Vibration: A technical guideline, February 2006. (AVATG)
	Structural damage	British Standard BS 7385.2-1993 Evaluation and measurement for vibration in Buildings Part 2 (BS 7385.2) Australian Standard AS 2187.2-2006 Explosive-Storage and use Part 2:Use of explosives (AS 2187.2)

5.2.1. Human comfort

Perceptible vibration can be an annoyance to building occupants, particularly if the duration or frequency of events is significant. Vibration criteria are provided by Assessing Vibration: A technical guideline (AVATG) and this provides guidance in terms of continuous and impulsive vibration, and intermittent vibration. Vibration from construction activities associated with the proposed development would be generally considered intermittent vibration.

Intermittent vibration

The intermittent vibration criteria provided by AVATG is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration are provided in Table 5-7. 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 5-7 Human comfort criteria – intermittent vibration

Land use	Vibration Dose Value (VDV) design goals, $ms^{-1.75}$			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas (1)	0.10	0.20	0.10	0.20
Residences (2)	0.20	0.40	0.13	0.26

Land use	Vibration Dose Value (VDV) design goals, $ms^{-1.75}$			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:

1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Continuous and impulsive vibration

Acceptable levels of human exposure to continuous and impulsive vibration are dependent on the time of day and the activity taking place in the occupied space. AVATG provides the preferred values for continuous and impulsive vibration. These are presented in Table 5-8.

Where vibration values are below the preferred values in Table 5-8, there is a low probability of adverse comment or disturbance to building occupants. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short duration. Vibration values above the preferred values in Table 5-8 may be dealt with through negotiation with the regulator and affected community.

Table 5-8 Human comfort criteria – continuous and impulsive vibration

Type	Location	Assessment period	Peak Particle Velocity (PPV), mms^{-1}	
			Preferred (z-axis)	Maximum (z-axis)
Continuous vibration	Critical areas (1)	When in use	0.14	0.28
	Residences (2)	Daytime	0.28	0.56
		Night-time	0.20	0.40
	Offices, schools, educational institutions, and places of worship	When in use	0.56	1.1
	Workshops	When in use	1.1	2.2
Impulsive vibration	Critical areas (1)	When in use	0.14	0.28
	Residences (2)	Daytime	8.6	17.0
		Night-time	2.8	5.6

Type	Location	Assessment period	Peak Particle Velocity (PPV), mms^{-1}	
			Preferred (z-axis)	Maximum (z-axis)
	Offices, schools, educational institutions, and places of worship	When in use	18.0	36.0
	Workshops	When in use	18.0	36.0

Notes:

1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

5.2.2. Structural damage

Vibration transmitted through the ground may cause damage to structures and architectural elements or discomfort to their occupants. The vibration levels at which people become annoyed are well below vibration levels at which damage occurs. The likelihood of such damage or discomfort may be ascertained by measuring the vibration from a vibrational impact close to the location of concern such as a building or other structure.

Transient vibration

Table 5-9 provides frequency-dependent guide levels for transient vibration described in BS 7385-2 and the AS 2187.2. The levels specified are peak component particle velocities, and the methodologies used for assessing the frequencies, are similar in both documents. The frequency-dependent guide values provide PPV for the prevention of minor or cosmetic damage occurring in structures from ground vibration.

Table 5-9 Transient vibration criteria for cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s and 4 Hz and above	-
Unreinforced or light framed structure. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note: Values referred to are at the base of the building.

Continuous vibration

For continuous vibration which has the potential to generate resonance within structures these values are typically reduced by 50 per cent. Common construction equipment such as rock-breaking and vibratory rollers are likely to generate

resonances which would attract this penalty. Table 5-10 presents the vibration screening criteria which should be applied for all construction activities.

Table 5-10 Continuous vibration criteria for cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	25 mm/s and 4 Hz and above	-
Unreinforced or light framed structure. Residential or light commercial type buildings	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above

Note: Values referred to are at the base of the building.

5.3. Operational noise and vibration

Table 5-11 summarises the potential operational noise and vibration impacts and the corresponding relevant guidelines or documents which provide appropriate design goals.

Table 5-11 Operational noise and vibration - impacts and relevant guidelines

Impact type	Sub-category	Relevant guideline or document
Environmental noise emission	Airborne environmental noise emission	Noise Policy for Industry, NSW EPA, October 2017 (NPfI)
	Sleep disturbance	
	Emergency plant	
	Traffic generating development	Road Noise Policy, Department of Environmental and Climate Change NSW, March 2011 (RNP)
External noise intrusion	Airborne external noise intrusion	State Environment Planning Policy (Transport and Infrastructure) 2021 (Infrastructure SEPP) NSW Development Near Rail Corridors and Busy Roads – Interim Guideline Australian / New Zealand Standard 2017:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS 2017:2016)
	Ground-borne noise and vibration	NSW Development near Rail Corridors and Busy Roads – Interim Guideline
Development Control Plan requirements		Sydney Development Control Plan (DCP) 2012, City of Sydney

5.3.1. Airborne environmental noise emissions

The NPfI provides guidance on appropriate noise levels for external noise emissions from fixed facilities on surrounding sensitive receivers. The NPfI considers noise goals in terms of intrusiveness and amenity noise levels. The intrusiveness noise

level protects against significant changes in noise, while the amenity noise level seeks to protect against cumulative noise impacts from industry. Together, these levels are used to assess the potential impact of noise and assess reasonable and feasible noise mitigation measures. Project noise trigger levels are developed through this process. They are not used directly as regulatory limits.

The NPfI requires a project to take consideration of other industrial noise sources in setting amenity noise objectives. In cases of a new development where there are no existing industrial sources, the NPfI accepts a default of the amenity noise level minus 5 dB to take account of future industrial sources.

For the proposed development, the services noise will be assessed with the default amenity noise level minus 5 dB adjustment to account for cumulative noise sources. The cumulative noise impact associated with the metro station and this proposal has not been assessed together as they will each meet an amenity noise level objective that allows for other industrial noise sources in the area. If both projects use their entire amenity noise criteria, the combined noise impact would remain 2 dB below amenity noise levels discussed below.

Intrusiveness base noise criteria

The intrusiveness noise level protects against significant changes in noise levels and is applicable to residential receivers only. The criterion is defined by the formula below:

$$L_{Aeq,15min} = rating\ background\ level\ (RBL) + 5\ dB$$

The RBL is the average background noise level over a measurement period of at least one week, as discussed in section 4.2.

Table 5-12 summarises the measured RBL and corresponding intrusiveness level for each time period.

Table 5-12 Operational noise intrusiveness levels – residential land uses

RBL, L_{A90}, dB(A)			Noise management level, $L_{Aeq,15min}$ dB(A)		
Day	Evening	Night	Day	Evening	Night
52	49	46	62	54	51

Amenity base noise criteria

The amenity noise level seeks to protect against cumulative noise impacts from industry.

The NPfI uses project noise trigger levels measured over a 15-minute time period, assessed as an $L_{Aeq,15min}$. The night-time amenity noise criterion is the most stringent, hence the controlling time-period. To account for converting $L_{Aeq,period}$ to $L_{Aeq,15min}$, the NPfI accepts a default conversion factor of $L_{Aeq,15min} = L_{Aeq,period} + 3$ dB.

To ensure industrial noise levels do not gradually increase with new developments, a minus 5 dB(A) correction is applied to the amenity noise level. The amenity noise levels have been presented in Table 5-13.

Table 5-13 Operational noise intrusiveness levels – non-residential land uses

Receivers	Noise amenity area	Time period	NPfI amenity noise level, L_{Aeq} dB(A)	Adjusted[1] amenity noise level, $L_{Aeq,15min}$ dB(A)
Residential	Rural	Day	50	48
		Evening	45	43
		Night	40	38
	Suburban	Day	55	53
		Evening	45	43
		Night	40	38
	Urban	Day	60	58
		Evening	50	48
		Night	45	43
Hotels, motels, caretakers quarters, holiday accommodation, permanent resident caravan parks	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day			
School classroom	Internal	Noisiest 1-hour period when in use	35	33[2]
Hospital ward	Internal	Noisiest 1-hour period	35	33
	External	Noisiest 1-hour period	50	48
Place of worship	Internal	When in use	40	38[2]
Passive recreation area	All	When in use	50	48
Active recreation area	All	When in use	55	43
Commercial premises	All	When in use	65	63
Industrial premises	All	When in use	70	68
Industrial interface	All	All	Add 5 dB(A) to the recommended noise amenity area	

Notes:

1. Adjusted level calculated by applying 5 dB reduction to account for cumulative existing and future industrial noise sources and 3 dB addition to adjust the amenity noise level from LAeq to LAeq,15min.

2. For assessment, 10 dB can be added to the internal noise level criteria to assess the external noise level. This is generally accepted as the reduction provided by the façade with an open window.

Project noise trigger levels

The project noise trigger level is the lower (i.e., the more stringent) value of the project intrusiveness noise level and project amenity noise level determined in this section.

Operational project noise trigger levels for residential land uses are presented in Table 5-14.

Table 5-14 Operational Project Noise Trigger Levels – residential land uses only

Time of day	Intrusiveness level, dB(A)	Adjusted amenity noise level (urban), dB(A)	Project noise trigger level, dB(A)
Day	57	58	57
Evening	54	48	48
Night	51	43	43

Corrections for annoying noise characteristics

Table C1 of the NPfI provides corrections for tonality, intermittency, irregularity or dominant low-frequency content. These corrections are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. NPfI also provides adjustments for duration that can increase the project noise criterion for unusual or one-off high-noise level events.

Low frequency noise correction

A difference of 15 dB or more between the C- and A-weighted noise measurements, identifies the potential for an unbalanced spectrum and an increased likelihood of low frequency noise annoyance.

The difference between C- and A-weighted noise levels is typically used as a screening tool to determine if further investigation is required to determine potential annoyance (i.e. where the difference is 15 dB or more). Where further investigation confirms significant low frequency content, a low frequency noise correction is applied to the predicted or measured noise levels.

The NPfI identifies that the corrections should “reflect external assessment locations”, so the existing noise environment should be considered.

At residential receiver locations the existing ambient noise levels are 9 dB, 10 dB, and 10 dB greater than the background noise during the daytime, evening and night-time period respectively. The design noise criteria will be below the existing ambient noise level so triggering of the low frequency noise criteria is unlikely.

5.3.2. Sleep disturbance

The NPfI contains guidance on sleep disturbance and the following screening levels are used to identify where further investigation of sleep disturbance should be undertaken for residential properties:

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

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

This assessment has considered both the night-time $L_{Aeq,15min}$ noise levels and L_{AFmax} noise levels, where they are relevant.

The sleep disturbance screening levels are presented in Table 5-15.

Table 5-15 Operational noise – sleep disturbance screening levels

Night time RBL, L_{A90} dB(A)	Sleep disturbance screening levels, dB(A)	
	$L_{Aeq,15min}$	L_{AFmax}
46	51	61

5.3.3. Emergency plant

In the absence of any relevant NSW guideline for emergency generators and equipment, it is recommended that intrusiveness noise criteria in Table 5-12 be relaxed by 5 dB(A) for emergency plant equipment. Table 5-16 presents criteria for emergency operations noise criteria.

Table 5-16 Emergency plant operational noise criteria – residential land uses

Receiver	Noise amenity area	Time period	NPfI Intrusiveness criteria, $L_{Aeq,15min}$ dB(A)	Emergency operations noise criteria, $L_{Aeq,15min}$ dB(A)
Residential	Urban	Day	57	62
		Evening	54	59
		Night	51	56

5.3.4. Traffic generating development

Guidance for the assessment of noise from traffic movements to and from site, including truck and car movements, is provided by the RNP.

Table 5-17 presents the RNP road traffic noise assessment criteria for residential/commercial land use developments with potential to create additional traffic on existing roads. The external noise criterion is assessed at 1 metre from the affected residential building facades and at a height of 1.5 metres above the ground or floor level.

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Table 5-17 Operational noise assessment criteria – traffic generating development

Road category	Type of project / land use	Assessment criteria, dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-	$L_{Aeq(15hr)}$ 60 (external)	$L_{Aeq,(9hr)}$ 55 (external)

Road category	Type of project / land use	Assessment criteria, dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
	arterial roads generated by land use developments		
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hr)}$ 55 (external)	$L_{Aeq,(1hr)}$ 50 (external)

5.3.5. Airborne external noise intrusion

Residential land uses

The State Environment Planning Policy (Transport and Infrastructure) 2021 (Infrastructure SEPP) provides guidelines to ensure that the development of new residential buildings protects occupants adequately from noise associated with existing road and railway infrastructure.

The key provisions in the SEPP related to rail corridors are:

"2.99. Excavation in, above, below or adjacent to rail corridors

(1) This clause applies to development (other than development to which section 2.101 clause applies) that involves the penetration of the ground to a depth of at least 2 m below ground level (existing) on land:

a) within, below or above a rail corridor; or

b) within 25m (measured horizontally) of a rail corridor; or

c) within 25m (measured horizontally) of the ground directly below a rail corridor

d) within 25m (measured horizontally) of the ground directly above an underground rail corridor

2.100 Impact of rail noise or vibration on non-rail development

(2) This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration :

a) residential accommodation,

b) a place of public worship,

c) a hospital,

d) an educational establishment or centre-based child care facility.

…

(3) If the development is for the purpose of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

a) in any bedroom in the building – 35 dB(A) at any time between 10.00pm and 7.00am,

b) *anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time."*

Non-residential land uses

All internal areas shall be designed to mitigate external noise intrusion to the recommended internal noise criteria based upon their use contained within AS/NZS 2107:2016 "*Acoustics – Recommended design sound levels and reverberation times for building interiors*" (AS/NZS 2107:2016) which provides recommended design internal noise levels for different building types and occupancies.

All internal areas of the development shall be designed to mitigate external noise intrusion to the recommended internal noise criteria contained within AS/NZS 2107:2016 based upon their use.

Combined internal noise levels due to external noise intrusion and internal mechanical services such as air conditioning and mechanical ventilation plant should not exceed the upper level of the range recommended in AS/NZS 2107:2016.

Internal noise levels due to road traffic noise intrusion should be controlled to meet AS/NZS 2107:2016 recommended design sound levels less 3 dB. This allows for an equal contribution from mechanical services noise sources within the development.

Table 5-18 summarises the external noise intrusion criteria for non-residential land uses.

Table 5-18 External noise intrusion – non-residential land uses

Type of occupancy / activity	Design sound level range, $L_{Aeq,T}$ dB(A)
Educational Buildings	
- Lecture rooms up to 50 seats	30 to 35
- Teaching spaces/single classroom – open plan teaching space	35 to 45
Health Buildings - Consulting rooms	40 to 45
Office Buildings - General office areas	40 to 45
Hotels and Motels in inner city areas or entertainment districts or near major roads - Sleeping areas (night-time)	35 to 40
Small Retail Stores (General)	<50

5.3.6. Ground-borne noise and vibration

Ground-borne noise

Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present where airborne noise does not provide a masking effect. The NSW Development near Rail Corridors and Busy Roads – Interim Guideline specifies a night-time residential noise criterion of $L_{Amax,slow}$ 35 dB(A) to which 95 percent of train passbys must comply.

Ground-borne vibration

The NSW Development near Rail Corridors and Busy Roads – Interim Guideline specifies vibration criteria listed in the Assessing vibration: a technical guideline (AVATG) for appropriate vibration goals for continuous, impulsive, and intermittent vibration.

These criteria have been defined previously in this document and can be found in Table 5-7.

5.3.7. Development Control Plan requirements

The City of Sydney noise and vibration requirements for any existing or new premises are contained in the Sydney Development Control Plan 2012 (DCP). It is noted that the DCP is not applicable to SSDA, however does provide good guidance for assessing noise impacts at residential developments.

The key provisions in the DCP relating to acoustics are:

4.2.3.11 Acoustic privacy

(1) A Noise Impact Assessment prepared by a suitably qualified acoustic consultant may be required when submitting a development application for commercial and retail uses which may affect the acoustic privacy of the adjacent residential use.

(2) Where necessary, a residential development is to include acoustic measures to reduce the impact of noise from existing or planned external sources (for example busy roads, adjoining industries, live music venues and public parks and plazas in which people may congregate or host live music or events).

(3) Development is to incorporate measures that reduce the entry of noise from external sources into dwellings.

(4) Where possible, the attenuation of noise at its source is preferred. Where this option is adopted, the applicant will need to demonstrate that the measures to be undertaken:

(a) have the consent of relevant parties associated with that noise source;

(b) last for the life of the development proposal.

(7) The repeatable maximum $L_{Aeq(1hour)}$ for residential buildings and serviced apartments must not exceed the following levels:

(a) for closed windows and doors:

(i) 35dB for bedrooms (10pm-7am); and

(ii) 45dB for main living areas (24 hours).

(b) for open windows and doors:

(i) 45dB for bedrooms (10pm-7am); and

(ii) 55dB for main living areas (24 hours).

(8) Where natural ventilation of a room cannot be achieved, the repeatable maximum $L_{Aeq(1hour)}$ level in a dwelling when doors and windows are closed and air conditioning is operating must not exceed:

(a) 38dB for bedrooms (10pm-7am); and

(b) 48dB for main living areas (24 hours).

(9) These levels are to include the combined measured level of noise from both external sources and the ventilation system operating normally.

(10) To limit the transmission of noise to and between dwellings, all floors are to have a weighted standardised impact sound level ($L'_{nT,w}$) less than or equal to 55 where the floor separates a habitable room and another habitable room, bathroom, toilet, laundry, kitchen, plant room, stairway, public corridor, hallway and the like.

(11) The overall design and layout of dwellings, where appropriate, is to include:

(a) a limit on window size and number where oriented towards an intrusive noise source;

(b) seals at entry doors to reduce noise transmission from common corridors or outside the building;

(c) minimisation of the number of shared walls with other dwelling units;

(d) storage, circulation areas, and non habitable rooms to buffer noise from external sources;

(e) double or acoustic glazing; and

(f) operable acoustic screens to balconies.

(12) Mixed-use development which includes two or more dwellings is to provide separate lift access and a separate entrance for use exclusively for the dwellings.

6. Impact assessment

6.1. Construction noise impacts

6.1.1. Construction staging

Construction planning is proceeding on the basis of two possible staging scenarios:

- Scenario 1: Continuity of construction works from station to proposed development
- Scenario 2: Gap between completion of station (with full de-mobilisation) and commencement of proposed development works.

For both scenarios, the main bulk of construction works (i.e., with highest noise impact) for the proposed development would occur after the main works for the metro station has completed. Therefore, although there will be some overlap in construction activities occurring at the metro station and the proposed development for Scenario 1, the worst-case (highest noise) construction impacts can be considered separately.

Detailed construction scenarios are to be established in the Construction Noise and Vibration Management Plan (CNVMP) when more detail is available about the program of works including construction staging and phases, construction activities, equipment types and locations, noise and vibration source levels, and hours of work.

6.1.2. Construction hours

It is anticipated that most construction works would be carried out during ICNG standard working hours. Any work undertaken outside of standard working hours will be in accordance with the ICNG. Internal fit-out works may be undertaken outside of standard working hours once the building façade / glazing has been completed, this would be carried out in accordance with the ICNG requirements.

There are a range of activities which could occur out of hours on a major construction project such as:

- relocation of utilities
- the delivery of materials as required by the Police or other authorities for safety reasons
- where it is required to avoid the loss of lives, property and/or to prevent environmental harm in an emergency
- works which are determined to comply with the relevant Noise Management Level (NML) at the most affected sensitive receiver.

Any construction work outside ICNG standard hours (including one or two nights of work) would require prior approval. This would include a noise impact assessment to determine the potential for sleep disturbance impacts and the identification of reasonable and feasible noise management and mitigation measures.

6.1.3. Construction plant and equipment

Table 6-1 presents typical sound power levels of the construction equipment used in this assessment as well as the cumulative level of all of the listed equipment.

These sound power levels are typical levels taken from the data provided in the Australian Standard AS 2436-2010 “Guide to noise and vibration control on construction, demolition and maintenance sites”, and the UK Department for Environmental, Food and Rural Affairs (DEFRA) “Update of noise database for

prediction of noise on construction and open sites". The data assume equipment is modern and in good working order.

Table 6-1 Typical sound power levels of modelled construction equipment

Scenario	Equipment/ activity	Qty	SWL, dB(A)
Tower construction	Diesel tower cranes	2	99
	External man and material hoist	2	94
	Electric concrete placing boom	1	103
	Electric formwork hoist	2	82
	Diesel manitou at ground	1	92
	Forklift	1	101
	Delivery trucks of various sizes at ground	1	98
	Rubbish removal trucks at ground	1	98
	Diesel mobile cranes at ground	1	104
	Overall sound power level		**110**

Source: AS 2436-2010 and Department for Environmental, Food and Rural Affairs

For the noise assessment, a 'worst-case' (highest noise level) construction scenario has been modelled. The modelled scenario includes all the listed equipment operating at the same time for the entirety of the 15-minute assessment period. In addition, a 5 dB reduction has been applied to account for the shielding effect from site hoarding.

6.1.4. Assessment methodology

In order to quantify noise emissions from the proposed construction works, environmental noise modelling software (SoundPLAN version 8.2) has been used to predict the $L_{Aeq,15min}$ noise levels at nearby noise sensitive receivers.

The environmental noise model includes:

- ground terrain, sourced from SIX Maps Spatial Data
- building footprints, shapefiles from the Sydney Metro West Stage 3 CSSI EIS noise model and verified with 3D model of surrounds
- construction works area with the combined overall source noise levels of the anticipated equipment.

The predicted construction noise levels are likely to be conservative as they assume a potential worst-case scenario where all equipment operates simultaneously and continuously for the entire 15-minute period. As such, noise levels on site are likely to be lower than the worst-case noise levels presented for most time periods during the works.

6.1.5. Predicted results

Noise at sensitive receivers from construction activity at the proposed development site has been modelled based on the scenario outlined in section 6.1.3 and the methodology outlined in section 6.1.4.

The predicted results are presented in Table 6-2, with a noise contour map provided in Appendix B.

Table 6-2 Predicted standard construction hour noise impacts

ID	Address	Receiver type	NML, dB(A)	Predicted noise level, $L_{Aeq,15min}$ dB(A)	Exceedance
R-1	Sydney Lyric Theatre, 55 Pirrama Road	Drama theatre	50	62	12
R-2	The Darling Hotel, 80 Pyrmont Street	Hotel	65	64	-
R-3	80 Pyrmont Street	Commercial	70	69	1
R-4	Sandcastle Studios, 33 Union Street	Video production studio	50	67	17
R-5	35 Union Street	Mixed commercial /residential	60	75	15
R-6	29 Union Street	Residential	60	74	14
R-7	Dodgy Sound, 100 Pyrmont Street	Music recording studio	45	74	29
R-8	69-71 Edward Street	Commercial	70	74	4
R-9	Electric Avenue Studios, 102 Pyrmont Street	Music Recording Studio	45	68	23
R-10	The Sebel, 104 Pyrmont Street	Hotel	65	73	8
R-11	50 Union Street	Commercial	70	74	4
R-12	84 Union Street	Mixed commercial /residential	60	70	10
R-13	Pyrmont Bridge Hotel, 96 Union Street	Hotel	65	64	-
R-14	1 Pyrmont Bridge Road	Residential	60	72	12
R-15	9 Pyrmont Bridge Road	Residential	60	72	12
R-16	21 Pyrmont Bridge Road	Commercial	70	73	3
R-17	One Darling Harbour, 50 Murray Street	Mixed commercial/ residential	60	58	-

Notes:

1. A 20 dB internal to external adjustment has been used to determine the NML of the studio receivers (R-4, R-7, R-9) and theatre receiver (R-1).
2. For receivers classified mixed use, the residential NML has been applied.

Exceedances of the NMLs have been predicted at 14 of the 17 assessed nearby sensitive receivers. At the two music recording studios, R-7 and R-9, the predicted exceedances were 29 dB(A) and 23 dB(A), respectively, which are in excess of 20 dB above the NML (noting that a 20 dB difference is described as four times loud). As exceedances of the NMLs are predicted, it is important that all feasible and

reasonable noise management and mitigation measures are included in the contractors CNVMP, to be prepared as part of the subsequent Detailed SSDA.

6.1.6. Cumulative impacts

Stage 3 CSSI works

As per the discussion of construction staging in section 6.1.1, the main construction works (having highest noise impact) for the metro station (Stage 3 CSSI works) and the proposed development would not occur concurrently.

Notwithstanding, should the main construction works occur currently (i.e., with twice the amount of equipment and activity assumed in this assessment), the cumulative noise impact will be no greater than 3 dB above the levels presented in section 6.1.5. Subjectively, this increase in noise level is a just noticeable difference and can be managed with mitigation measures detailed in section 7.

In practice, whilst there may be some overlap between the main construction works of the proposed development and the later stage works associated with the metro station (for Scenario 1), the noise impact from the proposed development is expected to dominate the overall impact.

Future developments

There is a potential for other future developments (not associated with the project) to be proposed near the project site. At this stage, there are known nearby future developments such as the Sydney Fish Market SSD and the Harbourside Shopping Centre Redevelopment SSD. Sydney Fish Market is scheduled to open in 2024 before commencement of the proposed development construction in 2026. The nature and details of the Harbourside Shopping Centre Redevelopment are not yet available, therefore an objective assessment of its potential contribution to cumulative construction noise impacts cannot be conducted.

If significant noise generating construction activities are anticipated to occur at other sites near the proposed development, consultation should be undertaken with the contractors to manage cumulative impacts on sensitive receivers within common areas. It is anticipated that community consultation measures and the contractors' CNVMP (to be prepared as part of the subsequent Detailed SSDA) will be sufficient to manage any cumulative impacts that could arise.

6.2. Construction traffic noise impacts

It is anticipated that the construction haulage routes identified within Sydney Metro West Stage 3 CSSI EIS (and shown in Figure 6-1) will apply to the proposed development construction works.

The potential noise impacts at sensitive receivers will be assessed in accordance with the RNP. An assessment will be undertaken at a later stage when further details about traffic volumes (existing and future) and movements are known. However, given the existing traffic through the site and the ability of workers to use the existing public transport network, the traffic noise impacts from construction activities are likely to be negligible.

Further investigation of likely traffic noise impacts would be completed by the contractor in the CNVMP, including the identification of appropriate management and mitigation measures, if required.

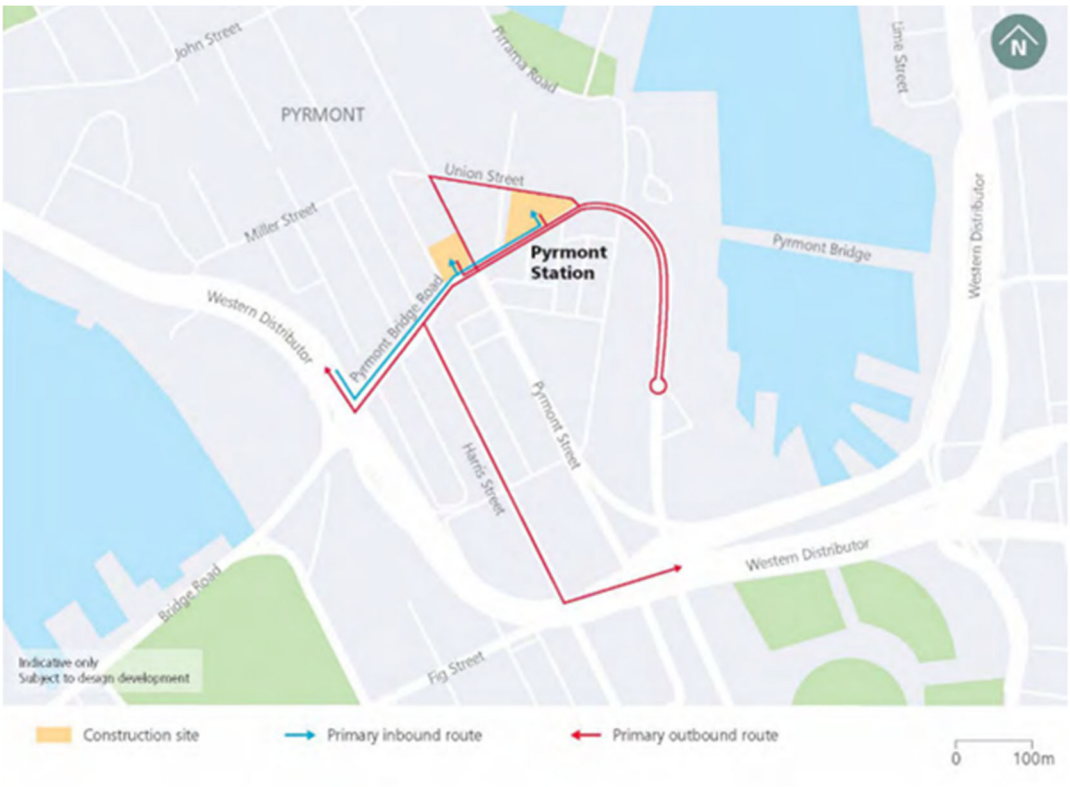


Figure 6-1 CSSI construction haulage routes, Pyrmont Station

6.3. Construction vibration impacts

There are no high vibration producing equipment identified in the construction scenario in section 6.1.3. If any high vibration activities are proposed in the later stages of the project, such as rock breaking, piling, excavation and vibratory rolling associated with additional foundational works at ground level, the impacts of these activities will need to be managed to determine any potential human comfort impacts to receivers or structural/cosmetic damage to nearby structures.

If the use of vibration intensive plant is proposed, management controls for the plant should be captured in the contractors CNVMP as part of the subsequent Detailed SSDA. The CNVMP should address potential impacts at all relevant receivers including any heritage listed building structures.

The CNVMP should also identify other vibration sensitive structures such as tunnels, fibre-optic cable, gas pipelines and other underground infrastructure. Specific vibration goals should be determined for these items to mitigate potential structural damage.

6.4. Operational noise impacts

6.4.1. Airborne environmental noise emissions

Building services

The environmental noise emission from the services plant in the proposed development should be assessed against the environmental criteria presented in section 5. This should be assessed in detail during design development.

Noise generated by the proposed development is expected to be controlled by a few major items of plant, including the following:

- heat pumps

- cooling towers
- stair pressurisation fans
- generators.

It is anticipated that the major items of plant would be located on the roof of the proposed development. Typical noise mitigation measures would likely be required, such as:

- acoustic louvres and attenuators on exhaust fans
- acoustic louvres and absorptive linings to plant rooms
- attenuators and acoustic louvres for generators.

Further detail about noise mitigation measures will be provided as the building services design develops.

Throughout the detailed design the cumulative impact of noise emissions from plant associated with the operation of the building would be assessed. Appropriate noise mitigation would be included in the design to meet the noise criteria in section 5.3. A review of potential plant and mitigation strategies has been completed and these mitigation strategies are considered reasonable and achievable.

Further information would be provided throughout the detailed design noise and vibration assessment to confirm appropriate noise attenuation is included in the design to comply with the applicable noise criteria.

Sleep disturbance

Noise emissions from the development are likely to be controlled by continuous noise from mechanical plant. Therefore, it is expected that compliance with the NPfI ambient noise criteria will also result in compliance with the sleep disturbance noise criteria.

It is expected that the following mitigation measures would be sufficient to minimise sleep disturbance:

- testing of emergency equipment, such as generators, during day-time periods
- implementation of mitigation measures for building services plant identified in this section.

Emergency plant

Emergency operations for the proposed development should be assessed during the Detailed SSDA. Acoustic treatments, such as attenuators, acoustic louvres and mufflers should be incorporated into the design as required to meet the emergency operations noise emission criteria.

6.4.2. Airborne external noise intrusion

External noise intrusion will be controlled by the acoustic performance of the façade. The composite performance of the façade is expected to be controlled by the glazing. A preliminary traffic noise intrusion assessment has been undertaken using a representative traffic noise spectrum based on the European Commission, Common Noise Assessment Methods in Europe 2012 (CNOSSOS-EU). Light, medium-heavy and heavy traffic spectrums Noise levels incident on the building façade were determined from the unattended noise measurements detailed in section 4.2. Noise levels at the measurement location were used to adjust the traffic noise spectrum to assess the worst affected façade of the commercial and residential land uses at the proposed development.

The following indicative glazing options for the façade glazing construction for commercial and residential uses are recommended.

Residential

The recommended minimum façade glazing specification for typical residential properties provided are:

1. Single laminated glass at least 10.38mm thick, or
2. IGU with 4mm / 12mm air gap/ 4mm glazing.

Office

The recommended minimum façade glazing specification for typical commercial/ offices are:

3. single laminated glass at least 9.38 mm thick, or
4. IGU with 4mm / 12mm air gap/ 4mm glazing.

Regulating noise intrusion through the glazed windows is only effective with windows completely closed. Hence, an option for additional mechanical ventilation within the sleeping areas for residential properties is recommended.

Note that the specified glazing thickness only considers acoustic requirements and does not consider other requirements such as thermal, wind/structural loading, or safety.

The glazing recommendation is indicative only and would need to be reviewed during detailed design stage.

6.4.3. Ground-borne / structure borne noise and vibration

Vibration generated from railway operation of the Sydney Metro West project can affect the proposed development through two transmission paths. The proposed development may be affected by structure-borne noise generated from the track and radiated up through the development above. The proposed development may also be affected by ground-borne noise generated by vibration radiating from the tunnel and through the soil into adjacent buildings.

These two transmission paths will be mitigated through track form design to ensure adequate vibration mitigation is achieved at the source to ensure criteria is achieved. No further vibration isolation of the proposed development is required.

Nevertheless, the developer should ensure that design of the development is fit for purpose and aligns with the intended use considered during the track-form design.

6.4.4. Road traffic generating development

The existing site incorporates a number of surface parking spots with aerial imagery indicating approximately 20 spots are available. The proposed development will incorporate up to 18 enclosed parking spots.

Based on the above, there is a minor decrease in car parking spaces in comparison to the existing use of the site. It is also expected that vehicle movements in an enclosed carpark will generate less environmental noise emissions in comparison to surface vehicle movements. The development of the Sydney Metro as an alternative transport mode to driving is also expected to lead to a reduction in road traffic noise associated with the site.

As such, no specific additional mitigation measures for road traffic noise are recommended as part of this proposal. However, opportunities to minimise future potential impacts should be considered as the design develops.

Car park noise emissions

The proposed development includes approximately 18 enclosed car parking spaces. Any noise generated by these activities would be controlled by the façade construction. Based on the current design arrangement, consideration of noise mitigation is not required.

Loading dock noise emissions

There is a loading dock which is accessed at ground level via Edward Street. The loading dock falls within the station envelope, but it is reasonable to expect that this loading dock would also service the proposed development.

Loading dock noise impacts will be considered further as the design develops. Opportunities to minimise future potential impacts should be considered as the design progresses. These may include reviewing the glazing thickness for external windows for the nearest sensitive apartments, reviewing operating times of the loading dock, the type of vehicles that will use the loading dock and the loading dock entry door specification. Good practice management measures should also be considered such as reducing engine idling, quiet use of materials handling equipment, minimising reversing beepers and horn signalling, and avoiding slamming doors and shouting between workers.

6.5. Operational vibration impacts

It is anticipated that operational vibration impacts associated with the development can be managed with standard mitigation measures. A summary of the noise and vibration mitigation measures relevant to the operation of the proposal is presented in Table 7-1. The list of measures will be reviewed and refined as part of the detailed design such that the operational noise and vibration requirements are met.

6.6. Cumulative operational noise and vibration impacts

The cumulative operational noise impact of the proposed development and other developments in the area is addressed by establishing appropriate noise criteria that take into account noise contributions from multiple sources (the proposed development and other developments). Each development has a shared responsibility to mitigate its noise emission and allow a reasonable contribution from other developments. Complying with the noise criteria established in this assessment would ensure that the cumulative noise impact from the proposed development and other developments will meet the environmental noise objective of the locality.

The operational vibration impact of the proposed development would be contained on site with the mitigation measures in Table 7-1 implemented. Therefore, the proposed development would not have any significant contribution to off-site cumulative vibration impacts.

7. Mitigation measures

7.1. Construction noise and vibration measures

Construction noise and vibration impacts should be mitigated in accordance with the Sydney Metro West – Construction Noise and Vibration Standard.

7.1.1. Construction noise and vibration management plan (CNVMP)

Prior to the commencement of major construction works, the future developer should develop a detailed CNVMP. The CNVMP should:

- identify relevant construction noise and vibration criteria as detailed in this report
- identify neighbouring land uses that are sensitive to noise and vibration
- summarise key noise and vibration generating construction activities and the associated predicted levels at neighbouring land uses
- identify reasonable and feasible work practices to be implemented during the works
- summarise stakeholder consultation and complaints handling procedures for noise and vibration.

7.1.2. Managing predicted exceedances from modelled construction scenarios

As exceedances of the construction noise management levels were predicted in section 6.1.5, further investigation should be undertaken in detailed design to manage these exceedances, including the following:

- The criteria for non-residential sensitive receivers are only applicable when the receiver is in use. Therefore, further investigation into the operation of these nearby sensitive uses should be undertaken to manage these impacts.
- The noise levels for these scenarios represent a typical worst-case with all equipment operating concurrently. These levels are considered conservative and as more detail about the construction methods and equipment is developed this can be refined further.

7.2. Operational noise and vibration measures

A summary of the noise and vibration mitigation measures relevant to the operation of the proposal is presented in Table 7-1. The list of measures will be reviewed and refined as part of the detailed design such that the operational noise and vibration requirements are met.

Table 7-1 Recommended operational noise and vibration measures

Operational item	Mitigation measures
Building services noise	In general, standard acoustic treatments should be implemented for all major equipment installed as part of the proposed development to meet the established criteria. Standard acoustic treatments could include the following: • acoustic barriers around roof top plant • robust construction of plant rooms • acoustic louvres to plant room openings

Operational item	Mitigation measures
	• acoustic attenuators for mechanical ductwork • acoustic mufflers in generator exhaust systems • internal lining of ductwork • selection of low noise plant Further detail around the mitigation measures for specific high noise plant will be added as the design develops.
Building services vibration	All major equipment, installed as part of the proposed development, should be mounted on isolation mounts. The following measures should be adopted for mounting of mechanical plant: • Isolation mounts and connections should be provided for all reciprocating and rotating equipment, pipework and ductwork. • Selection of suitable vibration isolation systems should be made based on the design minimum isolation efficiency, floor static deflection, and plant/equipment mass, rotational/reciprocating speeds and power requirements etc. • The method of vibration isolation should be selected for each particular application. • A minimum clearance of 50 mm between vibrating and rotating equipment and nearby building structure and 25 mm between the underside of a concrete inertia block or machine base and the top of a concrete floor slab should be achieved. Contractors must ensure that any debris between items of plant and the building structure is removed. • Unless otherwise specified the manufacturers' recommendations for installation of vibration isolation mounts and flexible connections should be strictly observed. • Where metal (coil) springs are required, they should be provided with neoprene pads in series fixed to the base of the springs. • All rotary machinery should be accurately balanced both statically and dynamically.
Emergency operation	Acoustic treatments, such as attenuators, acoustic louvres and mufflers, should be incorporated into the design as required to meet the emergency operations noise emission criteria.
Sleep disturbance	Appropriate reasonable and feasible acoustic treatments should be incorporated into the design of the proposed development as required to minimise sleep disturbance. It is expected that the mitigation measures detailed above for building services noise will be sufficient for managing sleep disturbance. Where possible, testing of emergency equipment, such as generators, should be scheduled during day-time periods.
Traffic noise intrusion	The preliminary assessment provides minimum glazing thicknesses. The recommended minimum façade glazing specification for typical residential properties provided are: • Single laminated glass at least 10.38mm thick, or • IGU with 4mm / 12mm air gap/ 4mm glazing. The recommended minimum façade glazing specification for typical commercial/ offices are: • single laminated glass at least 9.38 mm thick, or • IGU with 4mm / 12mm air gap/ 4mm glazing.

Operational item	Mitigation measures
	The preliminary assessment indicates that mechanical ventilation is incorporated into sleeping areas so that residents can keep windows shut if desired. These recommendations will be reviewed during the Detailed SSDA and it is noted that non-acoustic requirements (e.g. structural, safety or mechanical plant emissions) may have additional façade requirements.
Sydney Metro ground-borne/structure-borne noise and vibration	It is expected that structure-borne noise and ground-borne noise relating to the operation of Sydney Metro will be mitigated through track form design. No further vibration isolation of the proposed development is anticipated. The developer should ensure that design of the development is fit for purpose and aligns with the intended use considered during the track-form design.
Road traffic generated from development	Similar or minor decreases in total carparking spaces for the site in the podium building and the availability of Sydney Metro as an alternative transport option to driving are expected to lead to a reduction in traffic noise related to the site. Therefore, no net increase in the ambient acoustic environment on surrounding roads is expected. No specific additional mitigation measures are recommended at this stage. Road traffic noise impacts should be reassessed during detailed design when existing and future traffic volumes are available to ensure compliance with the environmental noise criteria.
Car park noise emissions	No net increase to the ambient acoustic environment is expected due to having a similar number or minor decrease in car parking spaces and the fact that the carparking will be located within the building rather than on the surface. No specific additional mitigation measures are recommended at this stage. Car park noise emissions should be re-assessed during detailed design to ensure that any change to the design arrangement results in compliance with the environmental noise criteria.
Loading dock noise emissions	No net increase to the ambient acoustic environment is expected due to the loading dock being located inside the building at ground level. During detailed design where more information about loading dock movements is available, these noise emissions should be assessed to ensure compliance with the environmental noise criteria. Further, opportunities to minimise potential impacts should be considered as the design develops including good practice management measures during loading/unloading operations.

8. Conclusion

This report presents the results of a noise and vibration assessment of the proposed development. The report has been prepared to outline the noise and vibration impacts of the proposed development and to specifically respond to the SEARs issued for the Concept SSDA. Construction and operational noise and vibration criteria for the proposed development have been established based upon the SEARs.

The site is located on a triangular parcel of land that is bounded by Edward Street, Union Street and Pyrmont Bridge Road. The surrounding receivers are a mix of commercial, residential, hotels and some specialised uses such as theatres and recording studios. The nearest sensitive receivers are those adjacent the site along Edward Street, Union Street and Pyrmont Bridge Road, approximately 20 metres from the site boundary.

Background noise measurements were completed as part of previous assessments associated with the metro station. The measured background noise levels have been used as the basis of the construction and operational noise criteria in this document.

An indicative construction scenario applicable to the proposed development has been modelled and construction noise levels at nearby sensitive receivers have been predicted. Applying a worst-case scenario (all anticipated construction equipment operating at the same time), construction noise has been predicted to exceed the noise management level at the majority of the nearby receivers that were assessed due to their proximity to the proposed development site, with the greatest exceedance occurring a music recording studio at Dodgy Sound, 100 Pyrmont Street.

A CNVMP will be prepared during the Detailed SSD stage for the management and minimisation of potential impacts on sensitive receivers. Based on the staging of the construction works, cumulative construction noise impacts from the site are anticipated to be dominated by works associated with the construction of the proposed development, with minimal contribution from overlapping construction activities associated with Stage 3 CSSI Application.

Cumulative impacts with other nearby future developments (such as the Sydney Fish Market and Harbourside Shopping Centre Redevelopment) have been considered. Sydney Fish Market is scheduled to open in 2024 before commencement of the proposed development construction in 2026. The nature and details of the Harbourside Shopping Centre Redevelopment are not yet available and therefore its potential contribution to cumulative construction noise impacts cannot be determined at this stage. It is expected that cumulative construction noise impacts of this and other future developments (where relevant) would to be managed through consultation and implementation of the CNVMP.

General operational noise and vibration control measures and recommended minimum glazing constructions have been included to comply with the applicable criteria. Further detailed assessments will be undertaken as the design develops and at the Detailed SSD preparation stage for operational vibration and operational noise impacts from:

- building services plant
- emergency plant
- road traffic generated from the development
- road traffic ingress
- car park noise
- loading dock noise.

will be undertaken as the design develops to ensure that the operational criteria will be met. Recommended minimum glazing constructions have been provided to control traffic noise ingress into the development. Operational noise and vibration control measures have been included to comply with the applicable criteria.

9. References

Australian Standard AS 2187.2-2006 “Explosive-Storage and use Part 2: Use of explosives”

Australian Standard AS 2436-2010 “Guide to noise and vibration control on construction, demolition and maintenance sites”

Australian / New Zealand Standard AS/NZS 2107-2016 “Acoustics – Recommended design sound levels and reverberation times for building interiors”

British Standard BS 7385.2-1993 “Evaluation and measurement for vibration in Buildings Part 2”

European Commission, Common Noise Assessment Methods in Europe (CNOSSOS EU), 2012

NSW Department of Environment and Climate Change, Interim Construction Noise Guideline, July 2009

NSW Department of Environment and Conservation, Assessing Vibration: A technical guideline, February 2006

NSW Department of Climate Change, Environment and Water, NSW Road Noise Policy, March 2011

NSW EPA, Noise Policy for Industry, October 2017

Protection of the Environment Operations Act 1997

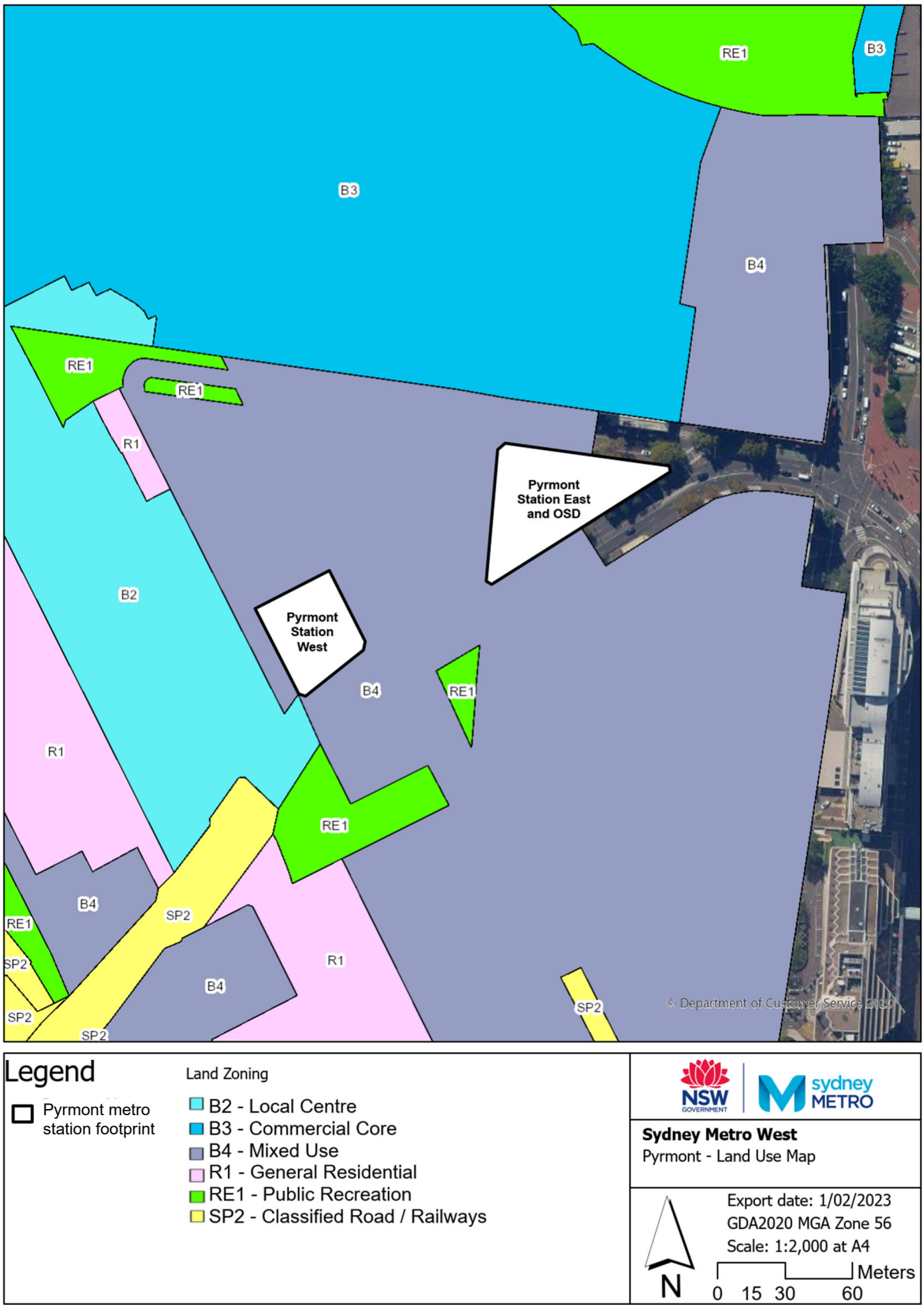
State Environmental Planning Policy (Transport and Infrastructure) 2021

Sydney Development Control Plan 2012

Sydney Metro Construction Noise and Vibration Standard, SM-20-00098866, Version 4.5, July 2022.

UK Department for Environmental, Food and Rural, Affairs Update of noise database for prediction of noise on construction and open sites.

Appendix A Planning zone map



Appendix B Construction noise contour map