Appendix X

Noise and vibration report

Sydney Metro West

Parramatta Over and Adjacent Station Development Noise and Vibration Report

Appendix X

September 2022

NSW GOVERNMENT

sydney METRO

Document Number: SMWSTEDS-SMD-PTA-SN600-NV-RPT-044004

REVISION	DATE	SUITABILITY CODE	TEAMBINDER DOCUMENT NUMBER	TB REVISION
F	16/09/2022	S4	SMWSTEDS-SMD-PTA-SN600-NV-RPT-044004	F

Approval Record

FUNCTION	POSITION	NAME	DATE
Author	Senior Sciences Engineer	Natalie Redmond	16/09/2022
Technical Checker	Principal Sciences Engineer	Moharis Kamis	16/09/2022
Technical Reviewer	Technical Director	Neil Mackenzie	16/09/2022
Coordinator	Senior Environmental Advisor	Jonathon Cook	20/09/2022
Approver	SM EDA Lead	Adrian Garnero	20/09/2022

Amendment Record

DATE	REVISION	AMENDMENT DESCRIPTION	AUTHOR
05/11/2021	A	Initial Issue	Natalie Redmond
17/12/2021	B	Second Issue	Natalie Redmond
20/01/2022	C	Update footprint as SM purchased Civic Link	Natalie Redmond
01/04/2022	D	Third Issue	Natalie Redmond
10/06/2022	E	Fourth Issue	Natalie Redmond
16/09/2022	F	Final Issue	Natalie Redmond

Mott MacDonald Australia Pty Ltd

Contents

List of Figures

List of Tables

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.
ASD	Adjacent station development
AVATG	Department of Environment and Conservation, Assessing vibration: a technical guideline, February 2006.
CBD	Central business district
CORTN	United Kingdom, Department of Transport (UKDOE), Welsh Office HMSO, Calculation of road traffic noise (1988)
CNVG	Construction noise and vibration guideline, NSW Department of Road and Maritime Services, August 2016
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
Concept SSDA	A concept development application as defined in section 4.22 of the EP&A Act. It is a development application that sets out the concept 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
CSSI	Critical state significant infrastructure
dB	decibel, unit used to measure the loudness of sound
dB(A)	'A'-weighted decibel
DCP	Development control plan
DPE	NSW Department of Planning and Environment
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
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
LA1	The noise level which is exceeded for 1% of the measurement period
LA10	The noise level which is exceeded for 10% of the measurement period
LA90	The noise level which is exceeded for 90% of the measurement period, commonly used to indicate the background noise level.
LAeq,T	The energy average noise level over the measurement period, T
LAFmax	The maximum noise level over the measurement period. This level is the maximum noise level due to an individual noise event
LGA	Local government area
NML	Noise management level(s)
NPfI	Noise policy for industry, NSW EPA, October 2017
OSD	Over station development
RBL	Rating background level, the median ABL over an entire noise monitoring period
RNP	NSW road noise policy, Department of Climate Change, Environment and Water 2011

Term	Definition
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State environmental planning policy
Stage 2 CSSI Application	Application SSI-19238057, including major civil construction works between The Bays and Hunter Street Station
Stage 3 CSSI Application	Application SSI-22765520, including rail infrastructure, stations, precincts and operation of the Sydney Metro West line
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(s)

Executive summary

This Noise and Vibration Impact Assessment 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 to secure concept approval for an over station development (OSD) and adjacent station development (ASD) on the Parramatta metro station site (referred to as the 'proposed development'). The proposed development will comprise three new commercial office buildings (Buildings A, C, D), and one new residential building (Building B).

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

The Noise and Vibration Assessment Report provides an assessment of operational and construction acoustic impacts from the project to neighbouring land uses as well as the impact to the proposed development from environmental sources (e.g. road traffic and rail).

A construction noise and vibration assessment was undertaken based on two indicative construction scenarios. Noise levels were predicted at nearby noise sensitive uses. Noise and vibration impacts are expected for nearby non-residential sensitive receivers (i.e., places of worship and educational facilities) as well as some nearby commercial buildings. These impacts will need to be managed throughout construction. Typical noise and vibration mitigation recommendations have been provided. It is expected that construction impacts are considered in more detail during the development of the Construction Noise and Vibration Management Plan as part of Detailed SSDAs.

Operational noise and vibration impacts from mechanical plant have been considered and it is anticipated that typical mitigation measures will be able to achieve compliance with the assessment criteria. Indicative design solutions have been provided based on preliminary assessments of mechanical plant and general advice that is considered appropriate for developments of this type. Road traffic impacts in and surrounding the proposed development are not finalised at this stage but the location of car parking and loading docks underground, and a reduction in car parking (due to the removal of the former City Centre Car Park previously on site) indicates that traffic noise impacts are not likely to exceed the assessment criteria. Indicative glazing construction are provided for the proposed development for traffic noise intrusion. The acoustic façade glazing requirements can be refined as the design develops.

It is anticipated that track form design will mitigate ground-borne, and structure borne vibration from Sydney Metro West project. No additional vibration isolation measures for the proposed development in relation to the Sydney Metro West metro line are anticipated.

A Detailed SSDA is to be made after the Concept SSDA, to seek consent for the design and to physically carry out the proposal. A detailed noise and vibration assessment report will form part of the future Detailed SSDA.

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 have a target travel time of about 20 minutes between Parramatta and the Sydney CBD, 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 (Sydney CBD).

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

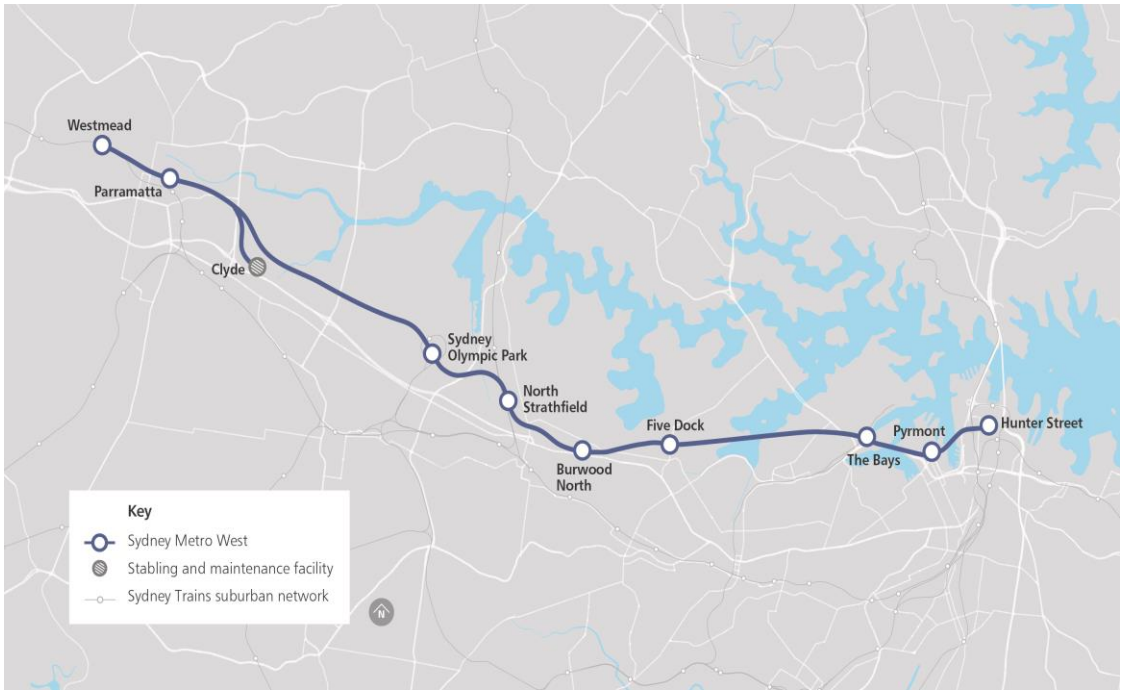

Figure 1-1 Sydney Metro West

1.2 Background and planning context

Sydney Metro is seeking to deliver Parramatta metro station under a two part planning approval process. The station 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), whereas the over and adjacent station developments are 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 Application (SSI- 19238057) – All major civil construction works between The Bays and Sydney CBD (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 (under assessment, lodged).

1.2.2 State Significant Development Application

The SSDA will be undertaken as a staged development with the subject Concept SSDA being consistent with the meaning under section 4.22 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and seeking conceptual approval for a building envelope, land uses, maximum building heights, a maximum gross floor area, pedestrian and vehicle access, vertical circulation arrangements and associated car parking. A subsequent Detailed SSD/s is to be prepared by a future development partner which will seek consent for detailed design and construction of the development.

1.3 Purpose and scope

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 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 22 February 2022 which states that the Environmental Impact Statement is to address the requirements shown in Table 1-1.

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

Key issue	SEARs requirement	Addressed in
1. Statutory 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 for any non-compliances. If the development is only partly State significant development (SSD) declared under clause 8(1) of the State and Regional Development SEPP, provide an example of how the remainder of the development is sufficiently related to the component that is SSD.	Section 5
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 construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed manage and mitigation measures that would be implemented.	Throughout report
22. Construction Operation and Staging	If staging is proposed, provide details of how construction and operation would be managed, and any impacts mitigated.	Section 7

2 The site and proposal

2.1 Site location and description

The subject application is in the Parramatta CBD, in the City of Parramatta Local Government Area (LGA). It is within the city block bounded by George Street, Church Street, Smith Street, and Macquarie Street.

The site presents a 164m long frontage to Macquarie Street, 125m frontage to George Street, 48m frontage to Church Street, and 15.5m frontage to Smith Street (in the form of Macquarie Lane).

The site location is shown in Figure 2-1 and Table 2-1.

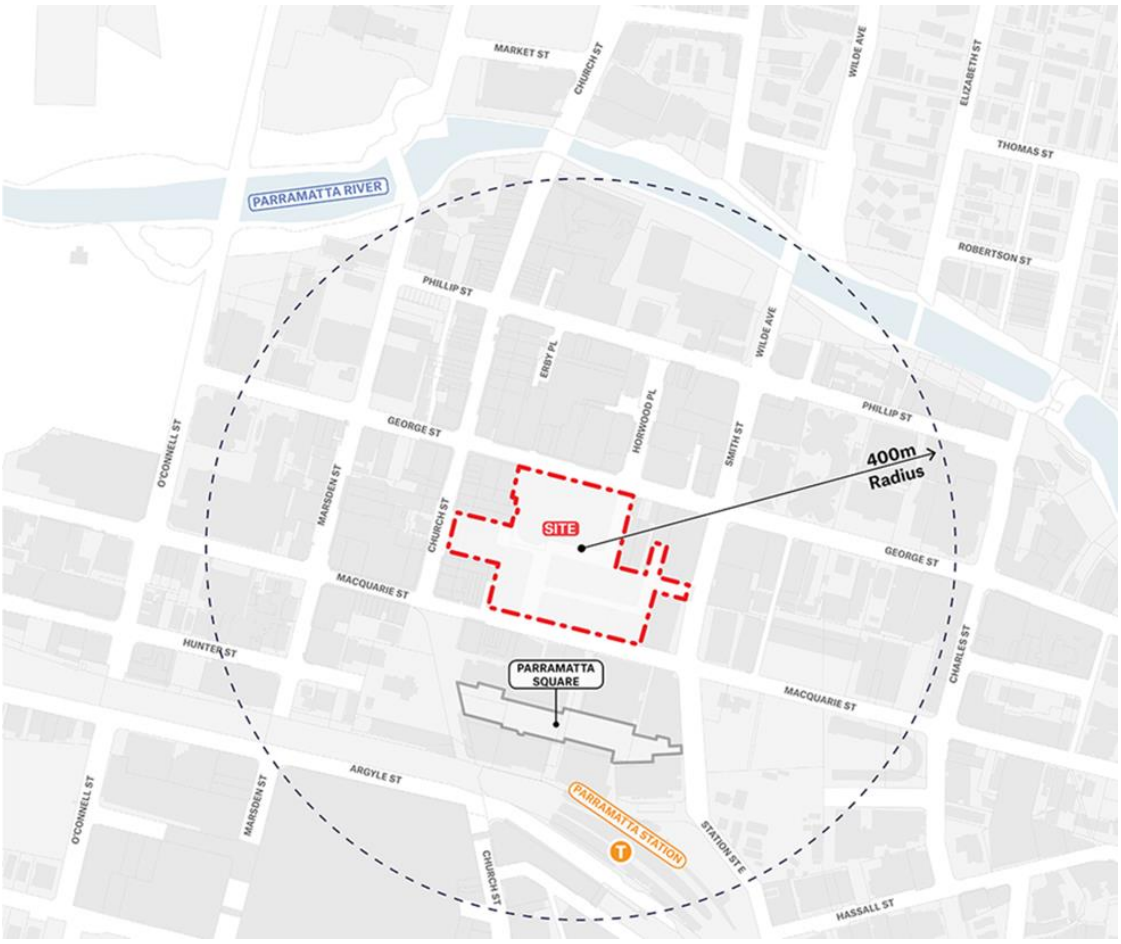

Figure 2-1 Parramatta metro station location precinct

As described in Table 2-1, the site comprises fourteen (14) different allotments of varying sizes. It is irregular in shape, with a total area of approximately 24,899m^2.

Table 2-1 Site legal description

Street address	Legal Description
41-59 George Street	Lot 10 in DP858392
45A George Street	Lot 2 in DP701456
61B George Street	Lot 1 in DP607181
71 George Street	Lot 100 in DP607789
220 Church Street	Lot 1 in DP1041242
222 Church Street	Lot 1 in DP702291
232 Church Street	Lot 1 in DP651992
236 Church Street	Lot 1 in DP128437
238 Church Street	Lot 2 in DP591454
48 Macquarie Street	Lot B in DP394050
58-60 Macquarie Street	Lot 1 in DP399104
62-64 Macquarie Street	Lot AY in DP400258
68 Macquarie Street	Lot 1 in DP711982
70 Macquarie Street	Lot E DP 402952
72 Macquarie Street	Lot 3 in DP218510
74 Macquarie Street	Lot H in DP405846

2.2 Overview of this proposal

The Concept SSDA will seek consent for four building envelopes as detailed in Table 2-2 and Figure 2-2 below.

Table 2-2 Parramatta proposed development overview

Item	Description
Building use	**Building A:** Commercial and retail **Building B:** Residential and retail **Building C:** Commercial **Building D:** Commercial and retail
Building Height (Number of storeys)	**Building A:** 38 storeys **Building B:** 33 storeys **Building C:** 26 storeys **Building D:** 25 storeys
Gross Floor Area (m²)	**Building A:** 78,700 **Building B:** 20,000 **Building C:** 35,950 **Building D:** 55,350 **TOTAL: 190,000**
Car parking spaces	455

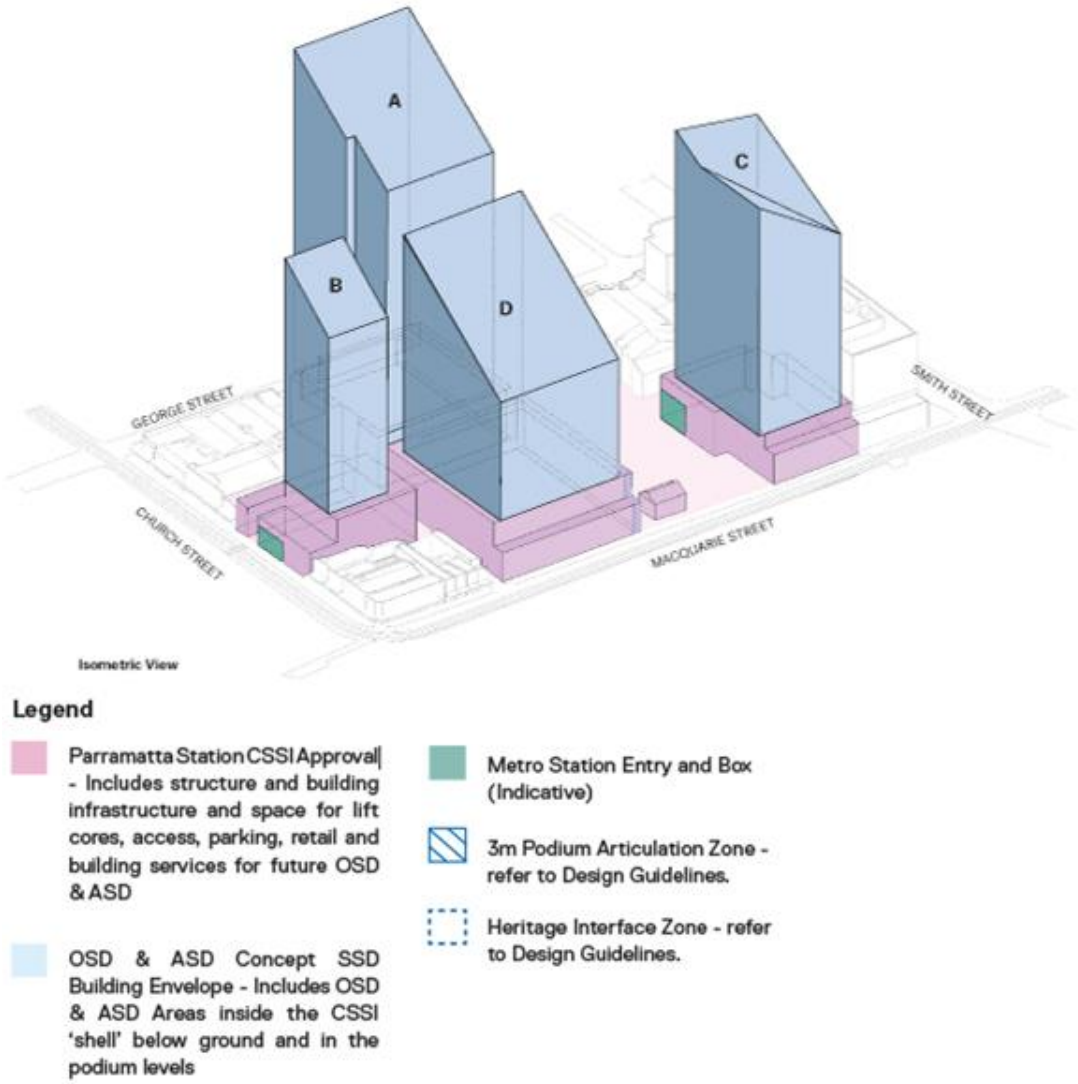

Figure 2-2 Proposed Concept SSDA development and CSSI scope

3 Scope of assessment

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

- review the existing environment and identify noise and vibration sensitive receivers throughout the proposed development assessment area
- determine the existing background noise levels based on previously undertaken ambient noise monitoring in the last 5 years
- based on the noise logging results and local noise environments, determine noise catchment areas (if applicable) for the assessment of noise impacts
- establishing representative construction scenarios, locations, working times and duration of activities that would apply to construction of the proposed development
- 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 and the Sydney Metro Construction Noise and Vibration Standard
- assess road noise impacts from construction activities in accordance with the Road Noise Policy (NSW Department of Climate Change, Environment and Water) (RNP)
- assessing potential construction vibration impacts from the proposed development in accordance with the EPAs Assessing vibration: a technical guideline
- assess potential operational noise impacts with reference to the Noise Policy for Industry (NPfI) and the RNP, where applicable
- identifying suitable management and mitigation measures to minimise the predicted noise and vibration impacts generated by the proposed development.

4 Existing noise and vibration environment

4.1 Existing noise environment

The proposed development site is in the Parramatta CBD, bounded by George Street, Smith Street, Macquarie Street, and Church Street.

The site is surrounded by high density commercial development, with some nearby educational uses and places of worship. Road traffic on the city streets surrounding the site is the controlling noise source in the existing environment. Parramatta Light Rail is currently under construction along Macquarie Street.

The nearest residential receivers are located approximately 160 metres south west of the site boundary on the corner of Marsden Street and Macquarie Street (45 Macquarie Street, Parramatta in the 'V by Crown' Complex).

A site map identifying the proposed development site and the uses of nearby noise sensitive receivers is provided in Figure 4-1.

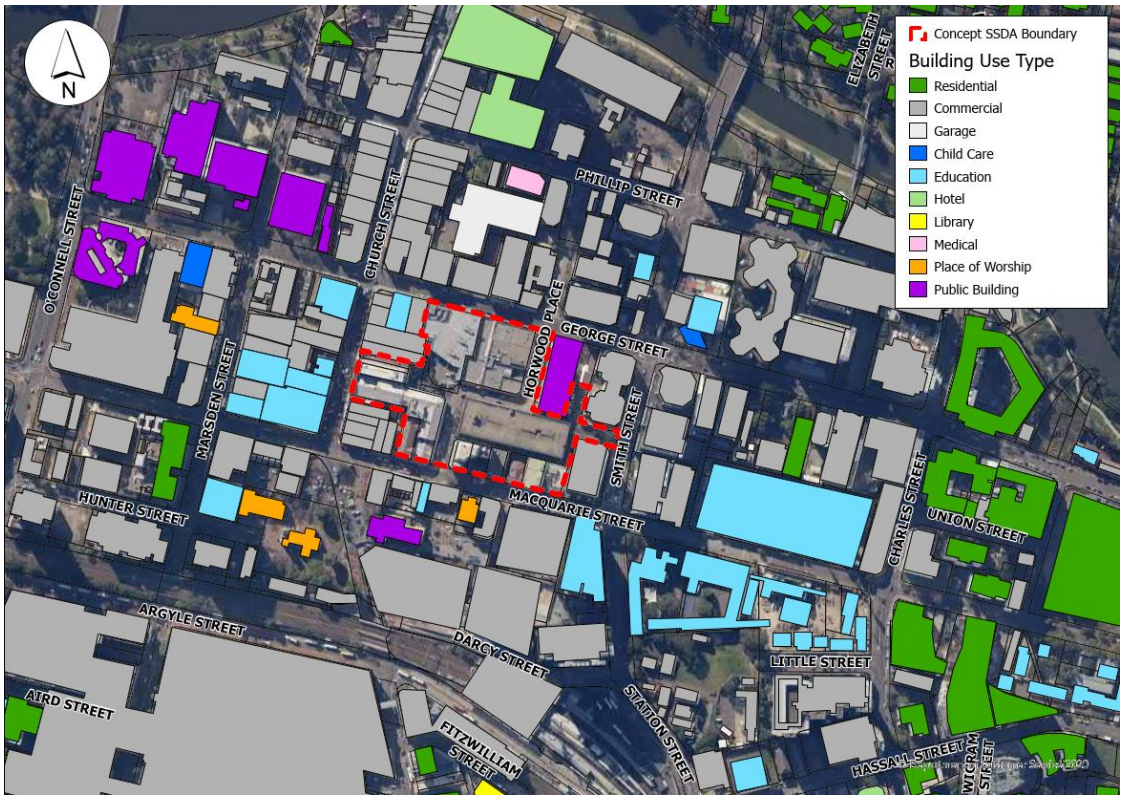

Figure 4-1 Proposed development and surrounding land use types

Source: Figure prepared in ArcGIS Pro, Imagery from SixMaps (NSW Department of Customer Services)

4.2 Noise catchment areas

Noise catchment areas have not been applied for this assessment. The site is in the centre of an urban area and there is no clear delineation where a change in background noise environment would be expected.

4.3 Noise monitoring

4.3.1 Unattended noise monitoring

Baseline unattended noise monitoring was carried out at sensitive receiver locations near Parramatta metro station between March and July 2019 as part of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

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

- L_{AFmax} – the maximum noise level over the measurement period. This level is the maximum noise due to an individual noise event
- L_{A10} – the noise level which is exceeded for 10% of the measurement period
- L_{Aeq} – the energy average noise level over the measurement period
- L_{A90} – the noise level which is exceeded for 90% of the measurement period. This is considered representative of the background noise level over the measurement period.

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 Concept and Stage 1 CSSI Approval Technical Paper 2 Noise and Vibration.

Figure 4-2 presents the unattended noise monitoring location in relation to the proposed development site. Table 4-1 is a summary of the noise logging results at this location. The NPfI defines three separate assessment time periods: daytime (7am to 6pm); evening (6pm to 10pm); and night-time (10pm to 7am). 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 4-1 Unattended noise monitoring results

Location ID	Address	Noise level (dB(A))					
		Background noise (RBL)			Average noise level (LAeq)		
			Evening	Night		Evening	Night
L.03	Arthur Phillip High School, Parramatta	58	53	43	69	67	62

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

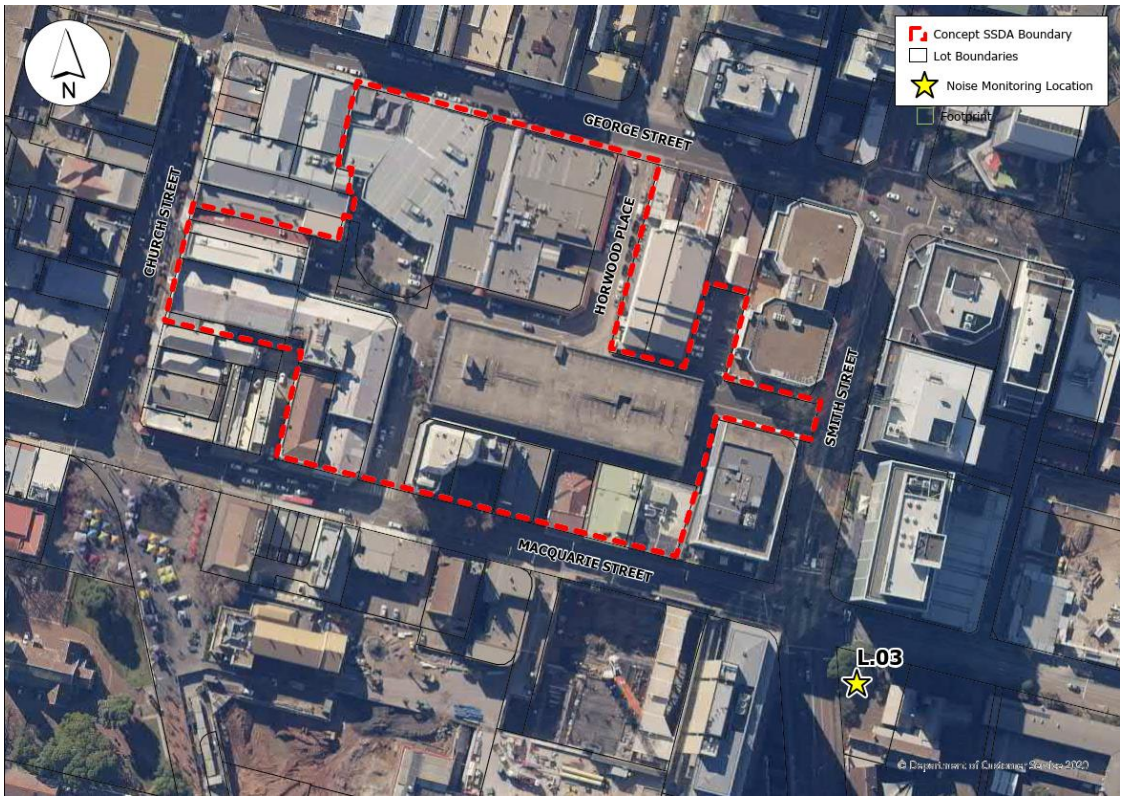

Figure 4-2 Unattended noise monitoring location

Source: Figure prepared in ArcGIS Pro, Imagery from SixMaps (NSW Department of Customer Services), Noise monitoring location from Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD – Technical Paper 2 – Noise and Vibration.

4.3.2 Attended noise monitoring

Given long term background noise monitoring has been completed in the area to determine existing noise environment under the Concept and Stage 1 CSSI approval, attended noise measurements are not required for this assessment.

5 Assessment criteria

5.1 Construction noise

Table 5-1 summarises the different construction impacts that shall be assessed and the relevant guideline or document for establishing the appropriate criteria.

Table 5-1 Construction noise categories to be assessed

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) Construction Noise and Vibration Guideline, Road and Maritime Services, August 2016 (CNVG)
	Sleep disturbance	Interim Construction Noise Guideline, Department of Environmental and Climate Change NSW, July 2009 (ICNG) Noise Policy for Industry, NSW EPA, 2017 (NPfI)
	Ground-borne noise	Interim Construction Noise Guidelines, Department of Environmental and Climate Change NSW, July 2009 (ICNG)
	Road traffic noise	Construction Noise and Vibration Guideline, Road and Maritime Services, August 2016 (CNVG) Noise Criteria Guideline, Roads and Maritime Services, (April 2015) Noise Mitigation Guideline, Roads and Maritime Services, (April 2015)

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. It is our understanding that the ICNG will remain applicable to this project.

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 ICNG also provides 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 development 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.

Residential land uses

Table 5-2 summarises the construction noise management levels for residential receivers.

Table 5-2 Construction noise management level criteria – residential land uses

Time of day	Construction noise management level, $L_{Aeq,15min}$	How to apply
Recommended standard construction 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.
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.

Table 5-3 summarises the construction noise management levels (NMLs) for the proposed development.

Table 5-3 Construction noise management levels – residential land uses

Rating background level (RBL)			Noise management level (NML)		
Daytime	Evening	Night-time	Daytime	Evening	Night-time
58	53	43	68	58	48

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

Construction noise management levels are assessed 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 most noise-affected point within 30 m of the residence is used for measuring or predicting noise levels is at. Noise levels may be higher at upper floors of the noise affected residence.

Non-residential sensitive land uses

Non-residential sensitive land use noise management levels are shown in Table 5-4.

Table 5-4 Construction noise management levels – non-residential sensitive land uses

Land use	Noise management level, $L_{Aeq,15min}$
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)(3)
Hospital wards and operating theatres	Internal noise level 45 dB(A)(1)
Places of worship	Internal noise level 45 dB(A) (2)
Active recreation areas (such as parks and sports grounds or playgrounds)	External noise level 65 dB(A)
Passive recreation areas (such as outdoor grounds used for teaching, outdoor cafes or restaurants)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended "maximum internal levels" in AS/NZS 2107:2016 for specific uses.
Childcare centres – Sleeping Areas(4)	Internal noise level 45 dB(A)(2)
Childcare centres – outdoor play areas(4)	External noise level 65 dB(A)

Note:

1. In order to assessed impacts on these land uses, It is assumed that these receiver types have fixed windows with a conservative 20 dB reduction for external to internal noise levels.
2. In order to assessed impacts on these land uses, receiver conservatively assumed to have operable windows and a 10 dB external to internal noise level.
3. A 20 dB reduction for external to internal noise levels has been applied for any educational institution in an office building, a 10 dB reduction for external to internal noise levels has been applied for any school classrooms on stand-alone school sites.
4. The ICNG and AS 2107 do not provide specific criteria for childcare centres. Childcare centres generally have internal play area and sleep areas. For these facilities, where feasible and reasonable the objective should be to achieve internal levels for sleeping of 45 dB(A) (consistent with hospital wards/places of worship) and for play areas of 65 dB(A) (consistent with playgrounds).

Other noise-sensitive businesses require separate specific noise goals, and it is suggested in the ICNG that the internal construction noise levels at these premises are to be referenced to the 'maximum' internal levels presented in AS 2107. Recommended 'maximum' internal noise levels from AS 2107 are reproduced in Table 5-5.

Table 5-5 AS 2107 construction noise - recommended maximum internal levels

Land use	Time period	AS 2107 classification	Recommended 'maximum' internal L_{Aeq}, dB(A)
Hotel	Daytime & Evening	Bars and Lounges	50 dB(A)(1)
	Night-time	Sleeping Areas: Hotels near major roads	40 dB(A) (1)
Café	When in use	Coffee bar	50 dB(A) (1)
Bar/Restaurant	When in use	Bars and Lounges / Restaurant	50 dB(A) (1)
Library	When in use	Reading Areas	45 dB(A) (1)
Court	When in use	Court rooms	35 dB(A) (1)
Public Building	When in use	Public Building	50 dB(A)(2)
Recording Studio	When in use	Music Recording Studios	35 dB(A) (1)
Theatre / Auditorium	When in use	Drama Theatres	30 dB(A) (1)

Source: AS 2107 and Sydney Metro West Construction Noise and Vibration Standard

Note:

1. In order to assessed impacts on these land uses, It is assumed that these receiver types have fixed windows with a conservative 20 dB reduction for external to internal noise levels.
2. In order to assessed impacts on these land uses, receiver conservatively assumed to have operable windows and a 10 dB external to internal noise level.

Non-sensitive land uses

Noise management levels for non-sensitive land uses are provided in Table 5-6.

Table 5-6 Construction noise management levels – non-sensitive land uses

Land use	Noise management level, $L_{Aeq,15min}$
Industrial premises	External noise level 75 dB(A)
Commercial premises (offices, retail outlets)	External noise level 70 dB(A)

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 Sydney Metro West Construction Noise and Vibration Standard approach to assessing sleep disturbance events is consistent with the NPfI.

A detailed maximum noise level event assessment is to be undertaken where night-time noise levels at a residential location exceed either of the following criteria:

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

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 will consider all feasible and reasonable noise mitigation measures with the goal of achieving the above trigger levels for night-time activities.

Table 5-7 summarises the sleep disturbance criteria for construction noise.

Table 5-7 Construction noise – sleep disturbance criteria

Night-time RBL, L_{A90} dB(A)	Construction noise sleep disturbance criteria	
	$L_{Aeq,15min}$	L_{AFmax}
43	48	58

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-bore noise management levels (residential receivers only) are:

- evening (6pm to 10pm) Internal LAeq,15min 40dB(A)
- night time (10pm to 7am) Internal LAeq,15min 35dB(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 associated with road project construction is not explicitly provided in either the ICNG, nor the *Road Noise Policy* (NSW Department of Environment, Climate Change, and Water 2011) (RNP). An approach similar to considering the work as a traffic generating development has been taken. 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 5.3.3.

5.2 Construction vibration

Table 5-8 summarises the construction vibration impacts that shall be assessed and the relevant guideline or document for establishing the appropriate criteria.

Table 5-8 Construction vibration categories to be assessed

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	German Standard DIN 4150-3 Vibrations in buildings - Part 3: Effects on structures. (DIN 4150-3)

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 provides guidance in terms of continuous and impulsive vibration, and intermittent vibration. Vibration from construction activities associated with this 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 below in Table 5-9. 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 5-9 Construction vibration – human comfort criteria – intermittent vibration

Land use	Vibration Dose Value (VDV) design goals ($m/s^{1.75}$)			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas (Note 1)	0.10	0.20	0.10	0.20
Residences (Note 2)	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:

1. 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 5-10.

Where vibration values are below the preferred values in Table 5-10, 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 5-10 may be dealt with through negotiation with the regulator and affected community.

Table 5-10 Construction vibration – human comfort criteria – continuous and impulsive vibration

Location	Assessment period	Peak Particle Velocity (PPV), mm/s	
		Preferred (z-axis)	Maximum (z-axis)
Continuous vibration			
Critical areas (Note 1)	When in use	0.14	0.28
Residences (Note 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 (Note 1)	When in use	0.14	0.28
Residences (Note 2)	Daytime	8.6	17.0
	Night-time	2.8	5.6
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

There are currently no Australian standards for the assessment of structural vibration. The most common international; standard referenced for major infrastructure projects in NSW is the German Standard DIN 4150-3 Vibrations in buildings – part 3: Effects on structures.

DIN 4150-3 provides recommended maximum vibration levels which reduce the likelihood of building damage. These limits have been summarised in Table 5-11.

Table 5-11 Construction vibration – structural damage criteria

Type of structure	Safe limits for building vibration velocity, mm/s			
	At foundation at a frequency of:			At the horizontal plane of the highest floor
	<10Hz	10Hz - 50Hz	50Hz - 100Hz	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

5.3 Operational noise – Environmental noise emission

The operational impacts for the environmental noise emission to be assessed are summarised in Table 5-12.

Table 5-12 Summary of operational impacts for environmental noise emission to be assessed

Impact type	Sub-category	Relevant guideline or document
Environmental noise emission	Airborne environmental noise emissions	NSW EPA, Noise Policy for Industry, October 2017 (NPfI)
	Sleep disturbance	Department of Environment, Climate Change and Water, NSW Road Noise Policy, March 2011 (RNP)
	Emergency plant noise	
	Traffic generating development	

5.3.1 Airborne environmental noise emission

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 this proposed development, the services noise have been assessed with the default amenity noise level minus 5 dB adjustment to account for cumulative noise sources. The cumulative noise impact associated with the Parramatta metro station and this proposed development have not been assessed cumulatively as they will each meet an amenity noise level objective that allows for other industrial noise sources. In the event that both developments 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:

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

The rating background level (RBL) is the average background noise level over a measurement period of at least one week, discussed previously in section 4.3.

Table 5-13 summarises the measured RBL and corresponding intrusiveness level for each time period.

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

Rating background level (RBL)			Noise management level (NML), $L_{Aeq,15min}$ dB(A)		
Daytime	Evening	Night time	Daytime	Evening	Night time
58	53	43	63	58	48

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 5-14.

Table 5-14 Operational noise amenity levels

Receiver	Noise amenity area	Time period	NPfI Amenity noise level, L_{Aeq} dB(A)	Adjusted amenity noise level (Note 1), $L_{Aeq,15min}$ 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, caretakes 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 (Note 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 (Note 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.

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 development 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”, or sensitive receiver locations so the existing noise environment should be considered.

The existing ambient noise levels are 11 dB, 14 dB, and 19 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 very unlikely.

Emergency plant noise

In the absence of any relevant NSW guideline for emergency generators and equipment, it is recommended that noise limits in Table 5-14 be relaxed by 5 dB(A) for emergency plant equipment. Table 5-15 presents criteria for emergency operations noise criteria.

Table 5-15 Emergency operations noise criteria – residential land uses

Receiver	Noise amenity area	Time period	NPfi Intrusiveness criteria, LAeq,15min dB(A)	Emergency operations noise criteria, LAeq,15min dB(A)
Residential	Urban	Day	63	68
		Evening	58	63
		Night	48	53

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:

- $L_{Aeq,15min}$ 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 5-16.

Table 5-16 Operational noise – sleep disturbance screening levels

Night-time RBL	Sleep disturbance screening levels, dB(A)	
	$L_{Aeq,15min}$	L_{AFmax}
43	48	58

5.3.3 Traffic generating development

Noise from traffic movements to and from site including truck and car movements shall be assessed under 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-arterial roads generated by land use developments	$L_{Aeq(15hr)}$ 60 (external)	$L_{Aeq,(9hr)}$ 55 (external)
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)

5.4 Operational noise – external noise intrusion

The operational impacts for the external noise intrusion to be assessed are summarised in Table 5-18.

Table 5-18 Summary of operational impacts for external noise intrusion to be assessed

Impact type	Sub-category	Relevant guideline or document
External noise intrusion	Airborne external noise intrusion	State Environment Planning Policy (Infrastructure) 2007 (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	NSW Development near Rail Corridors and Busy Roads – Interim Guideline

5.4.1 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

(1) 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”.

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 minus 3dB. This allows for an equal contribution from mechanical services noise sources within the proposed development.

The external noise intrusion for non-residential land uses are summarised in Table 5-19.

Table 5-19 External noise intrusion – non-residential land uses

Type of occupancy/activity	Design sound level range $L_{Aeq,T}$
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

5.4.2 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) is required to be complied with for 95 percent of train pass-bys.

5.4.3 Ground-borne vibration

The NSW Development near Rail Corridors and Busy Roads – Interim Guideline specifies vibration criteria listed in Assessing vibration: a technical guideline (Department of Environment and Conservation, 2006) for appropriate vibration goals for continuous, impulsive, and intermittent vibration. These criteria have been defined in Table 5-20.

Table 5-20 Construction vibration – human comfort criteria – intermittent vibration

Land use	Vibration Dose Value (VDV) design goals (m/s$^{1.75}$)			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas (Note 1)	0.10	0.20	0.10	0.20
Residences (Note 2)	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:

1. 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.

5.5 City of Parramatta DCP

No requirements for noise and vibration were identified in the Parramatta Development Control Plan (DCP) 2011.

6 Impact assessment

6.1 Construction noise and vibration impacts

For the purpose of this construction assessment, refer to the proposed development's construction site and nearby sensitive receivers identified on Figure 6-1.

6.1.1 Construction stages and scheduling

Construction works to take place for the proposed development have been outlined in Table 6-1. Works have been grouped into two indicative construction scenarios.

Table 6-1 Construction scenarios and expected work scheduling

Construction scenario	Construction hours
1. Construction – SSD Podium (Buildings A and D)	Day – standard hours
2. Construction – SSD Tower (Buildings A, B, C and D)	Day – standard hours

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, likely construction scenarios, equipment types and locations, noise and vibration source levels, and hours of work.

Staging

Construction staging is indicative and will be determined in future Detailed SSDs. The demolition, site establishment and excavations will be conducted as part of the preceding Sydney Metro Enabling Works under the Concept and Stage 1 CSSI Approval.

Construction outside standard working hours

It is anticipated that the majority of construction works would be carried out during standard working hours. No specific out of hours activities have been identified for the proposed development. However, if circumstances arise where outside of standard working hours works are required, these activities must be undertaken in accordance with the ICNG.

Specific activities could be permitted outside of hours, including:

- 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 Levels (NMLs) at the most affected sensitive receiver (i.e., Fit-out work inside the constructed building).

Any construction work outside 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.

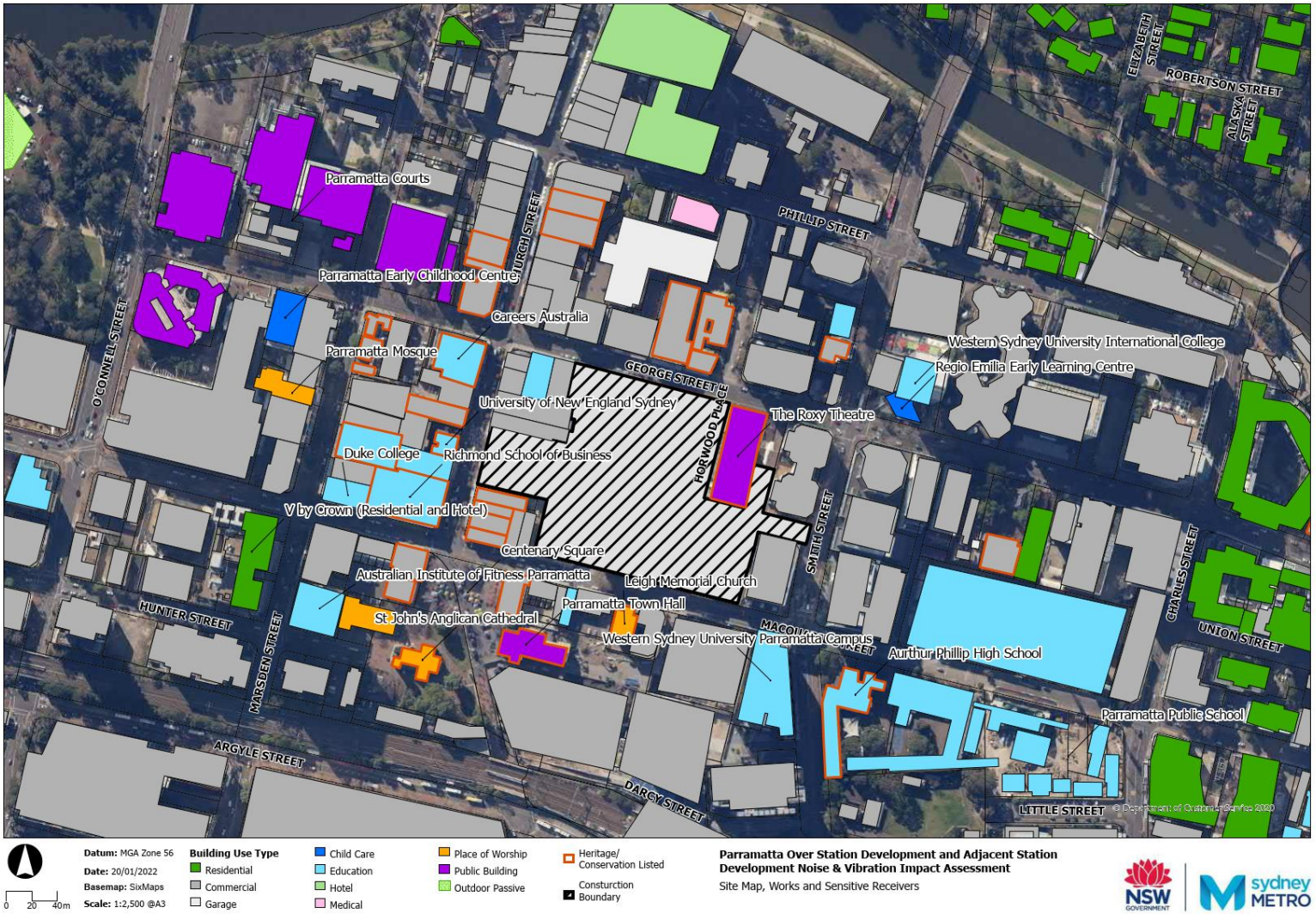

Figure 6-1 Site map, works and sensitive receivers

6.1.2 Plant and equipment noise levels

Table 6-2 presents the typical sound power levels of the construction equipment used in this assessment as well as the cumulative level for each scenario. These sound power levels are typical levels taken from the data provided in 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” noise database and an assumption that equipment is modern and in good working order.

For the noise assessment, only the worst-case construction scenarios for the SSD project components have been considered. The modelled scenario includes all equipment that could be reasonably assumed to be operating at the same time for an entire 15-minute period.

Cumulative impacts for the proposed development from the two construction scenarios (podium construction and tower construction) occurring consecutively have also been assessed. These impacts are indicative only and may not be representative of the approach taken by the developer or developers working on the proposed development site.

Table 6-2 Typical sound power levels of equipment for SSD construction scenarios

Scenario	Equipment / activity	Qty	‘A’ weighted total SWL dB(A)
Podium Construction (Buildings A and D)	Diesel tower cranes	2	99
	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
	Typical overall sound power level		**109**
Tower Construction (Buildings A, B, C and D)	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

Scenario	Equipment / activity	Qty	'A' weighted total SWL dB(A)
	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
	Typical overall sound power level		**110**

6.1.3 Assessment methodology

In order to quantify noise emissions from the proposed development's 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 NSW Spatial Services Six Maps database
- buildings footprints and heights, sourced from Open Street Map
- construction works area with the combined overall source noise levels of the anticipated equipment for each scenario.

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 are likely to be lower than the worst-case noise levels presented for most time periods during the works.

6.1.4 Construction site noise assessment

Noise levels have been predicted for the nominated construction scenarios. Predicted construction noise impacts for each construction phase are presented in Table 6-3.

The predicted construction assessment results are summarised as follows:

- **Podium construction:** 0 residential sensitive receivers and 12 non-residential sensitive receivers (i.e. place of worship, education) exceed the NMLs. The worst-affected sensitive receiver was 119 Macquarie St, Parramatta (place of worship) with an exceedance 20 dB over the NML
- **Tower construction**: 0 residential sensitive receivers and 15 non-residential sensitive receivers (i.e. place of worship, education) exceed the NMLs. The worst-affected sensitive receiver was 119 Macquarie St, Parramatta (place of worship) with an exceedance 15 dB over the NML
- **Podium and tower consecutive construction**: 0 residential sensitive receivers and 15 non-residential sensitive receivers (i.e. place of worship, education) exceed the NMLs. The worst-affected sensitive receiver was 119 Macquarie St, Parramatta (place of worship) with an exceedance 20 dB over the NML.

The lack of exceedances at residential receivers is expected due to the limited number of residential uses in the Parramatta CBD. Due to the close proximity of the non-residential sensitive uses to the proposed development's construction site, including some located directly adjacent to the site, it is reasonable to expect exceedances.

Commercial receivers which exceed the 70dB(A) criteria have been indicated on the figures in Construction. Impacts on nearby commercial uses will also need to be managed.

Further consideration of noise and vibration management and mitigation measures is provided in section 7.

The results have also been presented visually in Construction. Façade noise map results have been calculated for each receiver and the worst-case receiver noise level has been presented visually on these figures.

6.1.5 Cumulative construction impacts

Cumulative impacts from the concurrent construction of the proposed development and Parramatta metro station have the potential to increase noise at nearby sensitive receivers.

Construction planning is proceeding on the basis that the station could be constructed concurrently with Buildings B and C. The remaining buildings, Buildings A and D could be built at a later stage, with timing yet to be determined. For further details on the construction staging methodology, refer to the Constructability Environmental Management Statement.

Based on this construction planning, cumulative impacts could occur from the construction of the proposed development and Parramatta metro station. The cumulative noise impacts may increase noise levels at nearby sensitive receivers by as much as 3 dB(A) over the maximum noise level of the Parramatta metro station and proposed development individually. Although 3 dB(A) is generally considered just discernible, the cumulative impact of noise shall be managed as far as possible by the contractor to ensure that the potential for adverse impacts at sensitive receivers is minimised.

The Sydney Metro West Construction Noise and Vibration Management Strategy should be applied to manage cumulative impacts from the proposed development and Parramatta metro station.

In addition to the cumulative project impacts above, there is the potential for cumulative construction impacts with other future developments (not associated with the project) that could be proposed nearby to the project site with construction programs that overlap with the construction of the proposed development. Currently, there are no known nearby future developments with overlapping construction programs. However, if nearby future developments do arise, consultation should be undertaken with other contractors to manage cumulative impacts on sensitive receivers within common areas. It is expected that community consultation measures will be sufficient to manage any cumulative impacts that could arise.

In summary, cumulative noise impacts from the concurrent construction of the proposed development and Parramatta metro station could occur based on current construction planning. These impacts should be managed through application of the Sydney Metro West Construction Noise and Vibration Management Strategy. Cumulative noise impacts from the proposed development and nearby future developments are not expected as no nearby future developments are currently known. If such developments arise, cumulative impacts should be managed through consultation between contractors and with the community.

Table 6-3 Predicted standard construction hours (daytime) noise impacts, dB(A)

Receiver	Address	NML* dB(A)	Construction phase ($L_{Aeq,15min}$ dB(A))					
			Podium		Tower		Podium/tower consecutively	
			SPL (at worst affected floor)	Exceedance of NML	SPL (at worst affected floor)	Exceedance of NML	SPL (at worst affected floor)	Exceedance of NML
Residential receivers								
R1	45 Macquarie Street, Parramatta (V by Crown)	68	59		58		59	
R2	101 Marsden Street, Parramatta	68	51		51		51	
R3	70-74 Phillip Street, Parramatta	68	43		44		44	
R4	89 George Street, Parramatta	68	43		52		52	
Non-residential sensitive receivers								
R5	119 Macquarie Street, Parramatta (place of worship)	55	75	20	70	15	75	20
R6	97 Macquarie Street, Parramatta (education)	65	77	12	70	5	77	12
R7	1 Civic Place, Parramatta (public building)	60	66	6	67	7	67	7
R8	195 Church Street, Parramatta (place of worship)	55	58	3	62	7	62	7
R9	87 Marsden Street, Parramatta (education)	65	58		62		57	
R10	197 Church Street, Parramatta (education)	65	75	10	68	3	75	10
R11	197-207 Church Street, Parramatta (education)	65	77	12	69	4	77	12
R12	211 Church Street, Parramatta (education)	65	75	10	69	4	75	10
R13	25 George Street, Parramatta (education)	65	69	4	68	3	69	4
R14	37-39 George Street, Parramatta (education)	65	65		66	1	68	3
R15	150 Marsden Street, Parramatta (place of worship)	55	54		57	2	57	2

Receiver	Address	NML* dB(A)	Construction phase ($L_{Aeq,15min}$ dB(A))					
			Podium		Tower		Podium/tower consecutively	
			SPL (at worst affected floor)	Exceedance of NML	SPL (at worst affected floor)	Exceedance of NML	SPL (at worst affected floor)	Exceedance of NML
R16	9 George Street, Parramatta (child care)	55	54		55		55	
R17	12 George Street, Parramatta (court)	55	55		57	2	57	2
R18	30 Phillip Street, Parramatta (hotel)	70	58		56		58	
R19	55 Phillip Street, Parramatta (medical)	65	59		60		60	
R20	37 Smith Street, Parramatta (education)	65	55		58		58	
R21	100 George Street Parramatta (child care) (education)	55	58	3	58	3	58	3
R22	80-100 Macquarie Street, Parramatta (education)	65	55		56		56	
R23	175 Macquarie Street, Parramatta (Arthur Phillip High School) (education)	55	61	6	60	5	61	6
R24	169 Macquarie Street, Parramatta (education)	65	75	10	70	5	75	10
R25	The Roxy Theatre, 69 George Street, Parramatta (restaurant)	70	78	8	71	1	78	8

Note: *all NML are assessed externally in this assessment. Please see Table 5-4 for the internal to external façade factors that have been assumed for this desktop assessment.

6.1.6 Construction traffic noise

This preliminary assessment of construction traffic noise aims to determine whether traffic generated by construction of the proposed development would be significant, i.e. result in traffic noise level increase of 2 dB or more. Typically, traffic volume growth of at least 60% of the existing volume would be needed to result in a 2 dB increase. If the increase is less than 2 dB, no further assessment is required under the RNP. If the increase is greater than 2 dB then further assessment in accordance with the RNP would be required.

The Transport and Access Report provides indicative estimates of traffic generation associated with the Parramatta metro station fit-out and the proposed development construction works. The scenario which represents the worst-case for indicative construction traffic generation is when both Buildings B and C are being constructed concurrently with the Station. For this scenario, the greatest per hour construction traffic generation is estimated to be 48 vehicles per hour, comprising 24 light vehicles and 24 heavy vehicles per hour.

The primary and secondary access routes for construction vehicles are identified in Figure 6-2.

Figure 6-2 Parramatta Concept SSDA proposed construction haulage routes

A preliminary assessment was undertaken using the CoRTN to assess the potential increase in traffic noise from the addition of construction traffic when compared against existing traffic volumes. George Street, Smith Street and Macquarie Street have been considered as these roads are on the proposed haulage routes. Where available. existing traffic volumes data have been sourced from the Transport and Access Report.

For George Street and Smith Street, the increase in traffic noise level for the worst-case scenario of 48 additional construction vehicles is less than 2 dB. Therefore, no further assessment for these haulage roads would be required.

For Macquarie Street, existing traffic volumes are not available along the haulage route as the road is currently closed in both directions for Parramatta Light Rail construction. This means the potential increase in noise from construction traffic cannot be quantified. Notwithstanding, it is reasonable to assume that Macquarie Street would have similar traffic volumes as George Street considering both streets provide access to similar land uses and are accessible by similar sub-arterial roads. Therefore, the change in traffic noise on Macquarie Street is not expected to be greater than that on George Street.

Further to the above, it is noted that there are very few residential properties along the proposed haulage route and most of these residential properties are in high rise dwellings with a large distance from the road. Therefore, the overall noise level from construction traffic is expected to be below the RNP traffic generating development assessment criteria.

In conclusion, based on this preliminary assessment, noise impacts from construction generated traffic are not anticipated. Further investigation of likely traffic noise impacts would be completed by the contractor in the Construction Noise and Vibration Management Plan (CNVMP). This should include the identification of appropriate management and mitigation measures, where required.

6.1.7 Construction site compound

A compound site would be required for the proposed development. The location of the compound site will be determined at a later stage and the potential noise impacts of the compound site will be assessed by the contractor and included in the CNVMP.

6.1.8 Construction vibration assessment

The Transport for NSW Construction Noise Strategy provides safe working distances for vibration intensive activities. The safe working distances for cosmetic damage must be complied with at all times, unless otherwise approved by the relevant authority. The safe working distances have been reproduced in Table 6-4.

There are no high vibration producing equipment identified in the construction stages in section 6.1.1. Vibration impacts are not anticipated for the proposed development due to the lack of below-ground or ground disturbance construction works. Notwithstanding, if this changes and vibration activities are proposed (such as any of the equipment listed in Table 6-4), potential structural damage and human response impacts will need to be managed.

Table 6-4 Recommended safe working distances from vibration intensive plant

Plant item	Rating / description	Safe working distances	
		Cosmetic damage (BS7385)	Human response (OH&E vibration guideline)
Vibratory roller	<50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	<100 kN (Typically 2-4 tonnes)	6 m	20 m
	<200 kN (Typically 4-6 tonnes)	12 m	40 m
	<300 kN (Typically 7-13 tonnes)	15 m	100 m
	>300 kN (Typically 13-18 tonnes)	20 m	100 m
	>300 kN (Typically >18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg – 5 to 12t excavator)	2 m	7 m
Medium hydraulic hammer	(900kg – 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Heritage and conservation listed structures have been identified in Figure 6-1. While there are heritage receivers that fall within these safe working distances, the proposed works don't include any of the vibration intensive equipment listed in Table 6-4. As such, no vibration impacts would be expected on heritage and conservation listed structures. The CNVMP should confirm that none of the equipment in this list would be used. The CNVMP should review all proposed construction activities to confirm that the proposed works would not create a vibration impact on any structures.

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

6.2 Operational noise and vibration impacts

6.2.1 Site noise emissions

Building services noise emission

The environmental noise emission from the proposed development services plant should be assessed against the environmental criteria presented in section 5.3.1. This should be assessed in detail during design development as part of Detailed SSDAs.

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

- hat pumps
- cooling towers
- stair pressurisation fans
- generators.

The cooling towers are currently planned to be located on the roof of the building towers. Noise mitigation including acoustic louvres and attenuators on the exhaust fans are currently considered in the design and should provide suitable noise attenuation to meet applicable noise criteria in section 5.3.1.

Due to the weight and physical size of the heat pumps, they are currently proposed to be located on the podium level. Noise mitigation including ducted exhausts with an attenuator in the plenum have been considered to meet the applicable noise criteria.

Stair pressurisation fans would include suitable attenuators to meet the applicable noise criteria.

Generators are required for the commercial towers. They would generally be located on the podium and require attenuators and acoustic louvres to attenuate noise associated with air flow paths.

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 5.3.1. 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 attenuations included in the design to comply with the applicable noise criteria.

Emergency operations

Emergency operations for the proposed development should be assessed against the criteria presented in Table 5-15 during the Detailed SSDAs. 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

Noise emissions from the proposed development are controlled by the major mechanical plant discussed above. The plant all generate continuous noise, with L_{Amax} maximum noise levels typically 1 to 2 dB greater than the ambient L_{Aeq} noise levels. 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 mechanical plant identified in section 0.

Traffic 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 CNOSSOS-EU light, medium-heavy and heavy traffic spectrums with a 93% light vehicle, 6% medium-heavy and 1% heavy vehicle split). Noise levels incident on the building façade were determined from the unattended noise measurements detailed in section 4.3. Noise levels at this measurement location were used to adjust the traffic noise spectrum to assess the worst affected façade of the commercial buildings and residential buildings of the proposed OSD.

Daytime and night-time ambient noise levels were utilised. The following indicative glazing options for the façade construction for office and residential uses are recommended:

- single laminated glass at least 10mm thick, or
- insulated Glass Unit (IGU) with one layer at least 10mm thick.

It is also recommended that mechanical ventilation is provided in residential sleeping areas to give residents the option to shut windows instead of needing to keep them open for natural ventilation.

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 will need to be reviewed during detailed design stage.

Sydney Metro ground-borne/structure-borne noise and vibration impacts

Vibration generated for the 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. The proposed development may 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 defined in section 0 and 5.4.3 is achieved. No further vibration isolation of the proposed development is required.

6.2.2 Road traffic generating development

The Sydney Metro West – Parramatta Over Station Development and Adjacent Station Development Metro Station Transport and Access Report (Sydney Metro, 2022) estimates that the proportion of car trips will significantly reduce compared to existing mode share around the proposed development, given the improved active transport links (e.g. Civic Link) and the addition of the Parramatta Light Rail and Sydney Metro West metro line. The proportion of public transport trip is expected to significantly increase to become the primary form of travel to and from the proposed development.

A reduction in road traffic movements associated with the proposed development site is anticipated, no specific additional mitigation measures for road traffic noise are recommended as part of this assessment. However, opportunities to minimise future potential impacts should be considered as the design develops.

6.2.3 Carpark noise emissions

The concept plan for the proposed development site includes application for 455 underground car parking spaces. The existing site contained the former City Centre Carpark (768 spaces) which was demolished under CSSI Stage 1, as well as other commercial buildings with a small number of carparks for building users.

As a net decrease in car parking spaces is expected for the proposed development site, an increase in car parking noise impacts is not anticipated. Therefore, no specific mitigation measures are recommended for car parking noise impacts as part of this assessment.

6.2.4 Loading dock noise emissions

The proposed loading docks for the site will be located underground and accessed via George Street for the northern basement and Smith Street and Macquarie Lane for the southern basement. Macquarie Lane has previously provided access to the former City Centre Car Park and other commercial buildings so previous use was likely primarily private light vehicles, the northern basement is accessed via a new laneway where ground level carparking was previously located.

Given that no residential receivers are close to the loading dock site access route, impacts on sensitive uses are not anticipated. However, opportunities to minimise future potential impacts should be considered as the design progresses.

6.2.5 Vibration impacts

It is anticipated that operational vibration impacts associated with operation of the proposed development can be managed with standard mitigation measures outlined in section 0.

7 Mitigation measures

7.1 Construction noise and vibration measures

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

7.1.1 Construction noise and vibration management plan

Prior to the commencement of major construction works the contractor 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 6.1.4 for non-residential sensitive receivers and nearby commercial receivers. Therefore, further investigation should be undertaken as part of Detailed SSDAs to manage these exceedances, including the following:

- The criteria for non-residential sensitive receivers is 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 criteria for non-residential sensitive receivers is an internal criteria. While assumptions have been made for this assessment for typical external to internal noise attenuations, a detailed investigation including an assessment of the façade construction would ensure that these assumptions are reasonable
- 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.

7.1.3 Standard mitigation measures (TfNSW – Construction Noise Strategy)

To manage the potential impact of noise and vibration during construction, feasible and reasonable management measures and work practices should be implemented.

The standard mitigation measures outlined in the Transport for NSW Construction Noise Strategy are reproduced in Table 7-1.

Table 7-1 Management and mitigation measures

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise. Ground-borne noise & vibration.	In addition to the measures set out in this table, any project specific mitigation measures identified in the environmental impact assessment documentation (e.g. REF, submissions or representations report) or approval or licence conditions must be implemented.
Implement community consultation measures (refer to Appendix C of Transport for NSW Construction Noise Strategy for further details of each measure).	Airborne noise.	periodic notification (monthly letterbox drop or equivalent) (Note 1) website Project Infoline Construction Response Line email distribution list Community and Stakeholder Meetings and Community Based Forums (if required by approval conditions).
Site inductions	Airborne noise. Ground-borne noise & vibration.	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: all relevant project specific and standard noise and vibration mitigation measures relevant licence and approval conditions permissible hours of work any limitations on high noise generating activities location of nearest sensitive receivers construction employee parking areas designated loading/unloading areas and procedures site opening/closing times (including deliveries) environmental incident procedures.
Behavioural practices	Airborne noise.	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Monitoring	Airborne noise. Ground-borne noise & vibration.	A noise monitoring program should be carried out for the duration of works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration.	Attended vibration measurements shall be undertaken at all buildings within 20 m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.

Action required	Applies to	Details
Source controls		
Construction hours and scheduling	Airborne noise. Ground-borne noise & vibration.	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period	Airborne noise. Ground-borne noise & vibration.	High noise and vibration generating activities (Note 2) may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block (Note 3). No more than four consecutive nights of high noise and/or vibration generating work may be undertaken over any seven-day period, unless otherwise approved by the relevant authority.
Equipment selection	Airborne noise. Ground-borne noise & vibration.	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits.
Maximum noise levels	Airborne noise.	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Table 2 (of the Transport for NSW Construction Noise Strategy).
Rental plant and equipment	Airborne noise.	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 (of the Transport for NSW Construction Noise Strategy).
Use and siting of plant	Airborne noise.	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Airborne noise. Ground-borne vibration.	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
Non-tonal reversing alarms	Airborne noise.	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.

Action required	Applies to	Details
Minimise disturbance arising from delivery of goods to construction sites	Airborne noise.	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Construction related traffic	Airborne noise.	Schedule and route vehicle movements away from sensitive receivers and during less sensitive times Limit the speed of vehicles and avoid the use of engine compression brakes Maximise on-site storage capacity to reduce the need for truck movements during sensitive times
Silencers on mobile plant	Airborne noise.	Where possible reduce noise from mobile plant through additional fittings including: Residential grade mufflers Damped hammers such as “City” Model Rammer Hammers Air Parking brake engagement is silenced
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise.	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436: 1981 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities	Airborne noise.	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

Note:

1. Detailing all upcoming construction activities at least 14 days prior to commencement of relevant works
2. Includes jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling.
3. “Continuous” includes any period during which there is less than a 60-minutes respite between ceasing and recommencing any of the work.

7.2 Operational noise and vibration measures

A summary of the noise and vibration mitigation measures relevant to the operation of the proposed development is presented in Table 7-2. 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 7-2 Operational recommendations summary

Operational item	Mitigation measures
Building services noise	Acoustic treatment has been recommended for the following mechanical plant: cooling towers will incorporate acoustic louvres and attenuators on the exhaust fans heat pumps will incorporate ducted exhausts with an attenuator in the exhaust plenum stair pressurisation fans will include suitable attenuators generators will incorporate attenuators and acoustic louvres 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 include the following: acoustic barriers around roof top plant robust construction of plant rooms acoustic louvres to plant room openings acoustic attenuators for mechanical ductwork acoustic mufflers in generator exhaust systems internal lining of ductwork selection of low noise plant
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.

Operational item	Mitigation measures
Sleep disturbance	Appropriate reasonable and feasible acoustic treatments should be incorporated into the design of the proposed development buildings 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 recommends an indicative glazing thickness of 10.38mm thick laminated glass for office and residential uses in the proposed development buildings. 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 design stage 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.
Road traffic generated from development	The reduction in carparking spaces for the proposed development site and the availability of Sydney Metro as an alternative transport option to driving are expected to lead to a reduction in traffic volumes 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 a decrease in car parking spaces and the fact that the carparking will be located underground. During detailed design where more information about traffic movements is available, car park noise emission should be assessed to ensure compliance with the environmental noise criteria. Further, opportunities to minimise potential impacts should be considered as the design develops.
Loading dock noise emissions	No net increase to the ambient acoustic environment is expected due to the loading dock being located underground. 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.

8 Conclusion

This report presents the results of a noise and vibration assessment of the Concept SSDA which incorporates the Parramatta OSD and ASD. This report has been prepared to outline the noise and vibration impacts of the proposed development and to respond to the SEARs that have been adopted for this Concept SSDA.

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

Construction and operational noise and vibration assessment criteria have been established.

Indicative construction scenarios applicable to the proposed development have been modelled and construction noise levels at nearby sensitive receivers have been predicted. Construction noise has been predicted to exceed the noise management levels at some non-residential sensitive receivers (i.e. educational facilities and places of worship) due to their proximity to the proposed development site. The predicted noise levels also indicate that exceedances at commercial buildings are also likely. A CNVMP should be developed in order to manage and minimise potential impacts on nearby receivers. Recommendations have been included to reduce the impact to surrounding sensitive receivers.

Operational noise impacts have been assessed and recommended controls for operational noise and vibration have been identified. In general, typical noise and vibration controls are considered suitable for managing operational noise and vibration impacts. It is recommended that further detailed assessments are undertaken as the design develops to ensure that the operational criteria will be met. Operational noise and vibration mitigation and management recommendations have been included to comply with the applicable criteria.

Appendix A Construction noise modelling figures

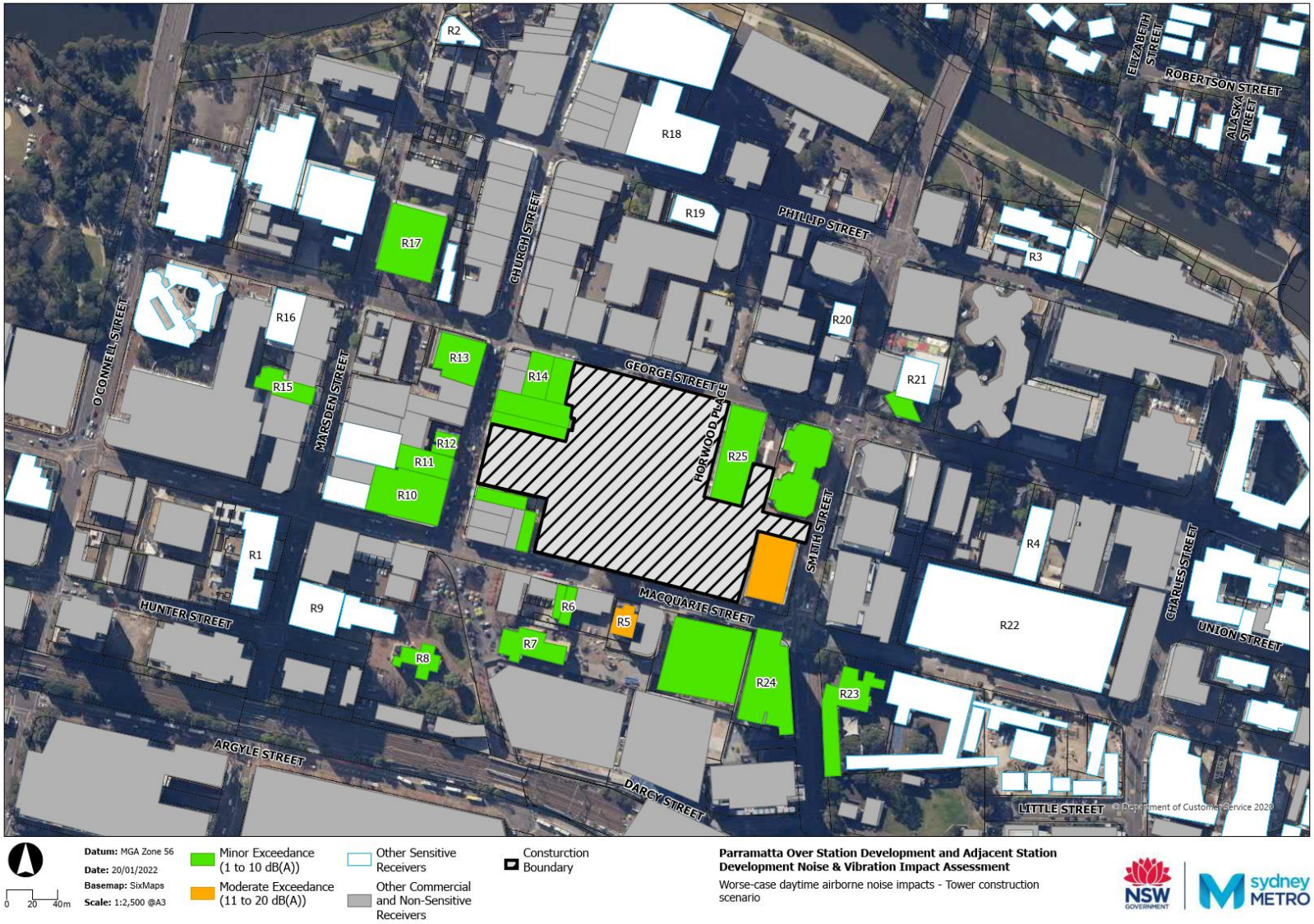

Figure A-1 Tower construction noise contours (not to scale)

Figure A-2 Podium construction noise contours (not to scale)

Figure A-3 Podium and tower construction noise contours (not to scale)