WATERLOO METRO QUARTER OVER STATION DEVELOPMENT

Environmental Impact Statement
Appendix K – Noise and Vibration Impact Assessment

SSD-10437 Southern Precinct

Detailed State Significant Development
Development Application

Prepared for **Waterloo Developer Pty Ltd**

30 September 2020

Reference	Description
Applicable SSD Applications	SSD-10437 Southern Precinct
Author	Stantec (Australia) Pty Ltd Brandon Notaras
Reviewed	Waterloo Developer Pty Ltd Patrick Garland
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1. Glossary and abbreviations

Reference	Description
ACHAR	Aboriginal Cultural Heritage Assessment Report
ADG	Apartment Design Guide
AHD	Australian height datum
AQIA	Air Quality Impact Assessment
BC Act	Biodiversity Conservation Act 2016
BCA	Building Code of Australia
BC Reg	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
CEEC	critically endangered ecological community
CIV	capital investment value
CMP	Construction Management Plan
Concept DA	A concept DA is a staged application often referred to as a 'Stage 1' DA. The subject application constitutes a detailed subsequent stage application to an approved concept DA (SSD 9393) lodged under section 4.22 of the EP&A Act.
Council	City of Sydney Council
CPTED	Crime Prevention Through Environmental Design
CSSI approval	critical State significant infrastructure approval
CTMP	Construction Traffic Management Plan
DA	development application
DPIE	NSW Department of Planning, Industry and Environment
DRP	Design Review Panel
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPA Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	ecologically sustainable design

Reference	Description
GANSW	NSW Government Architect's Office
GFA	gross floor area
HIA	Heritage Impact Assessment
IAP	Interchange Access Plan
LGA	Local Government Area
NCC	National Construction Code
OSD	over station development
PIR	Preferred Infrastructure Report
POM	Plan of Management
PSI	Preliminary Site Investigation
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No 55—Remediation of Land
SEPP 65	State Environmental Planning Policy No. 65 – Design Quality of Residential Apartment Development
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2009
SREP Sydney Harbour	State Regional Environmental Plan (Sydney Harbour Catchment) 2005
SSD	State significant development
SSD DA	State significant development application
SLEP	Sydney Local Environmental Plan 2012
Transport for NSW	Transport for New South Wales
TIA	Traffic Impact Assessment
The proposal	The proposed development which is the subject of the detailed SSD DA
The site	The site which is the subject of the detailed SSD DA
VIA	Visual Impact Assessment

Reference	Description
WMQ	Waterloo Metro Quarter
WMP	Waste Management Plan
WSUD	water sensitive urban design

2. Executive summary

This noise and vibration report has been prepared by Stantec (Australia) Pty Ltd to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site.

This report has been prepared to address the relevant conditions of the concept SSD DA (SSD 9393) and the Secretary's Environmental Assessment Requirements (SEARs) issued for the detailed SSD DA (SSD 10437).

This report concludes that the proposed Southern Precinct OSD is suitable and warrants approval subject to the implementation of the following mitigation measures:

- Acoustically rated glazing and solid façade elements to mitigate noise in the residential apartments;
- Acoustically treated natural ventilation devices to provide an alternative means of ventilation to habitable spaces within residential spaces that are noise-affected and cannot rely on opening their windows to obtain natural ventilation;
- Loading dock and waste collection shutter door to be closed during loading/unloading activities to ensure compliance with Sydney Metro and the EPA's Noise Policy for Industry;
- Acoustic barriers (solid or louvred) mitigate noise emissions from mechanical plant and equipment within the Level 24 plantroom;
- 2.4m high solid acoustic barrier (Class A or Class B hoarding) surrounding the perimeter of the site during the construction of the proposed development;

Following the implementation of the above mitigation measures, the remaining impacts are appropriate.

3. Introduction

This report has been prepared to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site. The detailed SSD DA is consistent with the concept approval (SSD 9393) granted for the maximum building envelope on the site, as proposed to be modified.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning, Industry and Environment (DPIE) for assessment.

The detailed SSD DA seeks development consent for the design, construction and operation of:

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9-storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 8 April 2020 and issued for the detailed SSD DA. Specifically, this report has been prepared to respond to the SEARs requirements summarised below.

Item	Description of requirement	Section reference (this report)
10	Noise and Vibration Impacts (Construction and Operation). An assessment of construction noise and vibration impacts. The assessment must also outline proposed noise and vibration mitigation and monitoring procedures having particular regard for potential impacts to the adjoining heritage listed 'Waterloo Congregational Church' site.	11 and 13
General	Noise and Vibration Impact Assessment	10 and 11
General	Operational Noise and Vibration Report	10 and 12
General	Acoustic Impact Assessment	10 and 11

Table 1 - SEARs requirements

This report has also been prepared in response to the following conditions of consent issued for the concept SSD DA (SSD 9393) for the OSD as summarised in the table below.

Item	Description of requirement	Section reference (this report)
B21(c)	Future development applications shall provide analysis and assessment of the impacts of construction works and include: Noise and Vibration Impact Assessment	11
B23	Future development applications shall be accompanied by a Noise and Vibration Impact Assessment that demonstrates the following requirements are met: (a) vibration from construction activities does not exceed the vibration limits established in British Standard BS7385-2:1993 Excavation and measurement for vibration in buildings. A guide to damage levels from ground borne vibration.	11.4
	(b) vibration testing is conducted before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent damage. in the event the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Applicant must review the construction methodology and, if necessary, propose additional mitigation measures.	-
	(c) advice of a heritage Specialist has been incorporated on methods and locations for installed equipment used for vibration movement and noise monitoring of heritage-listed structures.	-
B24	The Noise and Vibration Assessment must provide a quantitative assessment of the main noise generating sources and activities during operation. Details are to be included outlining any mitigating measures necessary to ensure the amenity of future sensitive land uses on the site and neighbouring sites is protected during the operation of the development	10 and 12
B25	The Noise and Vibration must address the conclusions and recommendations of the Concept Acoustic Assessment Report, SLR Consulting dated 9 November 2019.	3

Table 2 - Conditions of Concept Approval

To show compliance with this SEARs requirement, Table 3 outlines the appropriate mitigation measures outlined by SLR Consulting and the corresponding section within this report where the mitigation has been considered.

Section/Assessment	Measure	Section in SLR Report	Section in this report
Construction Noise – Recommended Construction Hours	Where possible, the construction works would be undertaken in accordance with the ICNG (discussed in Section 4.1.2) during the standard daytime working hours of: • 7.00 am to 6.00 pm Monday to Friday • 8.00 am to 1.00 pm on Saturdays. On this basis, the potential noise impacts from construction works have been predicted for the daytime period only.	5.2.1	11.1.1 and 11.3.1
Construction Noise	Where reasonable and feasible, the construction contractor will be required to implement best practice noise mitigation measures including: Judicious selection of mechanical plant and equipment (eg quieter machinery and power tools). Localised shielding of noisy equipment. Maximising the offset distance between noisy plant items and nearby noise sensitive receivers. Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers. Orienting equipment away from noise-sensitive areas. Carrying out loading and unloading away from noise-sensitive areas. Minimising consecutive works in the same locality. Considering periods of respite.	5.2.8	13

Construction Vibration Impacts	It is recommended to mitigate any potential impacts using the recommended safe working distances for vibration intensive plant as indicated in Table 18, taken from Transport for NSW's Infrastructure and Services Construction Noise and Vibration Strategy (2018)	5.2.10	11.2 and 11.4
In-Principle Acoustic Treatment to Mechanical Equipment & Plant	Selection of low-noise mechanical plant and other noise generating equipment. Judicious location of mechanical plant and equipment with respect to nearby noise-sensitive receivers. Barriers/enclosures (e.g. plant rooms). Silencers and acoustically lined ductwork.	5.3.1.1	10.3, 10.4 and 12.2
Internal Road Traffic Noise Levels	Assumption of 15dB façade loss to determine internal noise levels from traffic noise levels and acoustic absorption to underside of balcony The internal floorplate layout should be developed such that living spaces (not bedrooms) are located at the opening locations which are found to not comply with the night-time criteria	5.4.2.1	10.2
Sydney Metro Vibration Impacts	Vibration and ground-borne noise impacts from trains can be controlled at source through the use of trackforms which incorporate vibration-isolating components. It is anticipated that the criteria can be met through the use of resilient trackforms (potentially higher performing than those investigated in Table 19), building isolation in the form of bearings at the base of the buildings, or a combination of both.	5.5.2	10.7
Industrial Noise	It is anticipated that compliance with the final project trigger levels from cumulative industrial noise impacts will be achievable with standard noise mitigation measures.	5.6.2	10.3, 10.4, 10.5, 12.2, and 12.3

Table 3 – Stage 1 Mitigation Measures Compliance (by SLR Consulting)

Given there have been some changes to the design of the building form, uses and envelope from the Concept SSD DA, and technical information regarding the trackform design has now been made

available, some of the mitigation measures outlined by SLR Consulting may no longer be relevant to this project.

4. The site

The site is located within the City of Sydney Local Government Area (LGA). The site is situated about 3.3 kilometres south of Sydney CBD and eight kilometres northeast of Sydney International Airport within the suburb of Waterloo.

The Waterloo Metro Quarter site comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street (refer to Figure 1). The heritage-listed Waterloo Congregational Church at 103–105 Botany Road is within this street block but does not form a part of the Waterloo Metro Quarter site boundaries.

The Waterloo Metro Quarter site is a rectangular shaped allotment with an overall site area of approximately 1.287 hectares.

The Waterloo Metro Quarter site comprises the following allotments and legal description at the date of this report. Following consolidation by Sydney Metro (the Principal) the land will be set out in deposited plan DP1257150.

- 1368 Raglan Street (Lot 4 DP 215751)
- 59 Botany Road (Lot 5 DP 215751)
- 65 Botany Road (Lot 1 DP 814205)
- 67 Botany Road (Lot 1 DP 228641)
- 124-128 Cope Street (Lot 2 DP 228641)
- 69-83 Botany Road (Lot 1, DP 1084919)
- 130-134 Cope Street (Lot 12 DP 399757)
- 136-144 Cope Street (Lots A-E DP 108312)
- 85 Botany Road (Lot 1 DP 27454)
- 87 Botany Road (Lot 2 DP 27454)
- 89-91 Botany Road (Lot 1 DP 996765)
- 93-101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891)
- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)
- 156-160 Cope Street (Lot 31 DP 805384)
- 107-117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)
- 170-174 Cope Street (Lot 2 DP 205942).

The detailed SSD DA applies to the Southern Precinct (the site) of the Waterloo Metro Quarter site. The site has an area of approximately 4830sqm. The subject site comprises the following allotments and legal description at the date of this report.

- 130–134 Cope Street (Lot 12 DP 399757) (Part)
- 136–144 Cope Street (Lots A-E DP 108312) (Part)
- 93–101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891) (Part)
- 156–160 Cope Street (Lot 31 DP 805384)
- 107–117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)
- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)

- 170–174 Cope Street (Lot 2 DP 205942).

The boundaries of the overall site are identified at Figure 1, and the subject site of the detailed SSD DA is identified at Figures 2 and 3. The site is reasonably flat with a slight fall to the south.

The site previously included three to five storey commercial, light industrial and shop top housing buildings. All previous structures except for an office building at the corner of Botany Road and Wellington Street have been demolished to facilitate construction of the new Sydney Metro Waterloo station. As such the existing site is predominately vacant and being used as a construction site. Construction of the Sydney metro is currently underway on site in accordance with critical State significant infrastructure approval (CSSI 7400).

Figure 1 - Aerial image of the site
Source: Urbis

The area surrounding the site consists of commercial premises to the north, light industrial and mixed-use development to the south, residential development to the east and predominantly commercial and light industry uses to the west.

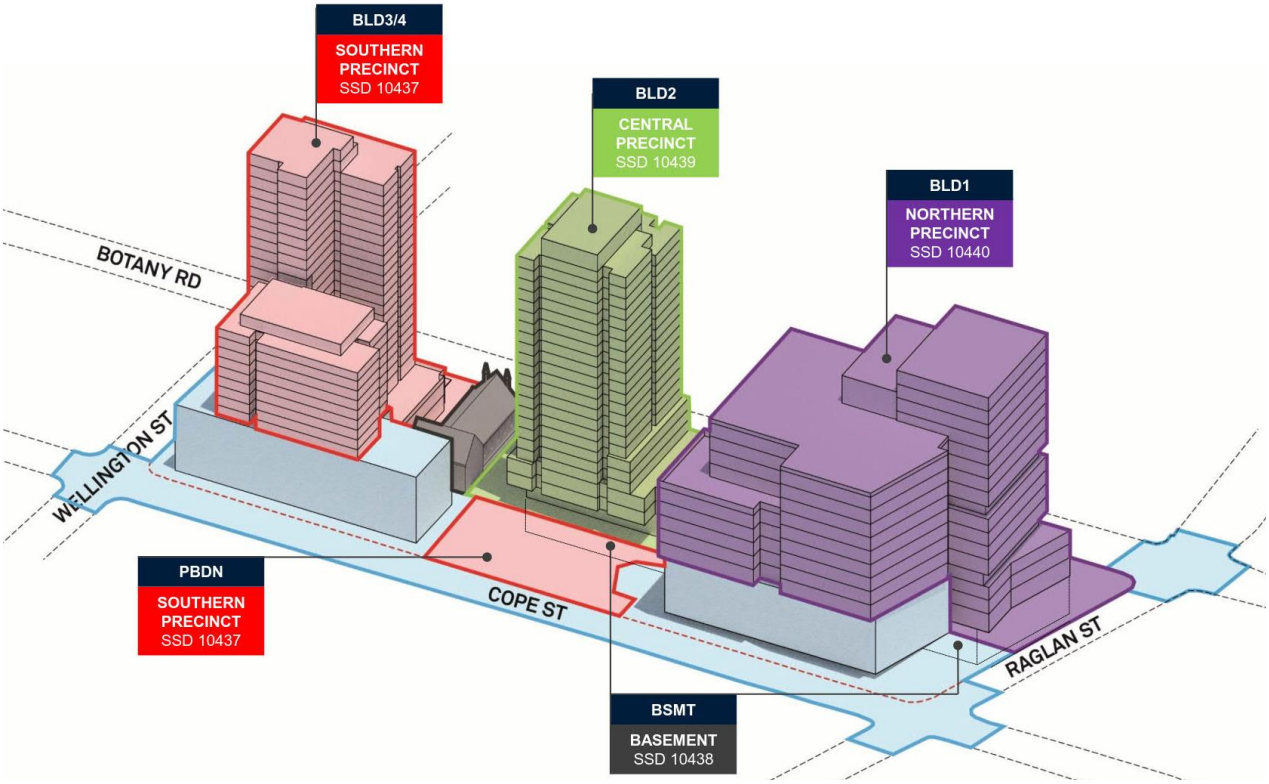

Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified
Source: HASSELL

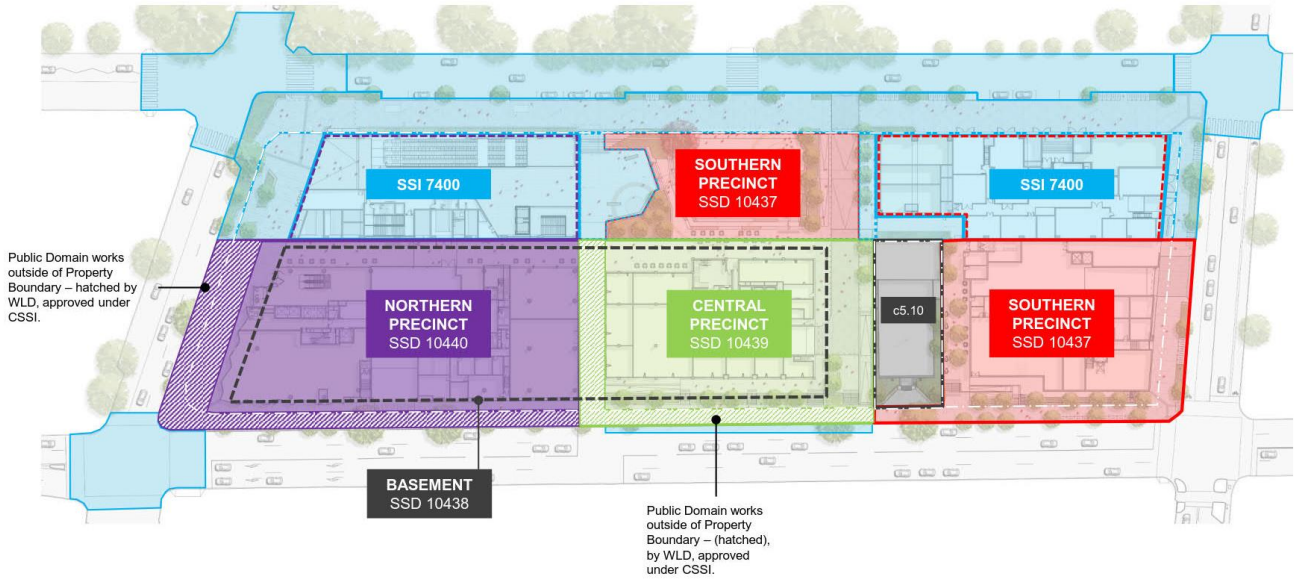

Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified
Source: Waterloo Developer Pty Ltd

5. Background

5.1 About Sydney Metro

Sydney Metro is Australia's biggest public transport project. Services started in May 2019 in the city's North West with a train every four minutes in the peak. A new standalone railway, this 21st century network will revolutionise the way Sydney travels.

There are four core components:

5.1.1 Sydney Metro North West

This project is now complete and passenger services commenced in May 2019 between Rouse Hill and Chatswood, with a metro train every four minutes in the peak. The project was delivered on time and $1 billion under budget.

5.1.2 Sydney Metro City & Southwest

Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of Metro Northwest at Chatswood, under Sydney Harbour, through new CBD stations and southwest to Bankstown. It is due to open in 2024 with the ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro City & Southwest will deliver new metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new underground metro platforms at Central Station. In addition, it will upgrade and convert all 11 stations between Sydenham and Bankstown to metro standards.

5.1.3 Sydney Metro West

Sydney Metro West is a new underground railway connecting Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between these two areas, linking new communities to rail services and supporting employment growth and housing supply between the two CBDs.

The locations of seven proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays.

The NSW Government is assessing an optional station at Pyrmont and further planning is underway to determine the location of a new metro station in the Sydney CBD.

5.1.4 Sydney Metro Greater West

Metro rail will also service Greater Western Sydney and the new Western Sydney International (Nancy Bird Walton) Airport. The new railway line will become the transport spine for the Western Parkland City's growth for generations to come, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service.

The Australian and NSW governments are equal partners in the delivery of this new railway.

The Sydney Metro project is illustrated below.

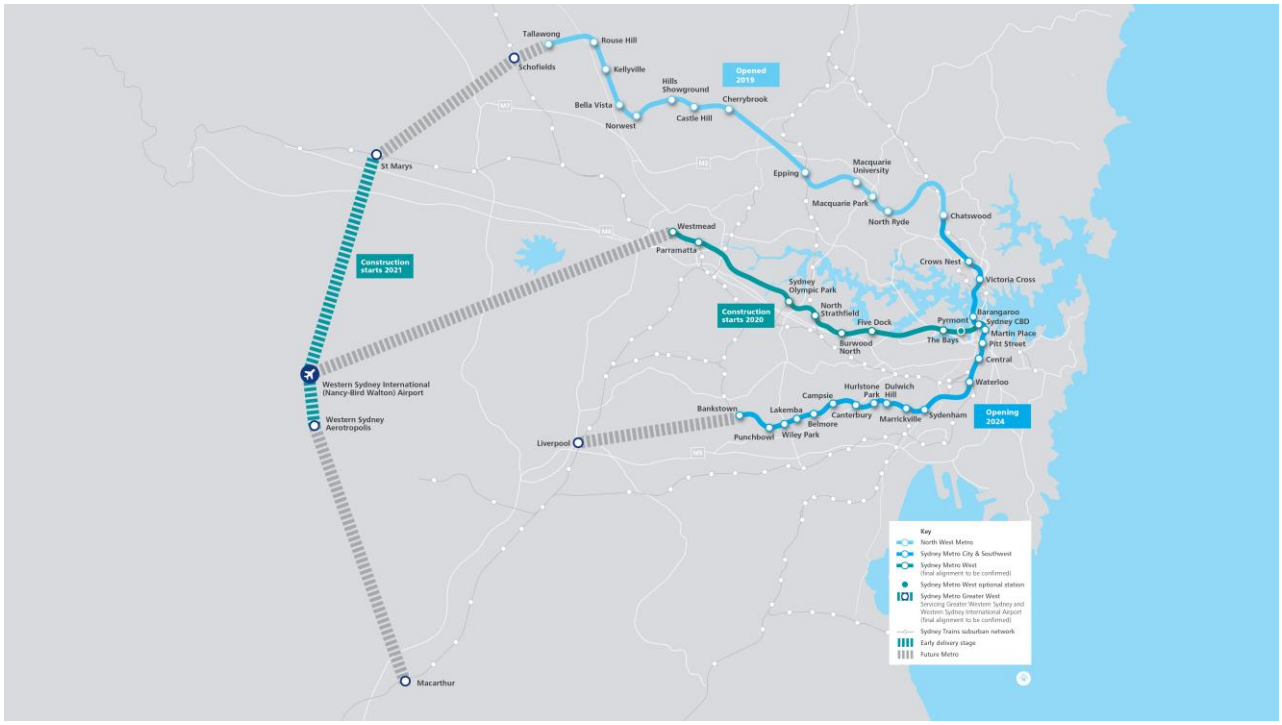

Figure 4 - Sydney Metro alignment map
Source: Sydney Metro

5.2 Sydney Metro CSSI Approval (SSI 7400)

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a critical State significant infrastructure (CSSI) project (reference SSI 7400) (CSSI approval). The terms of the CSSI approval includes all works required to construct the Sydney Metro Waterloo Station. The CSSI approval also includes the construction of below and above ground works within the metro station structure for appropriate integration with the OSD.

With regards to CSSI related works, any changes to the 'metro station box' envelope and public domain will be pursued in satisfaction of the CSSI conditions of approval and do not form part of the scope of the concept SSD DA or detailed SSD DA for the OSD.

Except to the extent described in the EIS or Preferred Infrastructure Report (PIR) submitted with the CSSI application, any OSD buildings and uses do not form part of the CSSI approval and will be subject to the relevant assessment pathway prescribed by the EP&A Act.

The delineation between the approved Sydney Metro works, generally described as within the two 'metro station boxes' and surrounding public domain works, and the OSD elements are illustrated in Figure 5.

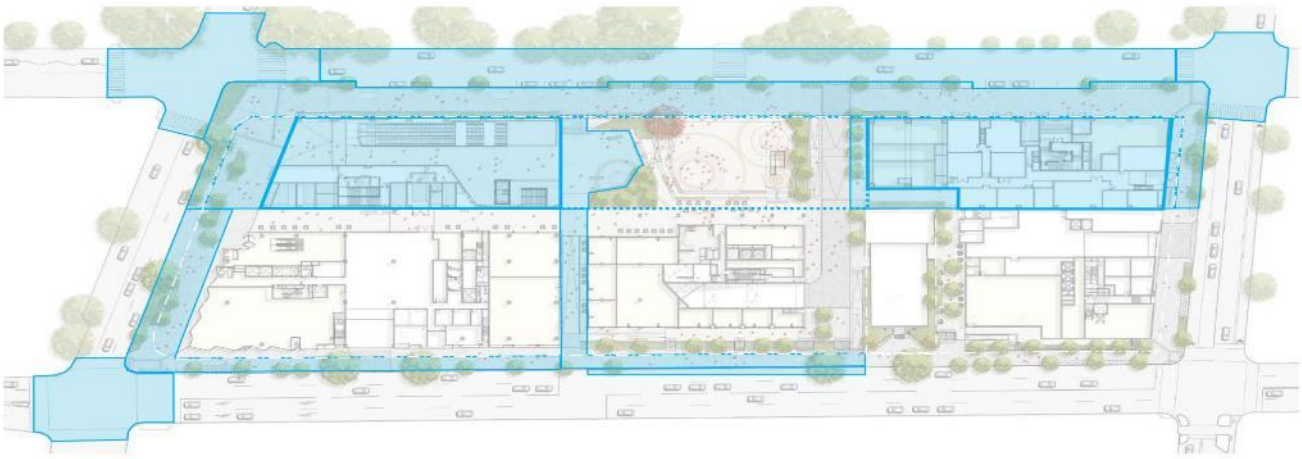

Figure 5 - CSSI Approval scope of works
Source: WL Developer Pty Ltd

5.3 Concept Approval (SSD 9393)

As per the requirements of clause 7.20 of the *Sydney Local Environmental Plan 2012* (SLEP), as the OSD exceeds a height of 25 metres above ground level (among other triggers), development consent is first required to be issued in a concept DA (formerly known as Stage 1 DA).

Development consent was granted on 10 December 2019 for the concept SSD DA (SSD 9393) for the Waterloo Metro Quarter OSD including:

- a maximum building envelope for podium, mid-rise and tower buildings
- a maximum gross floor area of 68,750sqm, excluding station floor space
- conceptual land use for non-residential and residential floor space
- minimum 12,000sqm of non-residential gross floor area including a minimum of 2,000sqm of community facilities
- minimum 5% residential gross floor area as affordable housing dwellings
- 70 social housing dwellings
- basement car parking, motorcycle parking, bicycle parking, and service vehicle spaces.

The detailed SSD DA seeks development consent for the OSD located within the Southern Precinct of the site, consistent with the parameters of this concept approval. Separate SSD DAs have been prepared and will be submitted for the Central Precinct Northern Precinct and Basement Car Park proposed across the Waterloo Metro Quarter site.

A concurrent amending concept SSD DA has been prepared and submitted to the DPIE which proposed to make modifications to the approved building envelopes at the northern precinct and central building. This amending concept SSD DA does not impact the proposed development within the southern precinct.

6. Proposed development

6.1 Waterloo Metro Quarter Development

The Waterloo Metro Quarter OSD comprises four separate buildings, a basement carpark and public domain works adjacent to the Waterloo Metro station.

Separate SSD DAs will be submitted concurrently for the design, construction and operation of each building in the precinct;

- Southern precinct SSD-10437,
- Basement Car Park SSD-10438,
- Central precinct SSD-10439, and
- Northern precinct-SSD-10440.

An overview of the Development is included below for context. This detailed SSD DA seeks development consent for the design, construction and operation of the Southern Precinct:

6.1.1 Southern Precinct

The Southern Precinct comprises:

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9 storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington Streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

6.1.2 Basement Car Park

The Basement Car Park comprises:

- 2-storey shared basement car park and associated excavation comprising
- Ground level structure
- Carparking for the Commercial Building 1, Residential Building 2, social housing Building 4, Waterloo Congregational Church and Sydney Metro
- Service vehicle bays
- commercial end of trip and bicycle storage facilities

- Retail end of trip and bicycle storage facilities
- residential storage facilities
- shared plant and services.

6.1.3 Central Precinct

The Central Precinct comprises:

- 24-storey residential building (Building 2) comprising approximately 126 market residential and 24 affordable housing apartments, to be delivered as a mixture of 1 bedroom, 2 bedroom and 3 bedroom apartments
- Ground level retail tenancies, community hub, precinct retail amenities and basement car park entry
- level 1 and level 2 community facilities (as defined in the SLEP) intended to be operated as a childcare centre
- landscaping and private and communal open space at roof top levels to support the residential accommodation
- new public open space including the delivery of the Church Square, including vehicle access to the basement via a shared way from Cope Street, expanded footpaths and public domain upgrades on Botany Road
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

6.1.4 Northern Precinct

The Northern Precinct comprises:

- 17-storey commercial building (Building 1) comprising Commercial floor space, with an approximate capacity of 4000 workers
- ground level retail tenancies, loading dock facilities serving the northern and central precinct including Waterloo metro station
- landscaping and private open space at podium and roof top levels to support the commercial tenants
- new public open space including the delivery of the Raglan Street Plaza, Raglan Walk and expanded footpaths on Raglan Street and Botany Road and public domain upgrades
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

7. Methodology

To assess the noise and vibration impacts of the proposed development (Southern Precinct), the following process was carried out:

- Identify and classify the surrounding noise and vibration sensitive receivers surrounding the proposed development;
- Identify and classify the noise and vibration sources generated by the proposed development, together with external noise and vibration sources impacting on the proposed development;
- Review historical site noise investigations and carry out additional site noise investigations to quantify the background noise levels local to the proposed development;
- Determine the project noise and vibration criteria applicable to the proposed development in accordance with the requirements listed in the Secretary's Environmental Assessment Requirements (SEARs), Waterloo Design and Amenity Guidelines dated March 2020 and Concept DA Conditions (SSD 9393);
- Assess the operational and construction noise and vibration impacts of the noise and vibration sources generated by the proposed development to the surrounding noise-sensitive receivers (including the Waterloo Congregational Church), together with any impacts on the occupants of the proposed development; and
- Provide details of mitigation measures required to alleviate noise and vibration impacts to achieve the project noise and vibration criteria.

The following operational noise and vibration assessments were conducted as part of this noise and vibration impact assessment:

- Noise impact of Botany Road on the student accommodation and residential apartments located within the Southern Precinct (closed and open windows assessment)
- Noise and vibration impacts of mechanical plant and equipment serving the proposed development on surrounding noise and vibration sensitive receivers (including the Waterloo Congregational Church);
- Noise and vibration impacts of the operation of the gym located on Level 1 and Level 2 within Building 3 on surrounding noise and vibration sensitive receivers;
- Noise impacts of additional traffic on surrounding local roads generated by the proposed development;
- Noise and vibration impacts of the Sydney Metro rail corridor on the structure of the proposed development, together with the occupants of the residential apartments; and
- Noise impacts of additional traffic on surrounding local roads generated by the proposed development.

The following construction noise and vibration assessments were conducted as part of this noise and vibration impact assessment:

- Noise generated during the construction of the proposed development and associated impacts on the surrounding noise sensitive receivers; and
- Vibration generated during the construction of the proposed development and associated impacts on the surrounding vibration sensitive receivers.

The noise and vibration assessments conducted as part of this report have been assessed to the noise and vibration criteria established by NSW Environment Protection Authority (EPA). In addition

to this, the noise and vibration assessments have been conducted considering the cumulative effects of the other precincts within the Waterloo Metro Quarter Development, these being:

- Northern Precinct
- Central Precinct
- Waterloo Integrated Station Development (ISD)
- Line-wide (trackform design)

Many of the noise and vibration sources within the OSD are shared amongst a common basement, and the equipment generating the noise and/or vibration serves many of the precincts under separate SSD DA's. The sources of noise and vibration within the OSD that have been assessed for the Southern Precinct in this SSD DA are:

- Mechanical plant and equipment located on Level 24 of Building 3
- Mechanical plant and equipment located on Level 9 of Building 4
- Loading dock activities located on Ground Floor of Building 3
- Increase in noise emissions of local roads due to traffic generated by the proposed development
- Construction of the structure and facade of the Central Precinct (Building 2) from Ground Level to the Rooftop

8. Site Noise Investigations

Site noise investigations were conducted to obtain background noise levels at the surrounding noise sensitive receivers together with characteristic noise emissions statistics associated with vehicle movements along Botany Road.

The results of the site noise investigations were acquired from a combination of noise monitoring conducted by Stantec Australia between the 7th and 13th April 2020, and previous noise monitoring conducted by SLR Consulting and presented in their report for the Waterloo Station Development EIS (Appendix N) dated 9 November 2019 accompanying the Concept SSD DA (SSD 9393), as these results were obtained prior to the COVID-19 pandemic and are a better representation of the traffic noise and typical background levels under typical conditions.

8.1 Historical Site Noise Investigations

Forming part of the Concept SSD DA (SSD 9393), both attended and unattended site investigations were conducted by SLR Consulting in November 2019, presented in their report for the Waterloo Station Development EIS (Appendix N) dated 9 November 2019. The results of these measurements are summarised below. As discussed above, the site investigations previously conducted by SLR Consulting are important because the results of the monitoring were obtained prior to the COVID-19 pandemic. The results of the monitoring conducted will be more relevant to typical background noise and traffic noise characteristic of the area.

8.1.1 Instrumentation

It is noted in the SLR Consulting Report that the following equipment was used for the noise surveys:

- Combination of Svantek 957 and Bruel and Kjaer 2250L noise loggers with serial numbers:
  S/N:20663
  S/N:3004636
  S/N:3003632
  S/N:3005908
  S/N:3005904
  S/N:3003389
- Brüel and Kjær 2270 Precision Sound Level Meter (S/N:3008204)

SLR consulting also notes:
Calibration of the sound level meter was checked before and after each measurement and the variation in calibration at all locations was found to be within acceptable limits at all times

8.1.2 Locations

The locations of noise monitors installed by SLR Consulting referenced in the Waterloo Station Development EIS (Appendix N) dated 9 November 2019 are shown in Figure 6 and listed in Table 4 below:

Noise Monitoring Location ID	Noise Monitoring Location Address	Equipment Serial Number
L1	1 Phillip Street, Waterloo	20663
L2	3 Phillip Street, Waterloo	3004636
L3	200 Pitt Street, Waterloo	3003632
L4	113 Wellington Street, Waterloo	3005908
L5	130 Botany Road, Waterloo	3005904
L6	34 McEvoy Street, Waterloo	3003389

Table 4 - SLR Consulting long-term noise measurement locations

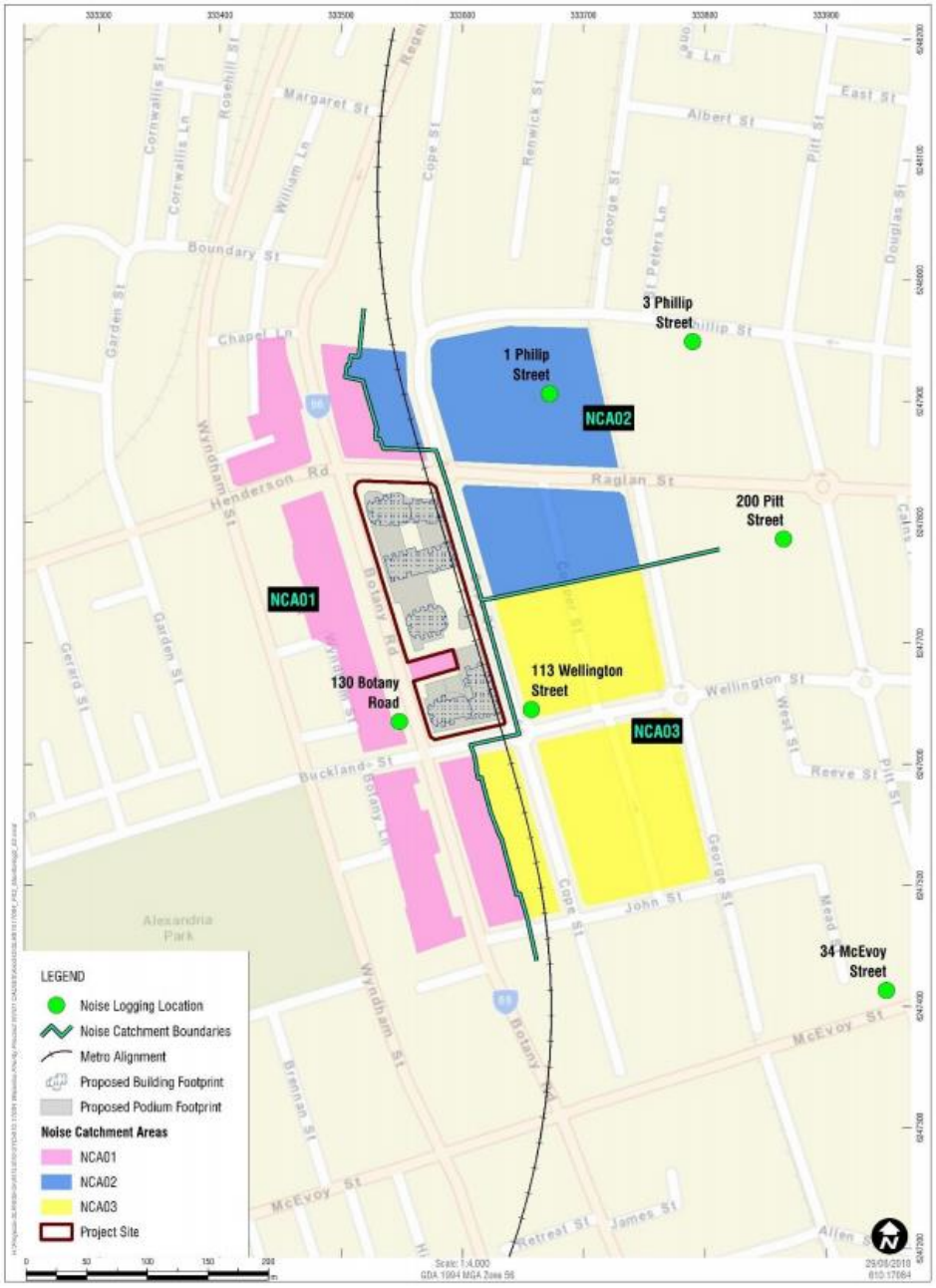

Figure 1 - Measurement locations conducted by SLR Consulting

8.1.3 Long-Term (Unattended) Noise Surveys

Outlined in SLR Consulting report, the results of the unattended ambient surveys are summarised in Table 5 as the Rating Background Level (RBL) noise levels for the Noise Policy for Industry (NPI) daytime, evening and night-time periods, and the LAeq (energy averaged) noise levels for the DoP Interim Guideline daytime and night-time periods

The 24 hour daily noise levels at each monitoring location are presented in Section 15.9.1 (Appendix 9 – Daily Long-Term (Unattended) Survey Results) of this report.

Noise Monitoring Location	Measured Noise Level (dB)							
	NPI Time Periods[1]						DoP Interim Guideline Time Periods[2]	
	Daytime – RBL	Evening - RBL	Night-time – RBL	Daytime - L_{Aeq}	Evening - L_{Aeq}	Night-time - L_{Aeq}	Daytime - $L_{Aeq(15hr)}$	Night-time - $L_{Aeq(9hr)}$
L1	50	46	40	57	53	50	56	51
L2	48	42	38	57	52	50	56	50
L3	47	43	37	61	58	59	60	59
L4[3]	50	46	41	65	57	54	64	54
L5	60	58	46	72	70	69	72	69
L6[4]	Failed	-	-	-	-	-	-	-

Table 5 - Long-term noise measurement summary conducted by SLR Consulting

Note 1: Noise Policy for Industry (NPI) assessment periods – Daytime: 7:00 am to 6:00 pm Monday to Saturday, 8:00 am to 6:00 pm Sundays and Public Holidays; Evening: 6:00 pm to 10:00 pm; Night: 10:00 pm to 7:00 am Monday to Saturday, 10:00 pm to 8:00 am Sundays and Public Holidays.

Note 2: DoP Interim Guideline Assessment Time Periods – Day: 7.00 am to 10.00 pm; Night: 10.00 pm to 7.00 am (weekly data).

Note 3: Attended noise measurements at this location identified a bird feeder located on the wall of the residential building. This was not identified at the time the noise logger was deployed as it was raining. At the time of the attended measurements the bird feeder attracted a large number of Rosellas which were generating noise levels over 100 dBA. This significant noise source is the reason that the DoP noise levels for L4 are higher than other comparable noise environment areas of the Waterloo project area.

Note 4: The noise logger at location L6 was damaged during the logging survey and no data was recorded.

8.1.4 Short-Term (Attended) Noise Surveys

Short-term (attended) noise surveys have been conducted by SLR Consulting. The results of these surveys are outlined in Table 6.

Measurement Location	Measured Noise Level (dB)[2]			Description of Ambient Noise Source during attended period
	L_{A90}	L_{Aeq}	L_{Amax}	
1 Phillip Street	48	58	75	Constant nature sounds with regular pedestrian movements. Intermittent traffic from Raglan Street and Phillip Street. Aircraft pass-bys are dominant sound source when present.
3 Phillip Street	52	61	85	Constant nature sounds with regular pedestrian movements. Intermittent traffic from Phillip Street. Dominant sound source is landscaping works in the area and aircraft pass-bys when present. It is expected that landscaping noise would not be present during night-time periods.
200 Pitt Street	55	62	81	Intermittent traffic noise from Raglan Street, particularly from vehicles travelling uphill. Landscaping works are dominant sound source during measurement. It is expected that landscaping noise would not be present during night-time periods.
34 McEvoy	58	66	80	Dominant sound source McEvoy Street traffic, with occasional pedestrian activity. Limited aircraft passbys during measurement.
113 Wellington Street	51	63	92	Constant parrot activity during measurement. Intermittent traffic noise from Wellington Road with some aircraft passby noise. Limited pedestrian activity.
130 Botany Road[1]	65	73	88	Traffic noise from Botany Road is dominant sound source, with limited aircraft passby.

Table 6 - Short-term noise measurement summary conducted by SLR Consulting

Note 1: Monitoring location near to building facade. Measured noise levels considered to represent facade affected noise levels which are up to 2.5 dBA higher than the equivalent free-field condition

Note 2: Measured Noise Level is rounded to the nearest whole number

8.2 Current Site Noise Investigations

Site surveys have been conducted by Stantec Australia to obtain current background noise levels. It should be noted that the site surveys were conducted during the COVID-19 pandemic. Please refer to Section 8.2.1 for further discussion surrounding consideration given to noise monitoring results affected by COVID-19.

Short-term and long-term noise surveys were carried out on and around the proposed development site to characterise the noise generated by nearby traffic noise sources (Botany Rd, Raglan St, and Wellington St), and background and ambient noise representative of the surrounding noise-sensitive receivers.

8.2.1 COVID-19 Pandemic and Effects on Noise Surveys

These noise surveys were carried out under noise-subdued circumstances as a result of the COVID-19 pandemic. For background and ambient noise, the noise statistics obtained will be lower than that of a typical day to day operation and hence can be considered the worst-case scenario.

For the traffic noise measurements, the noise statistics obtained will not be representative of typical traffic noise on Botany Road, Raglan Street, Wellington Street. As a result, the traffic noise measured on-site has been adjusted using comparisons between COVID-19 and standard peak hour traffic volumes on these roads.

8.2.2 Instrumentation

The following equipment was used for the noise surveys:

- ARL Environmental Noise Logger, NL-42EX, S/N 873125
- ARL Environmental Noise Logger, NL-42EX, S/N 521656
- ARL Environmental Noise Logger, NL-42EX, S/N 184109
- ARL Environmental Noise Logger, NL-42EX, S/N 184111
- ARL Environmental Noise Logger, NL-42EX, S/N 885460
- Hand-held sound spectrum analyzer BandK 2250, S/N 2709742;
- Sound Calibrator BandK Type 4231, S/N 2709826;

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

8.2.3 Locations

The site location, measurement positions and surrounding noise and vibration sensitive receivers are shown in Figure 2.

Figure 2 - Overview of the site, surrounding noise-sensitive receivers and measurement locations conducted by Stantec Australia

8.2.4 Long-Term (Unattended) Noise Surveys

Background Noise

Noise monitors were placed at position L1 and L5 as shown in Figure 2 measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. Noise monitors L1 and L5 were installed from the 7th to the 13th of April 2020. The results of the unattended background and ambient noise survey is shown in Table 7 below (for the day, evening and night periods).

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	61	57	50	44	42	36
L5	72	73	67	54	48	41

Table 7 - Long-term noise survey summary – Background noise (Stantec Australia Monitoring)

The local ambient noise environment is dominated by traffic noise from Botany Road throughout the majority of the day, evening and night periods. Note that any rain affected data during the period of logging has been excluded from the calculations. Refer to Figure 3 for the noise data for the total period of measurement.

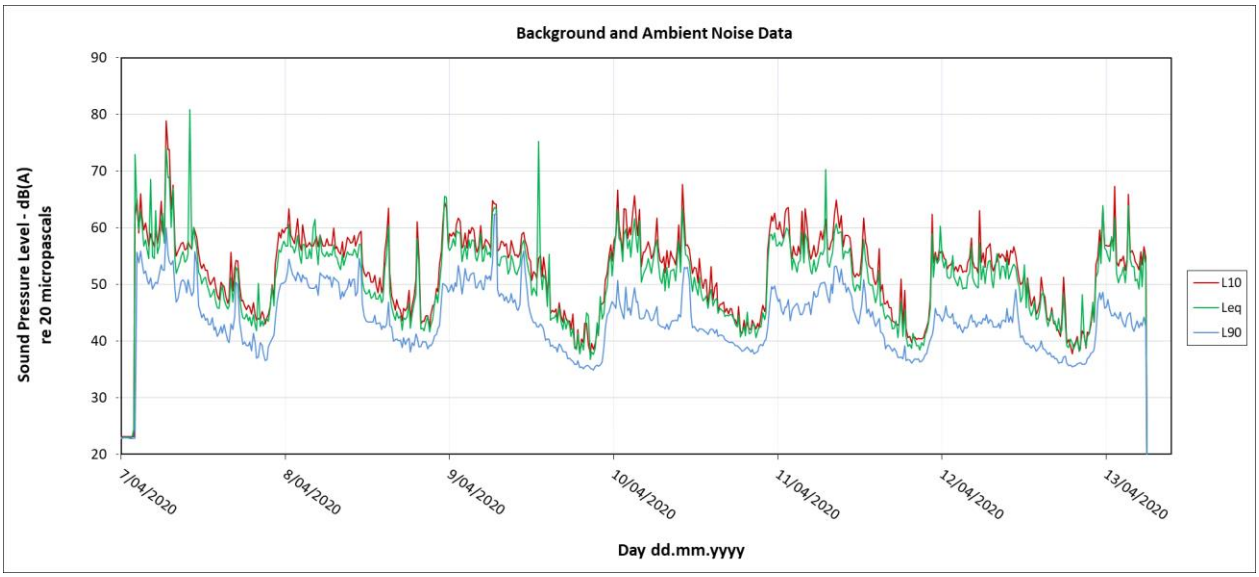

Figure 3 - Long-term background noise monitoring data – L1

Traffic Noise

Noise monitors were placed at positions L3, L4 and L5 as shown in Figure 2 to measure the noise generated by vehicle movements during the noisiest 1-hour day and the noisiest 1-hour night established in the Sydney DCP 2012, and the 15-hour day and 9-hour periods established in the DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline. Noise monitors L3, L4 and L5 were installed from the 7th to the 15th of April 2019. The results for the long-term traffic noise surveys are shown in Table 8 below (for the day and night periods).

Location	Equivalent Continuous Noise Level LAeq,period - dB(A)		Equivalent Continuous Noise Level LAeq,1hour - dB(A)	
	Day (15hr)	Night (9hr)	Day (Noisiest 1h)	Night (Noisiest 1h)
L3	73	59	75	61
L4	70	66	73	70
L5	73	67	76	71

Table 8 - Long-term noise survey summary – Traffic noise

Note 1: DoP Interim Guideline Assessment Time Periods – Day: 7.00 am to 10.00 pm; Night: 10.00 pm to 7.00 am (weekly data).

Note 2: Sydney DCP 2012 Assessment Time Periods – Day: All 24 hours; Night: 10.00 pm to 7.00 am (weekly data).

Note that any rain affected data during the period of logging has been excluded from the calculations. Refer to Figure 4 (L3), Figure 5 (L4) and Figure 6 (L5) for the noise data for the total period of measurement.

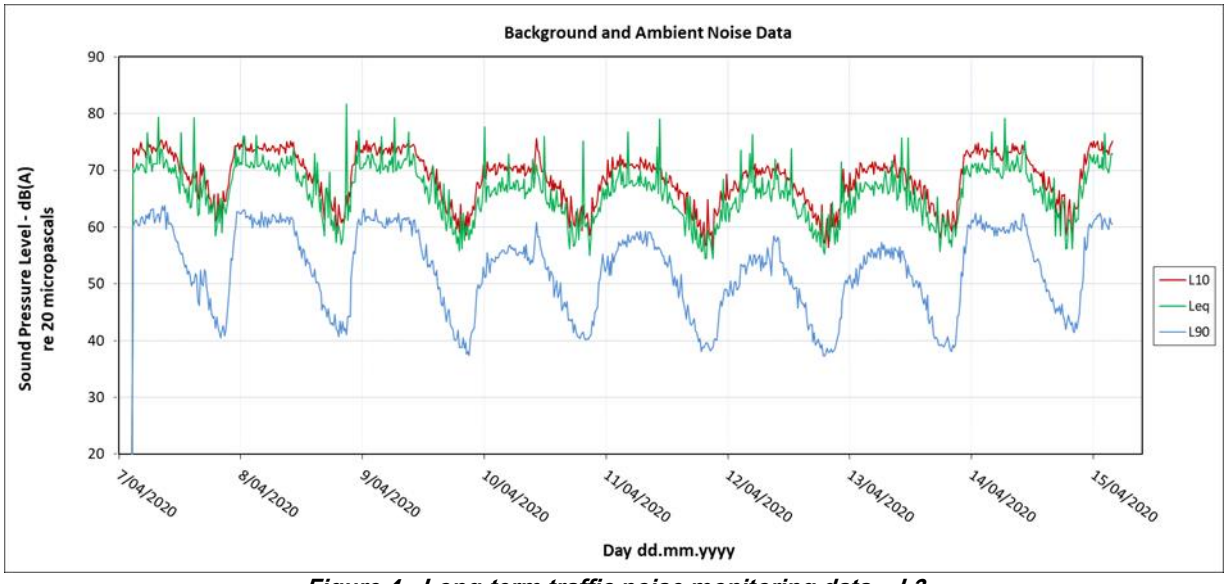

Figure 4 - Long-term traffic noise monitoring data – L3

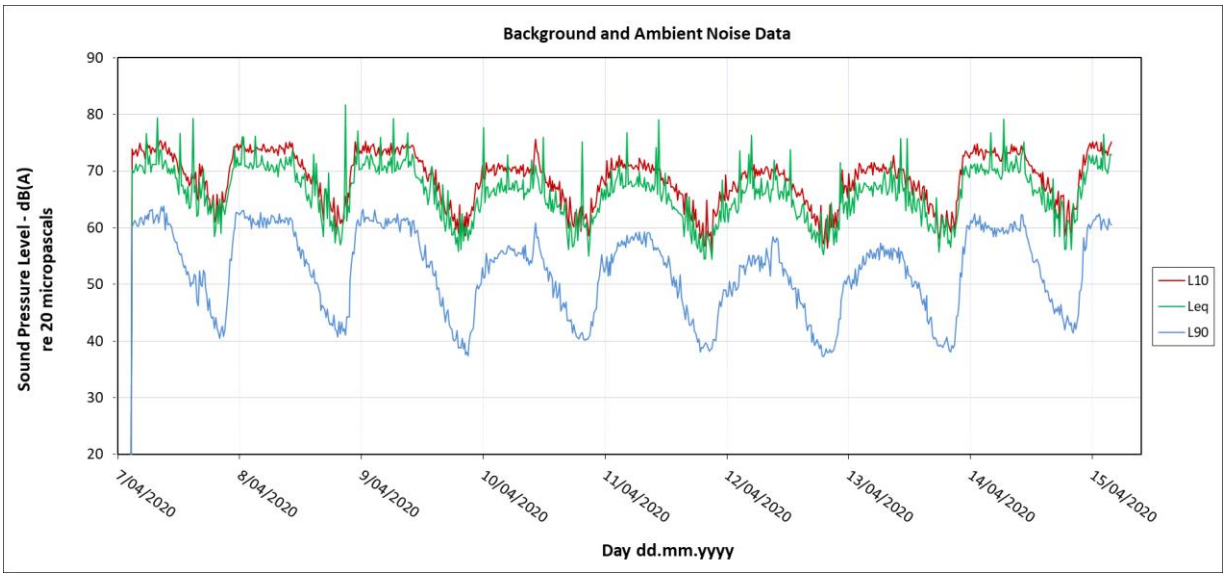

Figure 5 - Long-term traffic noise monitoring data – L4

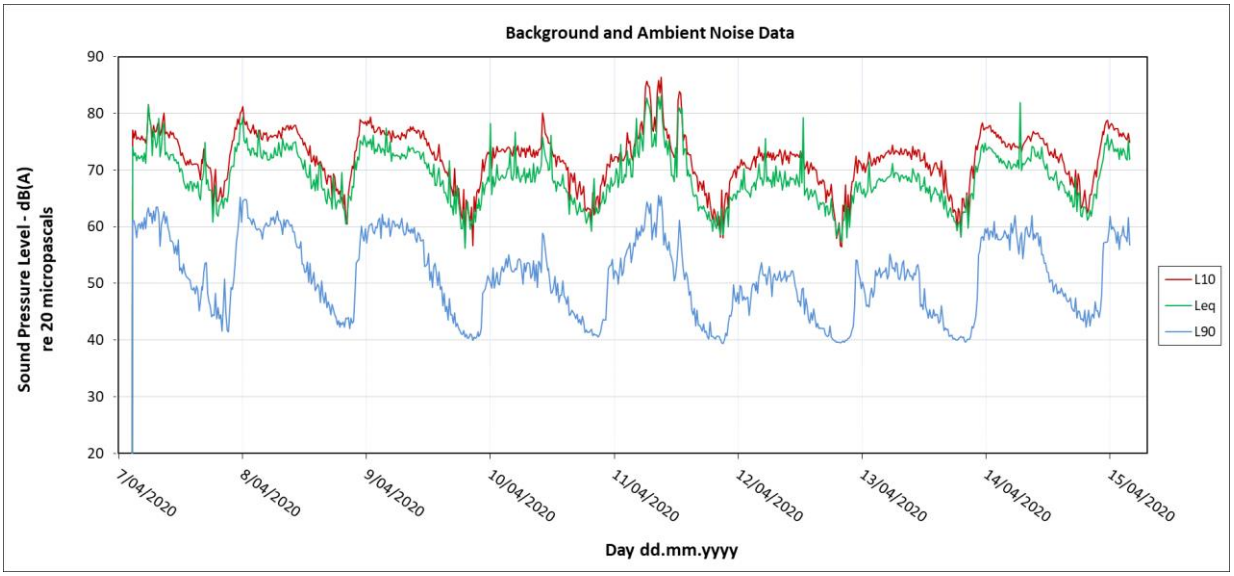

Figure 6 - Long-term traffic noise monitoring data – L5

The 24 hour daily noise levels at each monitoring location are presented in Section 15.9 (Appendix 9 – Daily Long-Term (Unattended) Survey Results) of this report.

8.2.5 Short-Term (Attended) Noise Surveys

Background Noise

Short-term noise measurements were conducted in the vicinity of surrounding noise-sensitive receivers to characterize the background and ambient noise associated with these receivers. The results of the background noise measurements conducted at locations P1 and P2 (see Figure 2 for location) are provided in Table 9.

The measurements were conducted at times either side of 7:00am to obtain the characteristics of the background noise in the area prior to the commencement of the

daytime period (daytime defined in the NPI, 7:00am – 6:00pm) and after the commencement of the daytime period.

Measurement Location	Measurement Time	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	Comments
P1	27/03/2020 6:21 AM	54	46	55	Constant nature sounds with intermittent pedestrian movements. Intermittent traffic from Cope Street.
P2	27/03/2020 7:27 AM	67	58	70	Constant bird activity and chirping during measurement. Intermittent traffic noise from Wellington Road. Limited pedestrian activity.

Table 9 - Short-term noise measurement summary conducted by Stantec

Traffic Noise

Short-term noise measurements of vehicle movements were carried out on Raglan Street, Botany Road and Henderson Road. A summary of the results of the short-term noise measurements of vehicle movements on these roads conducted at locations P3 – P6 is provided in Table 10.

The measurements were conducted at times either side of 7:00am to obtain the characteristics of the traffic noise in the area prior to the commencement of the daytime period (daytime defined in the DoP Interim Guideline, 7:00am – 10:00pm) and after the commencement of the daytime period.

Measurement Location	Measurement Time	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	Comments
P3	27/03/2020 7:07 AM	65	58	68	Dominant sound source is Raglan Street traffic, with occasional pedestrian activity. Limited aircraft passbys during measurement.
P4	27/03/2020 7:45 AM	72	62	74	Dominant sound source is Henderson Road traffic, with intermittent pedestrian activity.
P5	27/03/2020 8:19 AM	73	62	77	Dominant sound source is Botany Road traffic, with limited pedestrian activity. Construction works were being performed near-by.
P6	27/03/2020 6:45 AM	73	62	76	Intermittent sound source is Botany Road traffic, with limited pedestrian activity.

Table 10 - Short-term noise measurement summary conducted by Stantec

8.3 Summary of Noise Investigations

The site noise investigations are a key piece of information when understanding the existing ambient noise environment characteristic of the surrounding receivers to the proposed development. For the nominated criteria outlined in Section 9.2.2 where the measured results are required as the basis of the criteria, historical site noise investigation results, have been used because this more accurately reflects the ambient noise level for each noise catchment area (historical site noise investigation results were not affected by COVID-19 pandemic). We have delineated the various environments into Noise Catchment Areas (NCAs) together with the Integrated Station Development and the other buildings assessed in separate SSD DAs within the OSD precinct, which is outlined in Figure 7. The summary of the receivers within these catchments include:

- NCA01 - Mix of commercial and retail receivers
- NCA02 - Residential receivers
- NCA03 - Residential receivers
- SSD-10440 – Northern Precinct
- SSD-10439 – Central Precinct
- SSI-7400 – Integrated Station Development
- Waterloo Congregational Church

Figure 7 - Noise Catchment Areas (NCA)

9. Project Noise and Vibration Criteria

9.1 Relevant Noise and Vibration Assessment Documents

The project noise and vibration criteria has been established considering the following documents:

- Sydney Development Control Plan (DCP) 2012;
- State Environmental Planning Policy (SEPP) (Infrastructure) 2007;
- DoP – Development near Rail Corridors and Busy Roads – Interim Guideline;
- Noise and Vibration Impact Assessment prepared by SLR Consulting dated 09 November 2018 accompanying the Concept SSD DA (SSD 9393);
- City of Sydney's Draft Alternative Natural Ventilation of Apartments in Noise Environments – Performance Pathway Guideline
- NSW EPA Noise Policy for Industry (NPI) 2017
- NSW Apartment Design Guide 2015;
- Waterloo Metro Quarter Design and Amenity Guidelines;
- NSW Road Noise Policy, 2011 (RNP 2011);
- NSW EPA Interim Construction Noise Guideline 2009;
- Assessing vibration: A technical guideline 2006;
- British Standard BS5228 – Part 1:1997 "Noise and Vibration Control on Construction and Open Sites.";
- British Standard BS7358:1993 "Evaluation and Measurement for Vibration in Buildings" – Part 2: "Guide to Damage Levels from Groundborne Vibration"; and
- German Standard DIN4150 – Part 3: "Structural vibration in buildings – Effects on structures".
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development

9.2 Operational Noise Criteria

9.2.1 Internal Noise Levels

Design & Amenity Guideline – 3L Residential Amenity

The *Waterloo Metro Quarter Design & Amenity Guideline* aims to create a vibrant, mixed use centre that serves as a gateway to Waterloo with high quality public domain and built form that is distinctive and responds to the local character, place and context. The Waterloo Design and Amenity Guidelines are intended to support integrated development with Waterloo Station, referred to as integrated station development. It should be noted that the proposed development is within the precinct known as the Over-Station Development.

Whilst Waterloo Station has been approved under Critical State Infrastructure Application No. CSSI 15-7400 ("CSSI Approval"), the Guideline is intended to provide a precinct approach to support detailed design of the development and address the interface with the station. The public domain elements will be delivered across both the CSSI Approval and State Significant Development application for the Metro Quarter (SSD-9393).

Part 3L "Residential amenity" of the Guideline provides guidance on the selection of internal noise criteria for all uses within the proposed development. The Guideline states:

- *"Noise amenity to be confirmed against the following requirements:*

1. *Clause 3.6 of the Development Near Rail Corridors and Busy Road – Interim Guideline for Noise Criteria for all uses including windows closed and*
1. *Clause 4.2.3.11 of Sydney DCP 2012 for windows and doors open*

The project internal noise limits have been established in the next section on the basis of Part 3L "Residential amenity" of the Guideline stated above.

Sydney Development Control Plan (DCP) 2012

The *Sydney DCP 2012* states the following with regards to internal noise limits for the residential spaces within the proposed development:

"The repeatable maximum LAeq (1 hour) for residential buildings and serviced apartments must not exceed the following levels:

- *for closed windows and doors:*

1. *35dB for bedrooms (10pm-7am); and*
2. *45dB for main living areas (24 hours)*

- *for open windows and doors:*

1. *45dB for bedrooms (10pm-7am); and*
2. *55dB for main living areas (24 hours)"*

Where natural ventilation of a room cannot be achieved, the repeatable maximum LAeq (1hour) level in a dwelling when doors and windows are shut and air conditioning is operating must not exceed:

38dB for bedrooms (10pm-7am); and
48dB for main living areas (24 hours)"

In accordance with the Waterloo Metro Quarter Design and Amenity Guideline, noise amenity is to be confirmed against the open windows and doors requirement stated above. This has been considered when establishing the project internal noise limits in Table 13.

SEPP (Infrastructure) 2007 & Development Near Rail Corridors and Busy Roads – Interim Guideline

The *DoP's Development near Rail Corridors and Busy Roads – Interim Guideline* governs the required maximum internal noise levels averaged over particular time periods within bedrooms and living areas of apartments in the proposed development. The guideline details the application of clause 102 of the State Environmental Planning Policy (SEPP) Infrastructure which states the following for residential developments:

- *"If the development is for the purposes 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 LAeq levels are not exceeded:*

3. *In any bedroom in the residential accommodation – 35 dB(A) at any time between 10.00 pm and 7.00 am,*
4. *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time."*

The DoP's Development near Rail Corridors and Busy Roads – Interim Guideline also states the following in regards to an open windows (alternative means of ventilation) assessment:

- *"If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."*

Table 11 provides a summary of the internal noise limits for both windows closed and open established in Clause 3.6 "What Noise and Vibration Criteria Should Be Applied" of the DoP Interim Guideline. Note that the student accommodation is within the residential building and is classified as both a sleeping area and other habitable space and will therefore need to comply with both requirements.

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria dB(A)	Windows/Doors Open Criteria – dB(A)
Sleeping areas	10:00pm – 7:00am	LAeq,9h(night)	35	45
Other Habitable Rooms	At any time	LAeq,15h(day)	40	50

Table 11 - Summary of DoP's Interim Guideline criteria spaces adjacent to busy roads

In accordance with the Waterloo Design and Amenity Guidelines, noise amenity is to be confirmed against the closed windows and doors requirement stated above. This has been considered when establishing the project internal noise limits in Table 12 and Table 14.

Project Internal Noise Limits

Table 12 below outlines the project internal noise level targets for the development site-wide for the various metrics, summarising the internal noise level requirements from Section 9.2.1 for closed windows. For closed windows, the ISEPP 2007 criteria have been adopted in accordance with the Design & Amenity Guidelines.

Type of occupancy / activity	Metric	Standard	Noise Level Range dB(A)
Residential and Student Accommodation – Sleeping Areas	LAeq,9h (10pm – 7am)	ISEPP 2007	< 35
Residential and Student Accommodation - Other Habitable Rooms	LAeq,15h (At any time)	ISEPP 2007	< 40

Table 12 - Project internal noise limits – closed windows

Table 13 below outlines the project internal noise level targets for the development site-wide for the various metrics, summarising the internal noise level requirements from Section 9.2.1 for open windows.

Type of occupancy / activity	Metric	Standard	Noise Level Range dB(A)
Residential and Student Accommodation - Bedrooms	LAeq,1h,noisiest (10pm – 7am)	Sydney DCP 2012	< 45
Residential and Student Accommodation – Other Habitable Rooms	LAeq,1h,noisiest (24 hours)	Sydney DCP 2012	< 55

Table 13 - Project internal noise limits – open windows and doors

In instances where the internal noise limits cannot be achieved while windows are open to achieve natural ventilation, an alternative means of ventilation will need to be designed to provide ventilation to the noise-affected habitable spaces with windows closed, whilst simultaneously complying with the internal noise limits outlined in Table 14.

Type of occupancy / activity	Metric	Standard	Noise Level Range dB(A)
Residential and Student Accommodation - Bedrooms	LAeq,9h (10pm – 7am)	ISEPP 2007	< 45
Residential and Student Accommodation - Other Habitable Rooms	LAeq,15h (At any time)	ISEPP 2007	< 50

Table 14 - Project internal noise limits – closed windows & alternative means of ventilation operating

9.2.2 External Noise Emissions

NSW EPA Noise Policy for Industry (2017)

The *NSW Noise Policy for Industry* has been applied to address the noise emissions from the development to the surrounding noise-sensitive receivers. The NSW NPI sets out noise criteria to control the noise emission from industrial noise sources generated by the proposed development. Operational noise emissions from the development shall be addressed following the guideline in the NSW NPI.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established, the most stringent for each considered assessment period (day, evening, night) is adopted as the project noise trigger level (PNTL).

Intrusiveness Criteria

The NSW NPI states the following:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."

The intrusiveness criterion can be summarised as L_{Aeq}, 15 minute ≤ RBL background noise level plus 5 dB(A).

The noise surveys conducted by Stantec were taken during the COVID-19 pandemic, and hence the observed background levels (RBL) for Noise Catchment Area is noticeably lower than background levels taken by SLR Consulting. Therefore, the criteria outlined below are based on the SLR Consulting RBL's outlined in Table 5 of this report, with noise monitor 'L5; corresponding to NCA01 and 'L1' corresponding to NCA03.

Due to SLR consulting's long-term (unattended) results located at L4 (within NCA02) being affected by loud bird activity, the results recorded from noise monitor 'L3' have been used instead as this is more representative of the background noise level located within the noise catchment area (NCA02).

Receiver	Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
NCA02	Day (7:00am to 6:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	52
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min} \leq$ RBL + 5	42
NCA03	Day (7:00am to 6:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	55
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	51
	Night (10:00pm to 7:00am)	$L_{Aeq,15min} \leq$ RBL + 5	45
Central Precinct	Day (7:00am to 6:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	52
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min} \leq$ RBL + 5	42

Table 15 – NSW NPI intrusiveness criteria

Amenity Criteria

The NSW NPI states the following:

"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The recommended amenity noise levels have been selected on the basis of studies that relate industrial noise to annoyance in communities (Miedema and Voss, 2004).

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are reproduced below:

Receiver	Type of Receiver	Noise amenity area	Time of Day	L_{Aeq}, dB(A)	Project amenity noise level $L_{Aeq,period}$
				Recommended amenity noise level	
NCA01	Commercial	All	When in use	65	60
NCA02	Residential	Urban	Day	60	55
			Evening	50	45
			Night	45	40
NCA03	Residential	Urban	Day	60	55
			Evening	50	45
			Night	45	40
Central Precinct	Residential	Urban	Day	60	55
			Evening	50	45
			Night	45	40
Waterloo Congregational Church	Place of Worship	All	Day	50	57
			Evening	50	55
			Night	50	54

Table 16 - NSW NPI amenity criteria for external noise levels

Note 1: Urban area as defined in EPA NPI 2. 2.1.6.

Note that where the resultant project amenity noise level is 10dB or more lower than the existing industrial noise level the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

‘Modifying Factor’ Adjustments

The NSW NPI also states:

“Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level.”

In order to take into account the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Table C1 of Fact Sheet C of the NSW NPI (see Table 17 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method *(ISO1996.2-2007 – Annex D)*.	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note**: Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq,T}$ levels over same time period. Correction to be applied where the C minus A level is 15dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.
Intermittent Noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.\	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

Table 17 - Table C1 from the NSW NPI – Modifying factor corrections

Note 1: Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

Note 2: Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

Project Noise Trigger Levels

Refer to Table 18 for the NSW NPI project noise trigger levels for assessment of external noise emissions from the Metro Quarter Development. These project noise trigger levels (PNTLs) have been established in accordance with the NSW NPI and are in-line with those established in the SLR Consulting Acoustic Impact Assessment Report prepared as part of the Environmental Impact Statement accompanying the concept SSD Application for the OSD.

Receiver	Period	Descriptor	PNTL dB(A)
NCA01	Commercial Receivers		
	When in use	$L_{Aeq,15min}$	63
NCA02	Residential Receivers		
	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	55
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	43
NCA03	Residential Receivers		
	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	55
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	43
Central Precinct	Residential Receivers		
	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	55
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	43
Waterloo Congregational Church	Place of Worship		
	When in use – Day	$L_{Aeq,15min}$	60
	When in use – Evening	$L_{Aeq,15min}$	58
	When in use – Night	$L_{Aeq,15min}$	57

Table 18 - Project noise trigger levels (PNTL)

9.2.3 Traffic Noise Generation Criteria

The L_{Aeq} noise level or the "equivalent continuous noise level" correlates best with the human perception of annoyance associated with traffic noise.

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy which supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 19.

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

Table 19 - NSW Road Noise Policy – Traffic noise assessment criteria

If the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above.

If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2 dB above that of the corresponding 'no build option'.

9.3 Operational Vibration Criteria

9.3.1 Human Comfort

The NSW Environment Protection Authority (EPA) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

Continuous and Impulsive Vibration

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 20. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Offices, schools, educational institutions and place of worship	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
Offices, schools, educational institutions and place of worship	Day or night time	0.64	0.46	1.28	0.92

Table 20 - RMS values for continuous and impulsive vibration acceleration (m/s^2) 1-80Hz

9.3.2 Intermittent Vibration

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

Table 21 - Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

9.3.3 Cosmetic Damage

Table 22 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

Table 22 - Transient vibration guide values for cosmetic damage

9.3.4 Structural Damage

Ground vibration criteria is defined in terms of the levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 23 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

*For frequencies above 100Hz, at least the values specified in this column shall be applied

Table 23 - Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

9.4 Construction Noise Criteria

9.4.1 Interim Construction Noise Guideline (ICNG)

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (ICNG July 2009) under the NSW Environment Protection Authority (EPA), together with the City of Sydney's Construction Hours/Noise within the Central Business District – Code of Practice 1992. It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

In undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. The construction noise limits are presented in Table 24, and are applicable to the proposed development.

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Council's Hours: Mon – Fri (7:30am – 5:30pm) Sat (7:30am – 3:30pm) No work on Sunday and Public Holidays	Noise Affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ 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 residences 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 in, taking into account: ◦ Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2. of the ICNG

Table 24: Construction Noise Criteria at Residences

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

Table 25 below (Section 4.1.3 of the ICNG) sets out the noise management levels for other land uses, including commercial premises. The external noise levels should be assessed at the most affected occupied point for commercial and industrial uses, and at the most affected point within 50 metres of the area boundary for parks.

Land Use	Management Level, LAeq,15min – applies when land use is being utilized
Passive recreation, parks	External noise level 60 dB(A)
Places of worship	Internal noise level 45 dB(A) / External noise level 55 dB(A)
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)

Table 25 - Construction Noise Criteria for Other Land Uses

Based on the criteria in the tables above, the following noise management levels in Table 26 should be applied to the receivers within the Noise Catchment Areas outlined in Section 8.3. Construction during standard hours has been assumed.

Land Use	Receiver	Management Level, $L_{Aeq,15min}$
Commercial	NCA01	70 dB(A)
Place of worship	Waterloo Congregational Church	55 dB(A)
Residential	NCA02	50 dB(A) + 10 dB = **60 dB(A)**
	NCA03	47 dB(A) + 10 dB = **57 dB(A)**
Residential (Outside Recommended Standard Hours)	NCA02	50 dB(A) + 5 dB = **55 dB(A)**
	NCA03	47 dB(A) + 5 dB = **52 dB(A)**
Commercial	ISD (North and South)	70 dB(A)

Table 26 - Project Specific Construction Noise Management Levels

It is important to note that operation falling outside the standard hours recommended within the ICNG will be assessed under the Outside Recommended Standard Hours criteria.

9.5 Construction Vibration Criteria

It is important for vibration emissions from vibration-intensive equipment utilized during the construction works be managed to maintain appropriate levels of human comfort, and to avoid both cosmetic and structural damage. The vibration limits proposed in the ensuing sub-sections aid in achieving this outcome.

9.5.1 Human Comfort

The office of Environment and Heritage (OEH) developed a document, "Assessing vibration: A technical guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels from construction and operation of a development within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

Continuous & Impulsive Vibration

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 27. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Location	Receiver	Assessment period[1]	Preferred values		Maximum values	
			z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration						
Residences	NCA02 NCA03	Daytime	0.010	0.0071	0.020	0.014
		Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and place of worship	NCA01 Waterloo Congregational Church, ISD (North and South)	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration						
Residences	NCA02 NCA03	Daytime	0.30	0.21	0.60	0.42
		Night-time	0.10	0.071	0.20	0.41

Location	Receiver	Assessment period[1]	Preferred values		Maximum values	
			z-axis	x- and y-axis	z-axis	x- and y-axis
Offices, schools, educational institutions and place of worship	NCA01 Waterloo Congregational Church, ISD (North and South)	Day or night time	0.64	0.46	1.28	0.92

Table 27: Preferred and maximum weighted RMS values for continuous and impulsive vibration (m/s^2)

Intermittent Vibration

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Location	Receiver	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
		Preferred value	Maximum value	Preferred value	Maximum value
Residences	NCA02 NCA03	0.20	0.40	0.113	0.26
Offices, schools, educational institutions and place of worship	NCA01 Waterloo Congregational Church, ISD (North and South)	0.40	0.80	0.40	0.80

Table 28: Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

9.5.2 Cosmetic Damage

Table 29 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

Table 29: Transient vibration guide values for cosmetic damage

9.5.3 Structural Damage

Ground vibration criteria is defined in terms of the levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 30 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

Table 30: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

9.5.4 Project Construction Vibration Limits

Table 31 indicates the vibration criteria for the nearest residential properties to the development.

Receiver	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s^2 (RMS)		Intermittent $m/s^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
NCA02, NCA03	Daytime	10 - 20	7 - 14	0.20 - 0.40	5
	Night time	7 - 14	5 - 10	0.13 - 0.26	5
NCA01	At any time	64 - 125	46- 92	0.40 - 0.80	20
Waterloo Congregational Church	At any time	64 - 125	46- 92	0.40 - 0.80	3
ISD (North and South)	At any time	64 - 125	46- 92	0.40 - 0.80	20

Table 31 - Construction vibration criteria summary

10. Operational Noise and Vibration Assessment

10.1 Cumulative impacts

The outcomes of each of the assessments within Section 10 have hence considered the cumulative noise and vibration impacts from the precincts within the Waterloo Metro Quarter Development, particularly the increase in noise on the local road network associated with traffic generated by the proposed development.

10.1.1 Traffic Generation Noise Impact Assessment

For the road traffic noise assessment, existing peak hour traffic count and traffic generation for the site was based on the Traffic Impact Assessment prepared by "ptc.". This data has been used to calculate the expected noise increase due to traffic associated with the development onto Botany Rd, Wellington St, Raglan Rd and Cope St. The results are summarized in Table 32.

Location	Existing vehicles	Existing vehicles	Predicted Increase	Predicted Increase	Noise Level Increase dB	Noise Level Increase dB
	AM	PM	AM	PM	AM	PM
Botany Road	2,064	1,913	84.1	78	0.2	0.2
Wellington Street	254	342	19.3	22.9	0.3	0.3
Cope Street	122	145]	42.9	22	1.3	0.6
Raglan Road	532	606	40	43.1	0.	0.3
Henderson Street	1,876	2,016	92.6	91.8	0.2	0.2

Table 32: Existing and predicted traffic noise generation (peak hour)

Based on the results of the assessment, there is predicted to be less than a 1.3dB increase in traffic noise levels. Therefore, the proposed development is expected comply with the requirements of the NSW Road Noise Policy because the predicted increase is less than 2dB.

10.2 Road Noise Impact Assessment

10.2.1 Noise Modelling and Assumptions

In order to provide acoustic amenity to occupants of the proposed development and comply with the project specific internal noise limits, the noise impacts of surrounding roads (particular Botany Road) was assessed at the façade of the residential apartments within the proposed development.

3D acoustic modelling for noise emissions from the surrounding roads was conducted using the software SoundPlan (Version 8.1). Noise emissions and impacts from vehicle movements on the surrounding busy roads (Botany Road) were modelled in accordance with the CoRTN prediction techniques and calibrated to measurements and logger data from around the site.

This model is recognised by regulatory authorities around Australia and is endorsed by the NSW DPIE for use in projects of this scale. The acoustic modelling was undertaken considering specific meteorological characteristics such as wind speeds, prevailing wind directions and temperature in accordance with the hourly weather data for a full calendar year described in the Test Reference Year for Mascot 1987 (94767 Mascot (Syd AMO) 1978-87 1987).

3D modelling was implemented in this specific situation because of the complexity of integrating all noise sources and types of noise sources to develop an overall incident façade noise level. Attenuation due to distances, building shielding and environmental absorption, together with additional noise incident on the façade due to façade reflections are taken into account within the 3D model. The results of the 3D modelling are provided in Section 15.2 (in the form of façade noise contours), showing the incident noise levels on the façade as a result of noise emissions from the external noise sources mentioned above. The incident noise levels are presented in both the $L_{Aeq,1h}$ and $L_{Aeq,15h/9h}$ statistical forms for the purpose of demonstrating compliance with the Sydney DCP 2012 and DoP Interim Guideline limits.

10.2.2 Closed Windows Assessment

The general limiting factor of the performance of a building façade in term of noise attenuation is the glazing. In the case of the proposed development, the traffic noise on Botany Road places the largest acoustic demand on the facades' of the residential apartments.

In order to achieve the project internal noise limits established in Section 9.2.1, noise mitigation measures have been provided in Section 12.1.1.

10.2.3 Open Windows Assessment

An open windows assessment has been conducted to assess whether the habitable spaces can meet the project internal noise limits established in Section 9.2.1 with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the National Construction Code 2019 and Apartment Design Guide).

If there is an exceedance of the project internal noise limits with the windows open, the habitable space is considered noise-affected and an alternative means of ventilation is required in accordance with the requirements of the National Construction Code 2019 (i.e. an alternative ventilation system complying with AS 1668.2 and AS/NZS 3666.1). Together with the aforementioned performance requirement, we have also nominated the proposed development to meet the performance recommendations of the City of Sydney's Draft Alternative Natural Ventilation of Apartments in Noise Environments – Performance Pathway Guideline. These performance recommendations shall assist the proposed development in achieving sustainable natural ventilation outcomes.

The assessment has been conducted under the assumption the occupant has opened their windows to achieve natural ventilation (and as recommended in the DP&E Interim Guideline). That is, when the windows are open to 5% of the floor area of the room being ventilated, with a reduction of incident noise level to internal noise level of 10dB(A). Room loss has also been considered.

The locations of all noise-affected habitable spaces are indicated on the drawings provided in Section 15.4. Each noise-affected habitable space will require an alternative means of ventilation. All habitable spaces that have not been identified on the drawings have may rely on opening their windows to achieve the natural ventilation requirements of the National Construction Code 2019 and Apartment Design Guide while simultaneously complying with the project internal noise limits outlined in Section 9.2.1.

In order to achieve the project internal noise limits established in Section 9.2.1 whilst simultaneously achieving the natural ventilation requirements outlined in the City of Sydney's Draft Alternative Natural Ventilation of Apartments in Noise Environments – Performance Pathway Guideline, mitigation measures have been proposed in Section for the residential apartments.

10.3 Mechanical Plant & Equipment Noise Emissions

This assessment has considered the noise emissions from the mechanical plant serving the internal spaces of the development. These noise sources have been used to predict the worst-case scenario noise impact of the proposed use of the site to the nearby receivers within noise catchment areas NCA01 and NCA02, as well as the commercial receivers located within the Northern Precinct and residential receivers within the Southern Precinct of the OSD. The assessment has been conducted to achieve noise levels as per the NSW NPI. Both have been assessed at the most affected external point at the surrounding residential and commercial receivers.

In order to assess the worst-case scenario, it was assumed that the mechanical services associated with the development are running at any time throughout the daytime. While exact equipment has not been selected for the project, the sound power levels provided in Table 33 have been assigned to each significant plant and equipment item, based on typical noise emissions data for plant and equipment of the sizes indicated.

For our assessment we have assumed the following mechanical plant and equipment is located within the rooftop plantroom:

- Condenser Units
- Heat Pumps

Plant and Equipment	Sound Power Level re 10^{-12} W, dB – Octave Band Centre Frequency								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Condenser Units	70	73	69	67	67	61	55	49	70
Heat Pumps	104	108	104	99	93	88	83	76	101

Table 33 - Typical sound power levels of mechanical equipment and plant

The noise generated by the mechanical plant and equipment within the rooftop plantroom has been assessed to the noise-sensitive receivers surrounding the proposed development within the noise catchment areas (and specifically the rooftop plantroom), with consideration given to the following assumptions:

- The mechanical plant and equipment will be operating during all periods in any given day
- The load demanded of the mechanical plant and equipment will be reduced to approximately 60% during the evening period (6:00pm – 10:00pm) and 40% during the night-time period (10:00pm – 7:00am)

Table 34 provides a summary of the results of the noise impact assessment of the mechanical plant and equipment. The noise generated by the plant and equipment has been assessed with and without the noise mitigation measures outlined in Section 12.2.

Receiver	Period	Predicted Noise Level LAeq,15min - dB(A) Without Mitigation	Predicted Noise Level LAeq,15min - dB(A) With Mitigation	PNTL LAeq,15min - dB(A)	Compliance (Yes/No)
NCA01	When in use	18	6	63	Yes, with and without mitigation
NCA02	Day	51	45	55	Yes, with and without mitigation
	Evening	45	39	48	Yes, with and without mitigation
	Night	40	34	43	Yes, with and without mitigation
NCA03	Day	47	37	55	Yes, with mitigation
	Evening	41	31	51	Yes, with mitigation
	Night	36	26	45	Yes, with mitigation
Central Precinct (Residential)	Day	54	49	55	Yes, with mitigation
	Evening	48	43	48	Yes, with mitigation
	Night	43	38	43	Yes, with mitigation
Waterloo Congregational Church	Day	46	42	47	Yes, with and without mitigation
	Evening	40	36	45	Yes, with and without mitigation
	Night	35	31	44	Yes, with and without mitigation

Table 34 - Summary of results of mechanical noise impact assessment (with and without mitigation)

Based on the results of the assessment of the noise generated by the rooftop mechanical plant and equipment, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 upon implementation of the mitigation measures outlined in Section 12.2.

10.4 Stand-By Emergency Generator Noise Emissions

An assessment of the noise emissions of the generators has been conducted to investigate the noise impacts on the surrounding noise-sensitive receivers.

The assessment has been conducted under the following assumptions:

- Three (3) generators running under emergency operation (worst-case scenario);
- Generators operating during the night-time period (worst-case scenario)
- Each generator is housed in an acoustic canopy (see Section 12.2), where the sound pressure level measured at 7 metres under 100% load is 76dB(A); and
- Spectral noise emissions data are in-line with the values presented in Table 35.

Item	Sound Pressure Level @ 7m re $2x10^{-5}$ Pa, dB – Octave Band Centre Frequency								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Generator	67	92	96	98	98	97	94	96	76

Table 35 - Sound pressure level (measured at 7 metres) of a generator with an acoustic canopy

Table 36 provides a summary of the results of the noise impact assessment of the mechanical plant and equipment. The noise generated by the plant and equipment has been assessed with and without the noise mitigation measures outlined in Section 12.2.

Receiver	Predicted Noise Level $L_{Aeq,15min}$ - dB(A) Without Mitigation	Predicted Noise Level $L_{Aeq,15min}$ - dB(A) With Mitigation	PNTL (Night-time) $L_{Aeq,15min}$ - dB(A)	Compliance (Yes/No)
NCA01	35	22	63	Yes, with and without mitigation
NCA02	35	22	42	Yes, with and without mitigation
NCA03	31	17	45	Yes, with and without mitigation
Central Precinct (Residential, North Facade)	52	36	42	Yes, with mitigation

Table 36 - Summary of results of generator noise impact assessment (with and without mitigation)

Based on the results of the assessment of the noise generated by the generators, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 upon implementation of the mitigation measures outlined in Section 12.2.

10.5 Loading Dock & Waste Collection Impact Assessment

An assessment of the noise generated by activities within the Ground Level loading dock (such as garbage collections and deliveries) has been conducted to determine the impacts on the surrounding noise-sensitive receivers.

The loading dock is located within the Southern Precinct of the Waterloo Metro Quarter Development, where garbage and service vehicles enter via Wellington Road and exit via the use of a turntable within the loading dock. Table 37 outlines the sound power level (SWL) and typical duration (minutes) associated with each of the standard loading dock activities.

Loading Dock Activity	Typical Duration of Activity (minutes)	Sound Power Level $L_{Aeq,15min}$
Garbage truck unloading bins	2 minutes	88
Medium rigid truck accelerating	1 minute	72
Loading and Unloading Activities	10 minutes	88
Medium rigid truck idling on turntable	5 minutes	74

Table 37 - Typical sound power levels and durations of loading dock activities

The noise generated by the activities during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers, which are the commercial receivers located within NCA03. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises within NCA03 are summarised below in Table 38. The following assumptions have been made for the assessment:

- Service vehicles are assumed to be either medium rigid trucks or garbage trucks;b
- Two (2) service vehicle entering and exiting within a 15-minute period; and
- All medium rigid and garbage trucks will be entering and exiting at anytime in a 24hr period (day, evening and night-time periods).

Most Affected Noise Catchment Area	Predicted Noise Level No Mitigation $L_{Aeq,15min}$ - dB(A)	Predicted Noise Level with Mitigation $L_{Aeq,15min}$ - dB(A)	PNTL (Night time) $L_{Aeq,15min}$ - dB(A)	Compliance (Yes/No)
NCA03	42	15	45	Yes, with and without mitigation

Most Affected Noise Catchment Area	Predicted Noise Level No Mitigation $L_{Aeq,15min}$ - dB(A)	Predicted Noise Level with Mitigation $L_{Aeq,15min}$ - dB(A)	PNTL (Night time) $L_{Aeq,15min}$ - dB(A)	Compliance (Yes/No)
Nearest Affected Apartment from Proposed Development (BLDG3)	47	25	48	Yes, with and without mitigation

Table 38 - Predicted noise levels (with mitigation measures)

Based on the results of the assessment of the noise generated by activities within the Ground Level loading dock, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 upon implementation of the mitigation measures outlined in Section 12.3.

10.6 Metro Impact Assessment

10.6.1 Ground-borne noise / Regenerated Noise

An assessment for the ground borne noise, or regenerated noise, into the nearest affect residential spaces within the proposed development as a result of a train pass-by within the subterranean corridor has been conducted. Source vibration levels were provided by Sydney Metro.

The spectrum provided for this assessment is outlined in Table 39 below.

Velocity dB re 1nm/s – third-octave band centre frequencies (Hz)														
10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250
65	82	86	77	76	79	81	96	84	68	54	48	46	46	51

Table 39: Metro Station Vibration Spectrum - MOTIV Prediction

Based on the assessment and the structural concept design for the proposed development, the ground-borne noise generated within the residential spaces is predicted to comply with the requirements of the SEPP Infrastructure 2007 for both the residential areas (bedroom and lounge areas) and the child care centre spaces.

It should also be noted that beyond the assessment conducted within this report, there is an obligation on the trackform designers to ensure the trackform is designed such that the requirements of the SEPP Infrastructure 2007 are met without any additional mitigation provided to the structure of the building.

10.6.2 Human Comfort & Structural Damage

A vibration impact assessment to the Human Comfort and Structural Damage criteria, to the nearest affected structure of the development as a result of a train pass-by within the subterranean corridor has been conducted.

The predicted values were implemented into the assessment to determine whether there will be any adverse effect on occupants of the development with regards to human comfort, or any potential structural damage to the building. Refer to Table 40for the predicted vibration dose values in comparison to the criteria.

Period	eVDV (m/s$^{1.75}$)	Childcare Criteria	Residential Criteria	Complies (Yes/No)
Day (7am – 10pm)	0.0010	0.80	0.40	Yes
Night (10pm – 7am)	0.0010	0.80	0.26	Yes

Table 40: Vibration Dose Values from train vibration

Based on the results of the vibration dose value predictions, the vibration impact on the occupants of the proposed development is predicted to comply with the Human Comfort requirements of the SEPP Infrastructure 2007.

Refer to Figure 8 for the results of the vibration assessment in comparison to the structural damage criteria from DIN4150 – 3.

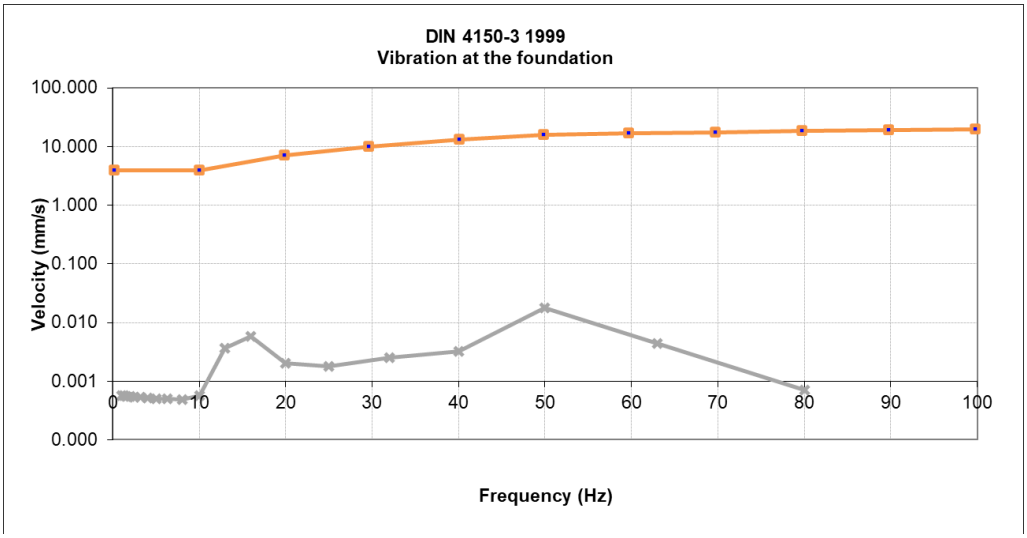

Figure 8: Metro vibration for structural damage (DIN 4150)

Based on the predicted vibration levels at the nearest structure of the proposed development, it is not expected that there will be any exceedance of the criteria established with regards to structural damage.

As a consequence, the vibration impact on the structure of the proposed development is predicted to comply with the requirements of the SEPP Infrastructure 2007 based on the structural design of the proposed development.

10.7 Building 3 Level 1 & 2 Gym

An assessment of noise emissions from the operation of the Level 01 and Level 02 gym interfacing the residential spaces above has been conducted. The noise emissions from the gym have been assessed to the threshold of human hearing.

The following assumptions and mitigation measures formed the basis of this assessment:

- The noise levels used have been based on measurements conducted and typical speech noise levels for raised and standard voice, with half raised and half standard shown in Table 42;
- Implementation of the mitigation measures outlined in Section 12.4; and
- Music has been included for the gym with a sound power level of 80 dB(A).

Item	Sound Power Level (dB) – Octave Band Centre Frequencies									Overall dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
1 person raised voice	60	60	58	64	74	69	65	57	43	74
1 person standard	54	54	52	58	68	63	59	51	46	68

Table 41 – Sound power level for voice efforts

Refer to Table 42 for the sound power level spectrum of the music used for this assessment.

Item	Sound Power Level (dB) – Octave Band Centre Frequencies									Overall dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Music for gym	84	84	82	80	78	75	69	67	57	80

Table 42 – Sound power level for music (in gym)

Based on these assumptions, the noise during the worst case 15-minute period has been predicted. The results are shown in Table 43.

Item	$L_{A10,15min}$ – Octave Band Centre Frequencies								
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Predicted Noise Level in Apartment	52	35	22	15	13	14	12	7	9
Criterion (Threshold of Human Hearing)	59	37	24	17	15	16	14	10	12
Compliance (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 43 - Predicted noise level from the gym to residents (with mitigation)

Based on this assessment the noise emission from the gym are not expected to exceed the threshold of human hearing.

The noise impact from the gym was also considered for the Waterloo Congregational Church. The assessment has been conducted under the assumption that the minimum single glazing thickness for the gym facade is 6.38mm laminated glass. Table 44 presents the predicted noise levels.

Item	$L_{A10,15min}$ – Octave Band Centre Frequencies								
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Predicted Noise Level at Church	31	29	23	17	15	7	0	0	0
Criterion (Threshold of Human Hearing)	59	37	24	17	15	16	14	10	12
Compliance (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 44 - Predicted noise level from the gym to Waterloo Congregational CHurch (with mitigation)

There is no expected noise impact exceedances from the gym to the Waterloo Congregational Church and no further mitigation measures are required.

10.8 Cope Street Plaza Public Noise

Cope Street Plaza will provide a public open space area of 1,341sqm. It will provide a meeting place for the community as well as showcase cultural artworks and stories. The Plaza will be located at footpath level and subtly separated from the surrounding circulation zones and outdoor dining areas to create a protected place for the community. The Plaza will be surrounded by active ground floor building uses to enhance activation during the day and evening.

A small pavilion will provide a permanent place for trade/busking/gathering linked to the original trade route walking trail now known as Botany Road. Distinctive planting will also allow an understanding of the six indigenous seasons to be highlighted through the native planting selection. Three feature trees are also proposed along the perimeter of the Plaza.

The activation of this public space will increase the general ambient and background noise in the surrounding areas, by virtue of its activation. Mitigation measures to reduce the noise would inherently screen the plaza from the street, inhibiting the activation of the space.

With regards to a noise impact, the noise emissions characteristics of the plaza are not expected to be offensive to the surrounding noise-sensitive receivers, given the sources of noise and wider intent of the environment should aid in attracting the local community to a communal meeting place.

11. Construction Noise and Vibration Assessment

11.1 All Precincts - Cumulative Construction Noise Assessment

11.1.1 Proposed Construction Activities

In this assessment, the noise impact from the construction works are considered, including impacts to Waterloo Congregational Church. The proposed construction works will comprise the following stages:

- Civil Works (Basement and Southern Precinct)
- Structure – All Precincts (Ground Level to Rooftop)
- Façade – All Precincts (Ground Level to Rooftop
- Fitout, Finishes and Services

The construction works are expected to occur during the following hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 7:00am to 3:30pm
- Sunday and public holidays: no work
- Safety inspections are permitted from 7:00am

The construction layouts and plans have been outlined in Mirvac's Construction & Environmental Management Plan (CEMP), and the worst case scenarios for both commercial and residential receivers have been covered.

11.1.2 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 45. The equipment noise levels have been extracted from AS 2436:2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.

Stages	Equipment	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
Civil Works (Excavation)	Excavator with hydraulic hammer (15t)	115	40	6	111
	Excavator (30-40t)	107	40	6	103
	Bobcat	104	40	6	100
	Bulldozer	108	40	6	104
	Mobile crane	104	16	2.5	96
	Powered hand tools	102	50	7.5	98
	CFA piling rig	111	20	2.5	103

Stages	Equipment	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
Structure & Facade	Crane (Diesel)	105	16	2.5	97
	Powered hand tools	102	50	7.5	99
	Concrete pump	108	20	3	101
	Truck	107	40	6	103

Table 45 – Cumulative Impact - Construction Equipment Noise Levels

11.1.3 Noise Modelling and Assumptions

In order to assess the noise impact from the site during the various construction stages, a noise model was prepared using commercial software SoundPLAN v8.1, which is a comprehensive software package for conducting three-dimensional complex noise propagation modelling. Using the software, a 3D model of the site and its surroundings was constructed including the nearby buildings, and the construction plant and equipment were positioned as noise sources. Within the model, the effects of the environment (built and natural) on propagation of sound were considered to reliably estimate the resulting noise effects on the surrounding noise sensitive receivers.

The noise model represents the 'reasonable' worst case periods of construction activities, meaning that all the equipment of each stage is operating simultaneously during a 15-minute observation period.

The assumptions that were made within the assessment include the following:

- The predicted noise levels represent the worst-case scenario for each receiver;
- The mitigation measures outlined in Section 13 are implemented;
- Neutral weather conditions; and
- Truck and light traffic movement is conducted in accordance with the Access Plan All Precincts.

The predicted noise levels at the surrounding noise catchment areas have been based on the assumptions and aforementioned sound power levels of the equipment provided in Table 45. The results of the predicted noise levels are presented in Section 11.1.1.

The prediction modelling was conducted for each of the following construction scenarios:

- Scenario 1: Civil Works (Basement and Southern Precinct)

- Scenario 2: Structure (GF – L5):

1. Northern Precinct – Structure (GF – L5)
2. Central Precinct – Structure (GF – L5)

3. Southern Precinct (Building 3 & 4) – Structure - (GF – L5)

- Scenario 3: Structure (L6 – L10) and Façade (GF – L5):

1. Northern Precinct – Structure (L6 – L10) and Façade (GF – L5):
2. Central Precinct – Structure (L6 – L10) and Façade (GF – L5):
3. Southern Precinct (Building 3 & 4) – Structure (L6 – L10) and Façade (GF – L5)

- Scenario 4: Structure (L11 – L15) and Façade (L6 – L10)

1. Northern Precinct – Structure (L11 – L10) and Façade (L6 – L10)
2. Central Precinct – Structure (L11 – L10) and Façade (L6 – L10)
3. Southern Precinct (Building 3 & 4) – Structure (L11 – L10) and Façade (L6 – L10)

- Scenario 5: Structure (L16 – L24) and Façade (L11 – L15)

1. Northern Precinct – Structure (L16) and Façade (L11 – L15)
2. Central Precinct – Structure (L16 – L23) and Façade (GF – L5)
3. Southern Precinct (Building 3 & 4) – Structure (L16 – L24) and Façade (L11 – L15)

11.1.1 Predicted Noise Levels

The predicted noise levels during for each scenario at each receiver location have been presented in Table 46, Table 47, Table 48, Table 49, and Table 50 and have been assessed to the construction noise criteria established in Section 9.4 The noise contour maps produced by the three-dimensional noise propagation modelling are provided in Section 15.8.1.

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min}$ dB	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	63 - 69	59 - 65	70	-	No
NCA02	62 - 67	62 - 64	60	2 – 4	No
			55 (Outside Standard Hours)	7 – 9	No
NCA03	50 - 69	49 - 72	64	0 – 8	No
			59 (Outside Standard Hours)	0 – 13	No
Waterloo Congregational Church	74 - 76	67 - 76	55	12 – 21	Yes*

Table 46 - Predicted Noise Levels – Scenario 1: Civil Works (Basement and Southern Precinct)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	57 - 64	54 - 61	70	-	No
NCA02	54 – 59	53 - 57	60	-	No
			55 (Outside Standard Hours)	0 - 2	No
NCA03	46 - 54	46 - 52	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	60 - 69	58 - 66	55	3 - 11	No

Table 47 - Predicted Noise Levels – Scenario 2: Structure (GF – L5)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	58 - 60	57 - 58	70	-	No
NCA02	50 - 57	49 - 55	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	51 - 55	50 - 55	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	61 - 65	59 - 61	55	4 - 6	No

Table 48 - Predicted Noise Levels – Scenario 3: Structure (L6 – L10) and Façade (GF – L5)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	57 - 59	56 - 59	70	-	No
NCA02	54 -57	54 - 56	60	-	No
			55 (Outside Standard Hours)	0 - 1	No
NCA03	53 -57	52 - 57	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	57 - 60	56 - 57	55	1 - 2	No

Table 49 - Predicted Noise Levels – Scenario 4: Structure (L11 – L15) and Façade (L6 – L10)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	55 - 58	55 - 56	70	-	No
NCA02	56 - 57	55 - 57	60	-	No
			55 (Outside Standard Hours)	0 - 2	No
NCA03	53 - 55	53 - 55	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	59 - 60	58 - 59	55	3 - 4	No

Table 50 - Predicted Noise Levels – Scenario 5: Structure (L16 – L24) and Façade (L11 – L15)

In the instance the excavation and piling for each of the precincts occurs simultaneously, the predicted noise level at nearest noise-sensitive receiver (Waterloo Congregational Church) will exceed the noise management level by 21 dB(A). This result is also conservative in the sense that the majority of the noise is generated by rock breakers in close proximity to the receiver, where this may not be the case in reality given the predominant soil type (sand).

Upon implementation of the mitigation measures outlined in Section 13, it is not expected there will be significant construction noise impacts on the surrounding noise-sensitive receivers within the nearby noise catchment areas.

11.2 All Precincts - Cumulative Construction Vibration Assessment

The vibration associated with construction is dependent on a number of variables including the types of machinery, the proximity to the nearby receivers as well as the ground type.

Generic safe working distances for vibration impacts associated with various types of machinery at given distances are presented within the transport for NSW 'Construction Noise Strategy' document. This document presents the safe construction working limits for Cosmetic Damage to adjacent structures (in accordance with BS 7385) and Human Comfort (OH&E).

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	Human Response (OH&E Vibration Guideline)
Concrete Vibrator	<50 kN (Typically 1-2 tonnes)	5m	15m to 20m
	<100 kN (Typically 2-4 tonnes)	6m	20m
	<200 kN (Typically 4-6 tonnes)	12m	40m
	<300 kN (Typically 7-13 tonnes)	15m	100m
	>300 kN (Typically 13-18 tonnes)	20m	100m
	>300 kN (> 18 tonnes)	25m	100m
CFA Piling Rig	≤ 800mm	2m (nominal)	N/A
Excavator with hydraulic hammer (15t)	(900kg – 12 to 18t excavator)	7m	23m

Table 51: Working Distances for Vibration Intensive Plant

Concrete vibrators are expected be used in close proximity to the Waterloo Congregational Church when pouring the Ground Level slab. In addition to this, piling and excavating with a hammer attachment may be conducted in close proximity to the Waterloo Congregational Church. Mitigation measures to ensure vibration generated on the structure of the Waterloo Congregational Church does not exceed the project vibration requirements are provided in Section 9.5.4.

11.3 Southern Precinct - Construction Noise Assessment

11.3.1 Proposed Construction Activities

In this assessment, the noise impact from the construction works are considered. The proposed early construction will consist of the following stages:

- Civil Works
- Construction of Basement
- Structure
- Façade
- Fitout, Finishes & Services

The construction works are expected to occur during the following hours:

- Monday to Friday: 7:30am to 5:30pm
- Saturday: 7:30am to 3:30pm
- Sunday and public holidays: no work

Work is permitted to commence at 7am Monday – Friday's for pre-start and safety inspections prior to general construction (noisy) works to commence at 7:30am

11.3.2 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 52. The equipment noise levels have been extracted from AS 2436:2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.

Stages	Equipment	Sound Power Level dB(A)
Civil Works (Excavation)	Excavator with hydraulic hammer (15t)	115
	Excavator (30-40t)	107
	Bobcat	104
	Bulldozer	108
	Mobile crane	104
	Powered hand tools	102
	CFA piling rig	111
Structure	Crane (Diesel)	105
	Powered hand tools	102
	Bobcat	104

Stages	Equipment	Sound Power Level dB(A)
	Concrete pump	108
	Truck	107
	Alimak hoist	95

Table 52: Construction Equipment Noise Levels

11.3.3 Noise Modelling & Assumptions

In order to assess the noise impact from the site during the various construction stages, a noise model was prepared using commercial software SoundPLAN v8.1, which is a comprehensive software package for conducting three-dimensional complex noise propagation modelling. Using the software, a 3D model of the site and its surroundings was constructed including the nearby buildings, and the construction plant and equipment were positioned as noise sources. Within the model, the effects of the environment (built and natural) on propagation of sound were considered to reliably estimate the resulting noise effects on the surrounding noise sensitive receivers.

The noise model represents the 'reasonable' worst case periods of construction activities, meaning that all the equipment of each stage is operating simultaneously during a 15-minute observation period.

The assumptions that were made within the assessment include the following:

- The predicted noise levels represent the worst-case scenario for each receiver;
- The ISD north and south station boxes have been completely constructed during the works;
- The mitigation measures outlined in Section 13 are implemented;
- Neutral weather conditions; and
- Truck and light traffic movement is conducted in accordance with the Access Plan for the Southern Precinct.

The predicted noise levels at the surrounding noise catchment areas have been based on the assumptions and aforementioned sound power levels of the equipment provided in Table 52. The results of the predicted noise levels are presented in Section 11.3.3.

The prediction modelling was conducted for each of the following construction scenarios:

- Scenario 1: Structure (BLDG 3: Ground – L5)
- Scenario 2: Structure (BLDG 3 & 4: L6 – L10) and Façade (BLDG 3: Ground – L5)
- Scenario 3: Structure (BLDG 3: L11 – L15, BLDG 4: L11 – L14) and Façade (BLDG 3 & 4: L6 – L10)
- Scenario 4: Structure (BLDG 3: L16 – L20) and Façade (BLDG 3: L11 – L15, BLDG 4: L11 – L14)
- Scenario 5: Structure (BLDG 3: L21 – L25) and Façade (BLDG 3: L16 – 20)

11.3.4 Predicted Noise Levels

The predicted noise levels during all phases for each receiver location have been presented in Table 53, Table 54, Table 55, Table 56 and Table 57 have been compared with the requirements of the Interim Construction Noise Guideline (ICNG). The noise contour maps produced by the three-dimensional noise propagation modelling are provided in Section 15.2.

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min}$ dB	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	47-64	39-55	70	-	No
NCA02	46-51	40-44	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	35-61	32-54	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	44-69	46-61	55	0-6	No

Table 53: Predicted Noise Levels – Scenario 1: Structure (BLDG 3: Ground – L5)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	39-58	39-55	70	-	No
NCA02	40-45	40-44	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	44-54	44-54	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	46-65	46-61	55	0-6	No

Table 54: Predicted Noise Levels – Scenario 2: Structure (BLDG 3 & 4: L6 – L10) and Façade (BLDG 3: Ground – L5)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	43-53	43-53	70	-	No
NCA02	47-52	45-52	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	52-53	52-53	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	38-57	38-56	55	0-1	No

Table 55: Predicted Noise Levels – Scenario 3: Structure (BLDG 3: L11 – L15, BLDG 4: L11 – L14) and Façade (BLDG 3 & 4: L6 – L10)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	42-55	42-54	70	-	No
NCA02	45-48	45-47	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	52-53	51-53	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	36-61	36-60	55	0-5	No

Table 56: Predicted Noise Levels – Scenario 4: Structure (BLDG 3: L16 – L20) and Façade (BLDG 3: L11 – L15, BLDG 4: L11 – L14)

Receiver	Predicted Noise Level Range - Without Mitigation	Predicted Noise Level Range – With Mitigation	Noise Management Level $L_{Aeq,15min}$ dB	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
NCA01	41-55	41-52	70	-	No
NCA02	50-53	50-52	60	-	No
			55 (Outside Standard Hours)	-	No
NCA03	45-50	45-50	64	-	No
			59 (Outside Standard Hours)	-	No
Waterloo Congregational Church	44-60	44-58	55	0-3	No

Table 57: Predicted Noise Levels – Scenario 5: Structure (BLDG 3: L21 – L25) and Façade (BLDG 3: L16 – 20)

Given the exceedance in the noise management level at any given time during the construction of the Southern Precinct is predicted to be limited to approximately 5 dB(A) upon implementation of the mitigation measures outlined in Section 13, it is not expected there will be significant construction noise impacts on the surrounding noise-sensitive receivers.

11.4 Construction Vibration Assessment

The vibration associated with construction is dependent on a number of variables including the types of machinery, the proximity to the nearby receivers as well as the ground type.

Generic safe working distances for vibration impacts associated with various types of machinery at given distances are presented within the transport for NSW 'Construction Noise Strategy' document. This document presents the safe construction working limits for Cosmetic Damage to adjacent structures (in accordance with BS 7385) and Human Comfort (OH&E).

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	Human Response (OH&E Vibration Guideline)
Concrete Vibrator	<50 kN (Typically 1-2 tonnes)	5m	15m to 20m
	<100 kN (Typically 2-4 tonnes)	6m	20m
	<200 kN (Typically 4-6 tonnes)	12m	40m
	<300 kN (Typically 7-13 tonnes)	15m	100m
	>300 kN (Typically 13-18 tonnes)	20m	100m
	>300 kN (> 18 tonnes)	25m	100m
CFA Piling Rig	≤ 800mm	2m (nominal)	N/A
Excavator with hydraulic hammer (15t)	(900kg – 12 to 18t excavator)	7m	23m

Table 58: Working Distances for Vibration Intensive Plant

Concrete vibrators are expected be used in close proximity to the Waterloo Congregational Church when pouring the Level 01 slab. In addition to this, piling and excavating with a hammer attachment may be conducted in close proximity to the Waterloo Congregational Church. Mitigation measures to ensure vibration generated on the structure of the Waterloo Congregational Church does not exceed the project vibration requirements are provided in Section 9.5.4.

12. Operational Mitigation Measures

12.1 Road Noise Mitigation

12.1.1 Closed Windows Mitigation

In order to achieve the project internal noise limits established in Section 9.2.1 the glazing components of the façade of the proposed development must meet the acoustic demand ratings presented in Table 59 below. The designations of acoustic demand ratings on the façade are indicated on the drawings provided in Section 15.3.

The double-glazed acoustic rating (R_w) is higher than the single-glazed acoustic rating is because of the reduction in acoustic performance double-glazed units (with 12-20mm cavities) experience at lower frequencies (63 Hz to 125 Hz), which are the peak frequencies typically characteristic of traffic noise emissions.

Acoustic Demand Rating	Single-Glazed Acoustic Performance (Weighted Sound Reduction Index, Rw)	Double-Glazed Acoustic Performance (Weighted Sound Reduction Index, Rw)
1	32	34
2	34	36
3	36	38
4	40	42

Table 59 - Acoustic demand ratings for façade of proposed development

In addition to the required glazing systems outlined in Table 59 and indicated in Section 15.3, the solid/non-glazed elements of the façade shall have an acoustic performance of no less than R_w 55 to ensure the resulting internal noise levels within each space in the proposed development do not exceed the project internal noise limits outlined in Section 9.2.1.

The acoustic demand ratings proposed above has been provided as a high-level analysis only. The acoustic performance of the glazing facade may be reduced at certain locations within the development during the detailed design phase of the project.

12.1.2 Open Windows Mitigation – Residential Apartments

The habitable spaces within apartments that are noise-affected and hence require an alternative means of ventilation will be provided with an acoustic ventilator to meet the project internal noise limits in Table 14. Details of the acoustic plenum along with the details of the critical components making up the acoustic plenum are provided in Appendix E for the development application.

Acoustic Ventilator – Locations

The locations of all acoustic ventilators proposed in the façade to mitigate the noise impacts of Botany Road while providing an alternative means of natural ventilation that are shown in the drawings provided in Section 15.5.

Acoustic Ventilator – Minimum Acoustic Performance Requirements

To achieve the project internal noise limits outlined in Table 14, the acoustic plenum shall achieve a transmission loss values equal to or greater than the values presented in Table 60.

Required Transmission Loss– Octave Band Centre Frequency						
63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
4	9	11	15	20	19	15

Table 60 – Minimum transmission loss requirements for each acoustic ventilator

Ventilation Performance Requirements & Natural Ventilation Study

The ventilation performance of the acoustic ventilators has been assessed and modelled to the requirements of the City of Sydney's Draft Alternative Natural Ventilation of Apartments in Noise Environments – Performance Pathway Guideline.

Stantec can confirm the design of the acoustic ventilator and all of the constituents of the acoustic ventilator satisfy the requirements of City of Sydney's Performance Pathway Guideline. Details of the ventilation performance modelling and study is presented in the Natural Ventilation Study provided in Section 15.7.

12.2 Mechanical and Generator Plant and Equipment

To meet the external noise emissions requirements for noise generated by the mechanical plant and equipment together with the generator plant, the following noise mitigation measures are required:

- Install acoustic barriers to the Level 24 plantroom where indicated in Figure 9 to the height shown in the architectural documentation. Acoustic barriers can be solid or can be an acoustic louvre, though the barrier must have a noise reduction of no less than the values shown in Table 61.
- Generators must be enclosed with an acoustic canopy to ensure the sound pressure level measured at 7 metres in each octave band centre frequency does not exceed the values shown in Table 35.

Louvre	Noise Reduction (dB) – Octave Band Centre Frequency					
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Type 1	8	8	8	10	15	21

Table 61 - Noise reduction required for types of acoustic barriers

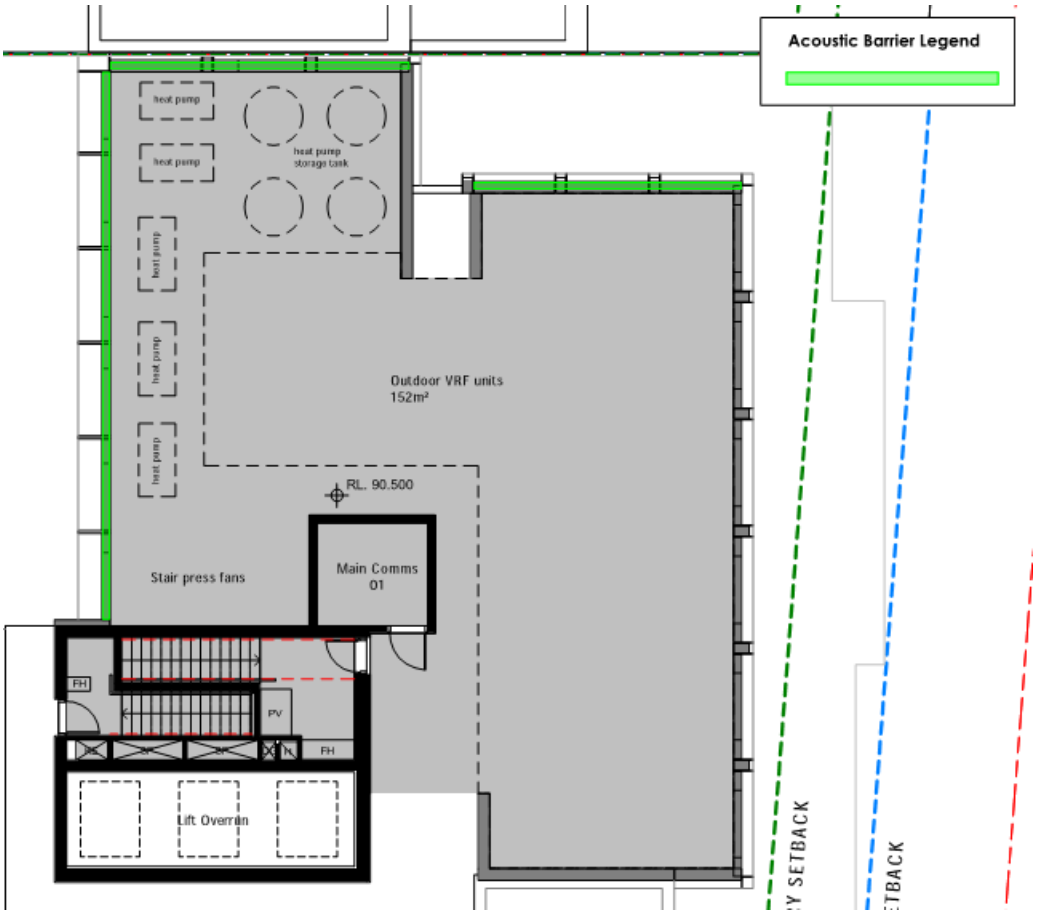

Figure 9 - Acoustic barrier type designations - Level 24 plantroom

Additional mitigation measures for the mechanical plant should be considered during the design development stage to ensure compliance with the outlined criteria at the nearest sensitive receivers. These amelioration measures could include but not limited to the following:

- Positioning mechanical plant away from nearby receivers
- Acoustic attenuators fitted to duct work
- Screening around mechanical plant
- Acoustic insulation within duct work

It should be noted that the noise reduction requirements will likely be refined and reduced once the mechanical plant and equipment selections and designs have been progressed further during the detailed design of the proposed development. The mitigation measures proposed at this stage of the development are conservative in nature.

12.3 Loading Dock and Waste Collection Impact Assessment

To ensure that compliance with the EPA's Noise Policy for Industry it is recommended that activities conducted within the loading dock are performed with the loading dock shutter door is closed. The insertion loss used for the assessment conducted in Section 0 is outlined in Table 62 below:

Required Transmission Loss– Octave Band Centre Frequency						
63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
2	3	6	10	14	16	14

Table 62 – Minimum transmission loss requirements for loading dock and waste collection

It is also recommended that the activities shall be conducted with the implementation of the following management practices:

- Not operating before 7am or after 10pm (7 days per week)
- Maintaining rubbish trucks and braking materials to minimize or eliminate noise such as squeaky brakes
- Educating drivers and collectors to be careful and to implement quiet work practices

12.4 Building 3 Level 1 & 2 Gym

12.4.1 Gym Ceiling

The separating floor-ceiling construction between the gym and residential apartments should be designed to achieve a transmission loss with values equal to or greater than those provided in Table 63.

Item	Transmission Loss (dB)								
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Floor-Ceiling Construction	25	40	53	58	58	57	55	55	50

Table 63 - Transmissions loss requirements of construction separating L07 and L08

12.4.2 Gym Floor

The gym floor will likely require vibration isolation, though this should be reassessed for a fitout development application. As the design develops and when more information is known regarding the structure, natural frequency and construction, the vibration isolation of the gym should designed.

As a preliminary mitigation method, the proposed thickness of the gym floor should be 201mm + the support channel thickness, from structural floor.

Refer to Figure 11 for the preliminary proposed vibration isolation gym floor construction.

The floor structure will likely be resiliently mounted on isolation springs (see Figure 10for an example). Isolation springs shall be selected in order to achieve the following:

- The static deflection of the isolation springs under total weight of the equipment and base shall provide a minimum of 95% isolation efficiency when the incremental static point load deflection of the supporting floor slab is considered.
- Natural frequency of the resiliently mounted floor shall be above 40% of the natural frequency of the supporting slab.

Isolated gym floor shall have no physical contact with room partitions. Therefore, any gap between the isolated floor and partitions shall be fully sealed with a close cell neoprene seal along the junction between isolated floor and partitions.

An insulation blanket shall be installed between floating gym floor and supporting concrete slab. Insulation shall have 75mm minimum thickness and achieve a minimum density of 15 kg/m3 when uncompressed.

In addition to the isolated floor system, we recommend the following isolation platform for any deadlift zones:

- Rogue Deadlift Platform (2.2m x 1.2m)

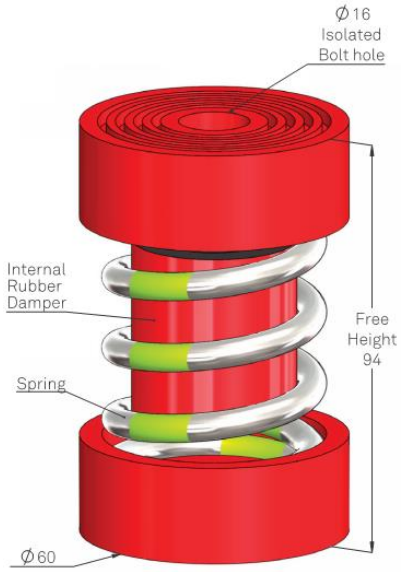

Figure 10 - Gym floor proposed isolation spring

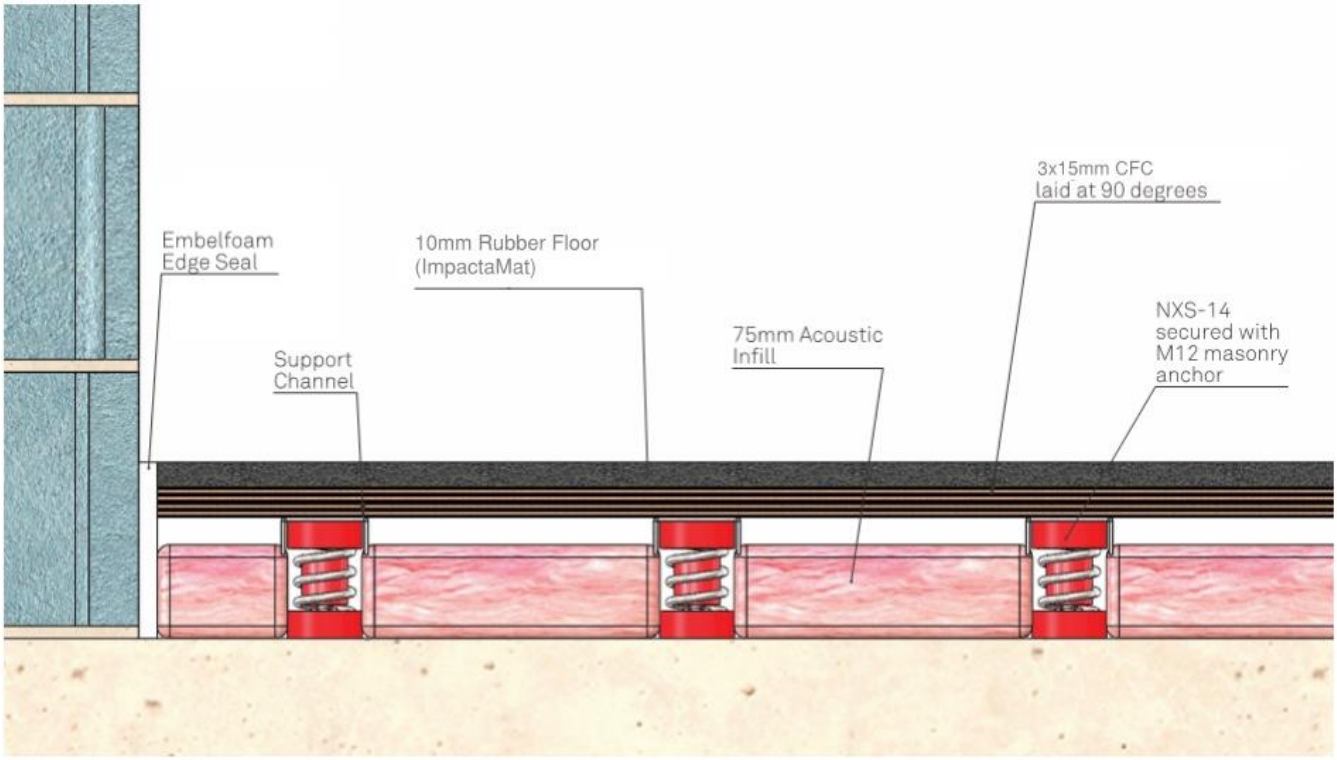

Figure 11 - Gym floor construction

13. Construction Mitigation Measures

13.1 Project Specific Noise and Vibration Recommendations

13.1.1 Noise

A solid acoustic barrier (made from plywood or similar) 2.4 metres above Ground Level is recommended to be erected around the perimeter of the site. The acoustic barrier could be either Class A or Class B type hoarding.

Where it proves reasonable and feasible, heavy truck movements are recommended to travel along Botany Road or Wellington Street to enter the construction site. This will not be possible for significant durations of construction on-site due to other site constraints that must be addressed by travelling along Cope St and Raglan St.

In addition, noise monitoring is recommended to be conducted at the most-affected noise-sensitive receivers in accordance with the monitoring programme proposed in Section 13.3.

The flow chart presented in Figure 12 should be used to assist with noise mitigation and management measures in order to comply with the standards outlined in this report.

13.1.2 Vibration

When pouring the Level 01 slab, attended vibration measurements should be conducted on the structure of the Waterloo Congregational Church to ensure the vibration generated on the structure does not exceed the values for cosmetic damage and structural damage outlined in BS 7385 and DIN 4150 (project construction vibration limits established in Section 9.5.4). The vibration will primarily be generated by the concrete vibrators used during the concrete pour and the piling activities during the Building 3 and 4 Civil works.

13.2 General Acoustic Recommendations for Construction

According to AS 2436 – 2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* the following techniques could be applied to minimize the spread of noise and vibrations to the potential receivers.

13.2.1 Noise

If a process that generates significant noise levels cannot be avoided, the amount of noise reaching the receiver should be minimized. Two ways of achieving this are to either increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens.

Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. Practices that will reduce noise from the site include:

- Increasing the distance between noise sources and sensitive receivers.
- Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportables can be effective barriers).
- Constructing barriers that are part of the project design early in the project to introduce the mitigation of site noise.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

13.2.2 Screening

On sites where distance is limited, the screening of noise may be beneficial, and this should be taken into account during the planning stages.

If structures such as stores, site offices and other temporary buildings are situated between the noisiest part of the site and the nearest dwellings, some of the noise emission from the site can be reduced. If these buildings are occupied, sound insulation measures may be necessary to protect workers inside the buildings.

A hoarding that includes a site office on an elevated structure offers superior noise reduction when compared with a standard (simple) hoarding. The acoustic performance is further enhanced when the hoarding is a continuous barrier.

Storage of building materials or the placement of shipping containers between the noise source and any noise-sensitive area may also provide useful screening and the same is true of partially completed or demolished buildings. A noisy, stationary plant can be placed in a basement, the shell of which has been completed, provided reverberant noise can be controlled. Where compressors or generators are used in closed areas, it is necessary to ensure that the exhaust gases are discharged directly to the outside air and that there is good cross-ventilation to prevent the build-up of poisonous carbon monoxide fumes and to allow an adequate air supply to maintain efficiency when operating the equipment.

Where such noise barriers are not practical, a worthwhile reduction in noise can be obtained by siting the plant behind and as close as possible to mounds of earth, which may effectively screen any noise-sensitive areas from the plant. These can often be designed into the construction schedule or site arrangement for future landscaping.

Water pumps, fans and other plant equipment that operate on a 24-hour basis may not be an irritating source of noise during the day but may be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground provided this does not generate reverberant noise. In such cases, however, adequate ventilation should also be ensured. Long, temporary earth embankments can provide quite an effective noise screen for mobile equipment moving, for example, on a haulage road. When the earthworks are complete, the earth mounds should be removed if possible, with smaller, quieter excavators. A noise barrier may be a more reliable method of noise control than the imposition of restrictions on throttle settings.

In many cases it is not be practical to screen earthmoving operations effectively, but it may be possible to partially shield a construction plant or to build-in at the early stages protective features required to screen traffic noise. Where earth noise barriers are not practical due to lack of space, consideration should be given to the possibility of constructing temporary screens from wood or any equivalent material in surface density.

The usefulness of a noise barrier will depend upon its length, its height, its position relative to the source and to the receiver, and the material from which it is made. A barrier designed to reduce noise from a moving source should extend beyond the last property to be protected to a distance of not less than ten times the shortest measurement from the property to the barrier. A barrier designed to reduce noise from a stationary source should, where possible, extend to a distance beyond the direct line between the noise source and the receiver to a distance equal to ten times the effective barrier height, which is the height above the direct line between source and receiver.

If the works are predominately within nominally closed structures, careful consideration should be given to reducing noise breakout at any openings.

13.2.3 Crane (diesel operated)

An appropriate silencer on the muffler and acoustic screen around the engine bay are recommended to attenuate the noise from it.

13.2.4 Reversing and warning alarms

Community complaints often involve the intrusive noise of alarms commonly used to provide a safe system of work for vehicles operating on a site. Beeper reversing alarm noise is generally tonal and may cause annoyance at significant distances from the work site.

There are alternative warning alarms capable of providing a safe system of work that are equal to or better than the traditional ‘beeper’, while also reducing environmental noise impacts. The following alternatives should be considered for use on construction sites as appropriate:

- Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal frequency ‘beep’) are less intrusive when heard in the neighbourhood.
- Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.
- Non-audible warning systems (e.g. flashing lights, reversing cameras) may also be employed, providing safety considerations, are not compromised.
- Proximity alarms that use sensors to determine the distance from objects, such as people or structures, and generate an audible alarm in cabin for the driver.
- Spotters or observers.

The above methods should be combined, where appropriate.

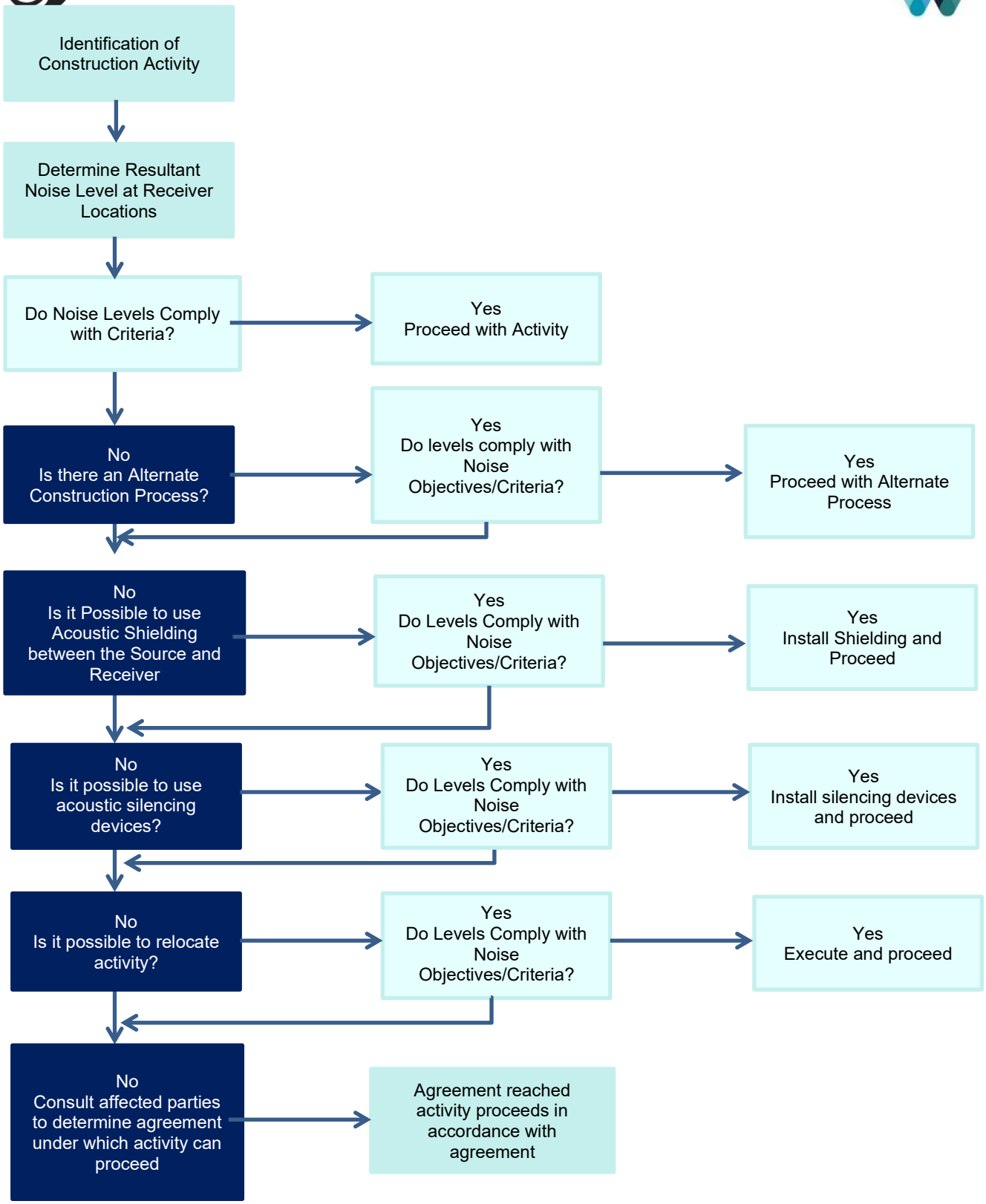

Figure 12: Noise mitigation management flow chart

13.3 Noise & Vibration Monitoring Strategy

13.3.1 General Methodology

Noise and vibration levels should be monitored from time to time to ensure that noise generated as a result of remediation and construction activities does not disturb local businesses and residents.

Monitoring may be in the form of regular checks by the builder or indirectly by an acoustic consultant engaged by the builder and in response to any noise or vibration complaints. Where noise and vibration criteria are being exceeded or in response to valid complaints, noise and / or vibration monitoring should be undertaken. This would be performed inside the premises of the affected property and on site adjacent to the affected receivers.

Monitoring is to be undertaken by an experienced noise and vibration monitoring professional or an acoustic consultant. The results of any noise or vibration monitoring are to be provided to the relevant party or person in a timely manner allowing the builder to address the issue and respond to the complaints.

Noise and vibration monitoring can take two forms:

- Short term monitoring
- Long-term monitoring

13.3.2 Short-term monitoring

Short-term monitoring consists of attended monitoring when critical stages of the construction are occurring. This normally provides real-time assistance and guidance to the subcontractor on site letting them know when the noise and vibration criteria are exceeded allowing the selection of alternative method on construction or equipment selection in order to minimise noise and vibration impacts.

13.3.3 Long-term monitoring

Similarly, long-term monitoring uses noise and vibration loggers providing real-time alerts to the builder / site manager when the noise and vibration criteria are exceeded.

Typically, the noise and vibration loggers stay on site for a period of several months for the critical construction stages of the project. Sometimes the period of construction noise and vibration monitoring is dictated by the local authorities through the DA conditions.

Both methodology are complementary and normally used simultaneously providing a significant of amount of data via the long-term monitoring but also providing information on the sources of noise and vibration generating exceedances via the short-term or attended monitoring.

13.3.4 Noise and Vibration Monitoring Programme

The proposed noise and vibration monitoring program during the construction works is outlined in Table 64.

Sensitive Receiver Details	Proposed Monitoring Type and Phase
Waterloo Congregational Church	Noise - Structure & Façade
	Vibration - Structure (During Ground Floor Slab pour)

Table 64 - Proposed noise and vibration monitoring locations details

The monitoring programme as shown above is to be carried out during the likely noisiest stages as agreed with the Acoustic Engineer and Contractor.

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14. Conclusion

A noise and vibration impact assessment for the proposed development located within the Southern Precinct of the Waterloo Metro Quarter Over Station Development has been conducted. This document forms part of the documentation package to be submitted to relevant authorities as part of the State Significant Development Application process (SSD-10437).

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 9. In terms of noise and vibration criteria, we have provided the following:

- Noise criteria for internal noise levels according to DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline and Sydney DCP 2012, provided in Section 9.2.1;
- Noise criteria for noise emissions from the development to noise-sensitive receivers in accordance with the Sydney DCP 2012, NPI,
- Traffic noise criteria for additional vehicle movements on public roads generated by the proposed development presented in Section 9.2.3;
- Operational vibration criteria for human comfort and structural damage, provided in Section 9.3;
- Construction noise criteria and construction hours provided in Section 9.4; and
- Construction vibration criteria for human comfort and structural damage, provided in Section 9.5.

Having given regard to the analysis conducted within this report, it is the finding of this noise and vibration impact assessment that the proposed development is compliant with the relevant noise and vibration criteria controls for this type of development, and it is expected to comply with the applicable regulations with regards to noise and vibration, particularly those listed above.

The design of the façade with mitigation measures outlined in 12, is predicted to allow the Southern Precinct (Buildings 3 and 4) to comply with the requirements of:

- Clause 3.6 of the Development Near Rail Corridors and Busy Road - Interim Guideline for Noise Criteria for all uses including windows closed and;
- Clause 4.2.3.11 of Sydney DCP 2012 for windows and doors open.

In addition to this, the Southern Precinct of the façade with mitigation measures outlined in Section 12 is predicted to allow the Southern Precinct (Buildings 3 and 4) to comply with the requirements of:

- Part 4J of the NSW Apartment Design Guide and (residential precincts);
- Clause 3.8 of Development Near Rail Corridors and Busy Road - Interim Guidelines for general guidance on how to reduce the impact of noise, noting that these measures may not be sufficient to meet the required noise criteria.

It is recommended the state significant development application for the proposed development is not rejected on the basis of noise and vibration, under the implementation of the mitigation measures outlined within the report.

15. Appendices

15.1 Appendix 1 – Glossary of Acoustic Terms

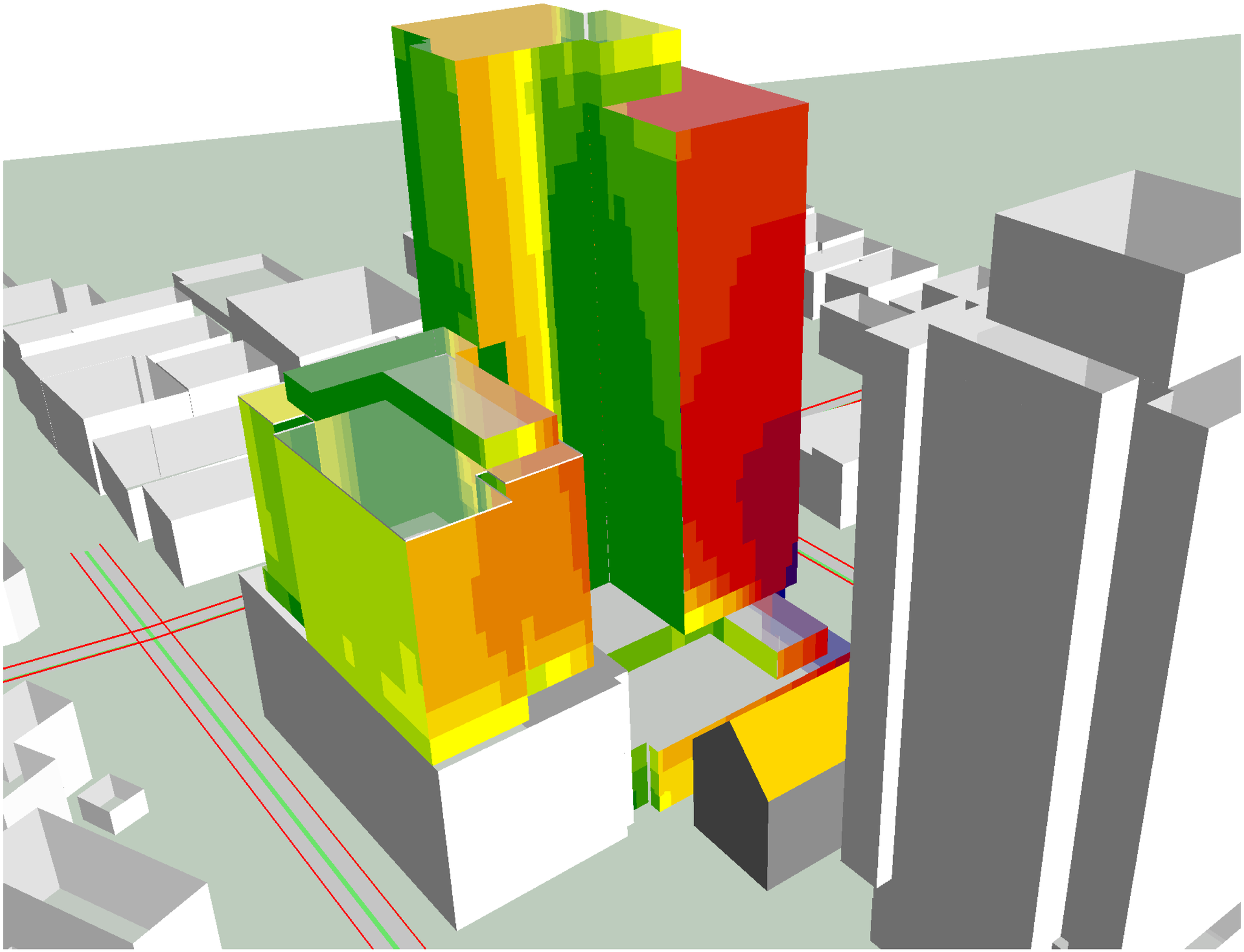
Acoustic Term	Definition
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A-filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).

Acoustic Term	Definition
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the LA90 noise level expressed in units of dB(A).
LAeq	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
LAeq,T	The constant A-weighted sound which has the same energy as the fluctuating sound of the measurement, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
Rw:	The Sound Insulation Rating Rw is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.

Acoustic Term	Definition
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

15.2 Appendix 2 – Airborne Noise Modelling

15.2.1 Sydney DCP 2012 – Noisiest 1 hour Period $L_{Aeq,1h,day}$ and $L_{Aeq,1h,night}$



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001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

< 45	49-51	55-57	61-63	67-69
45-47	51-53	57-59	63-65	69-71
47-49	53-55	59-61	65-67	> 71

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
DAYTIME
SYDNEY DCP 2012 - NOISIEST 1 HOUR

TITLE

Stantec

Noise Model
Day-time Model
Noise & Vibration

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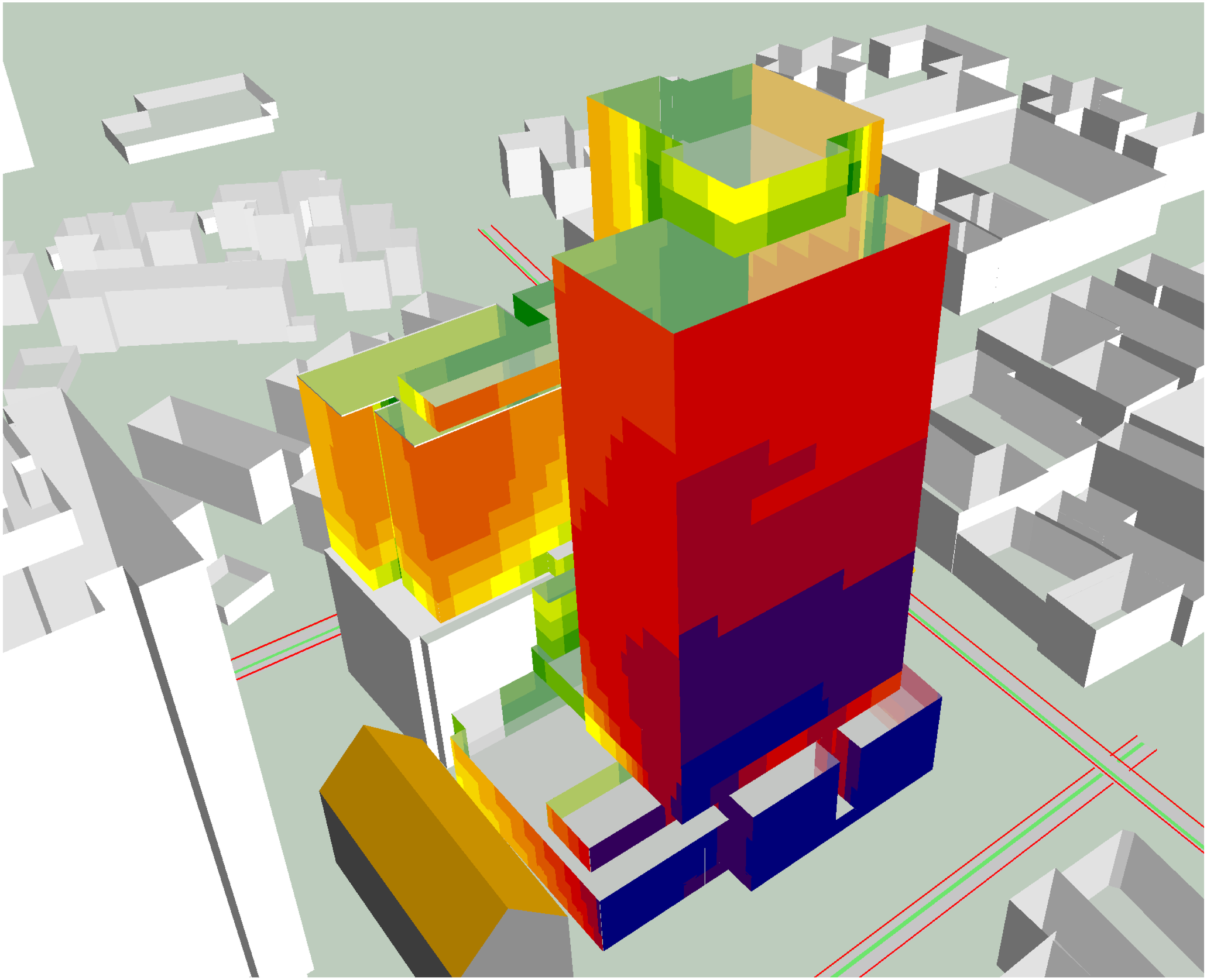

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PROJECT

FACADE NOISE MAP
DAYTIME
SYDNEY DCP 2012 - NOISIEST 1 HOUR

TITLE

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Noise Model
Day-time Model
Noise & Vibration

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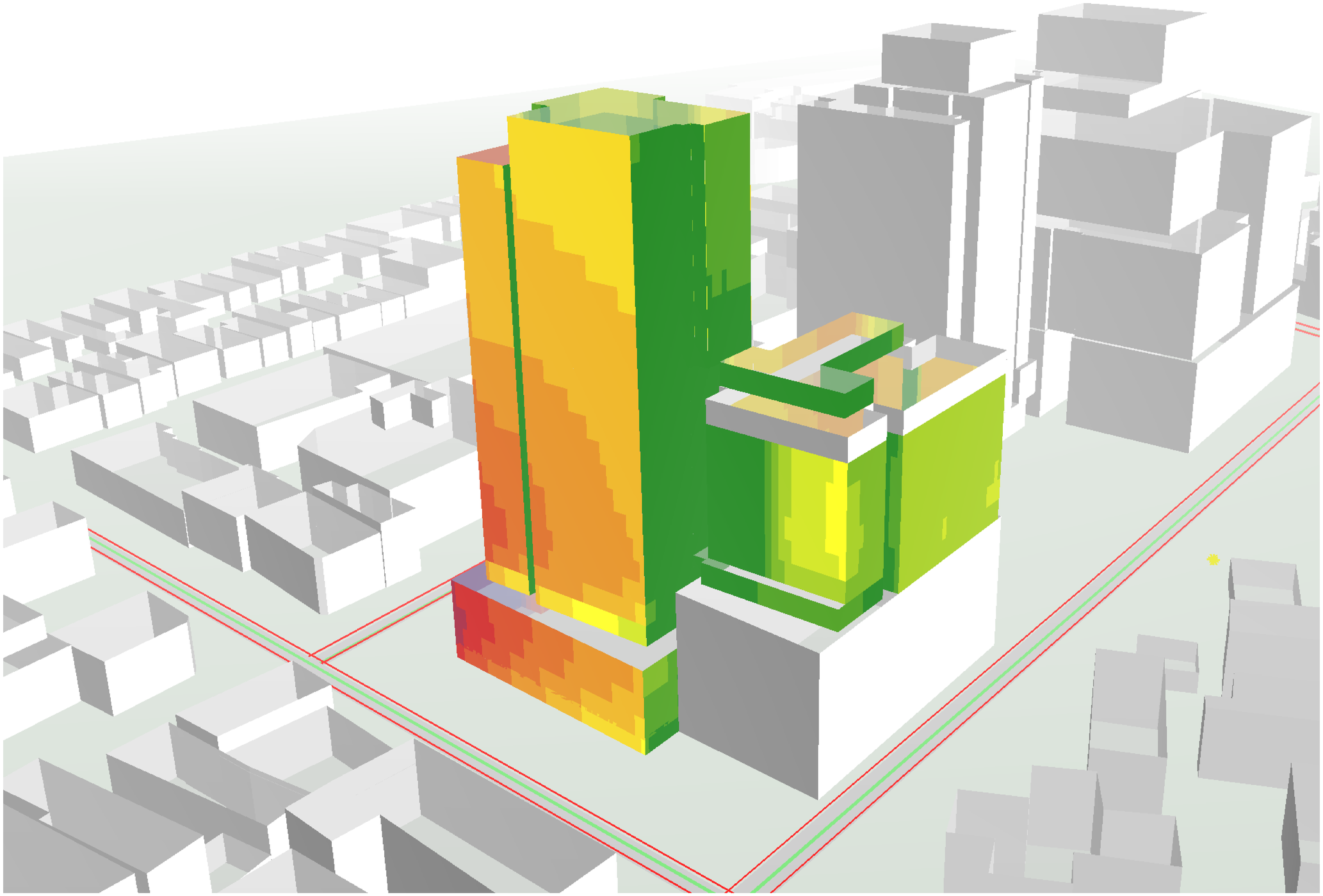

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FACADE NOISE MAP
DAYTIME
SYDNEY DCP 2012 - NOISIEST 1 HOUR

PROJECT | TITLE

Stantec

Noise Model

Day-time Model

Noise & Vibration

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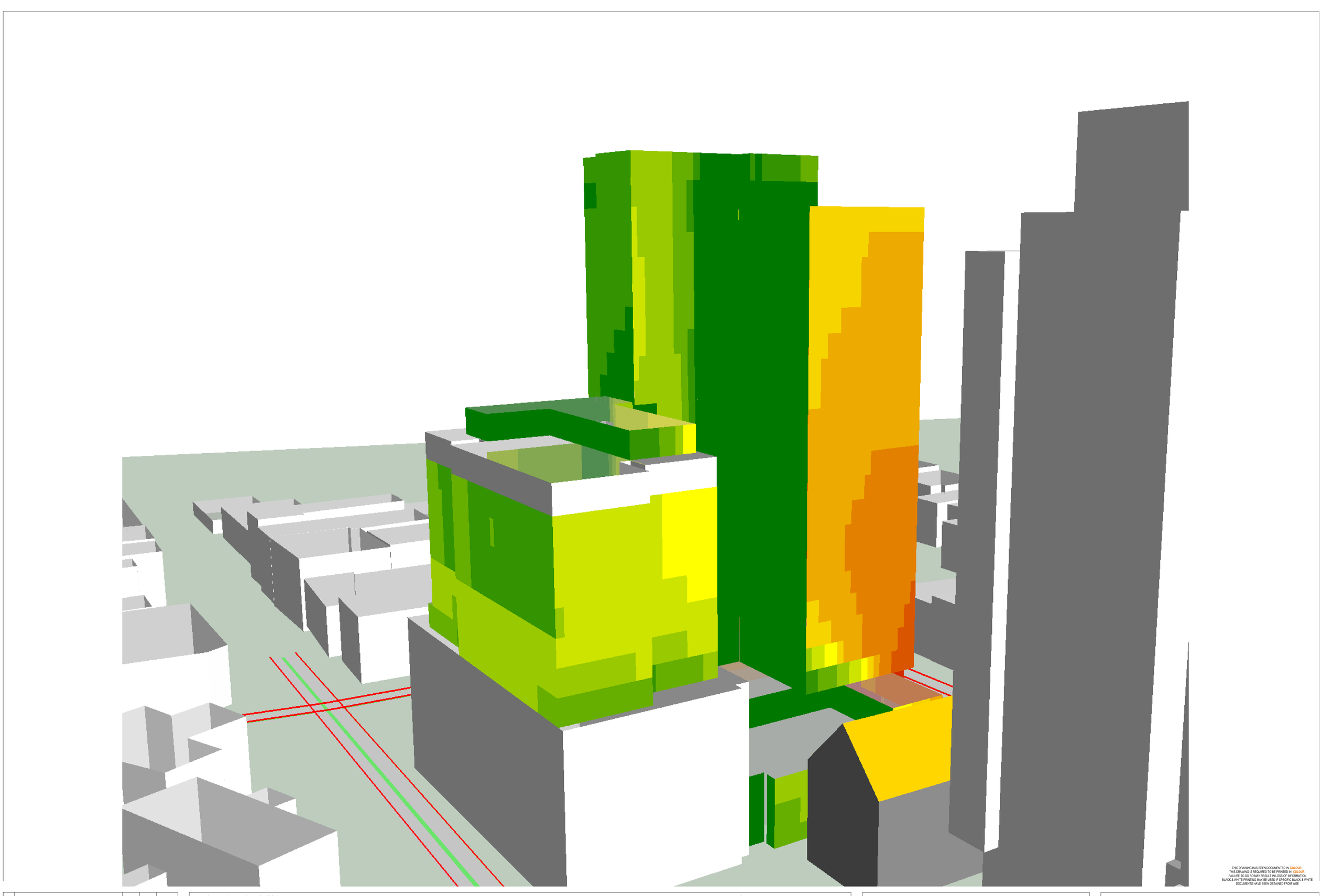

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Noise Level Legend - L_{Aeq} in dB(A)

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PROJECT: WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

TITLE: FACADE NOISE MAP
NIGHT-TIME
SYDNEY DCP 2012 - NOISIEST 1 HOUR

Stantec

Noise Model

Day-time Model

Noise & Vibration

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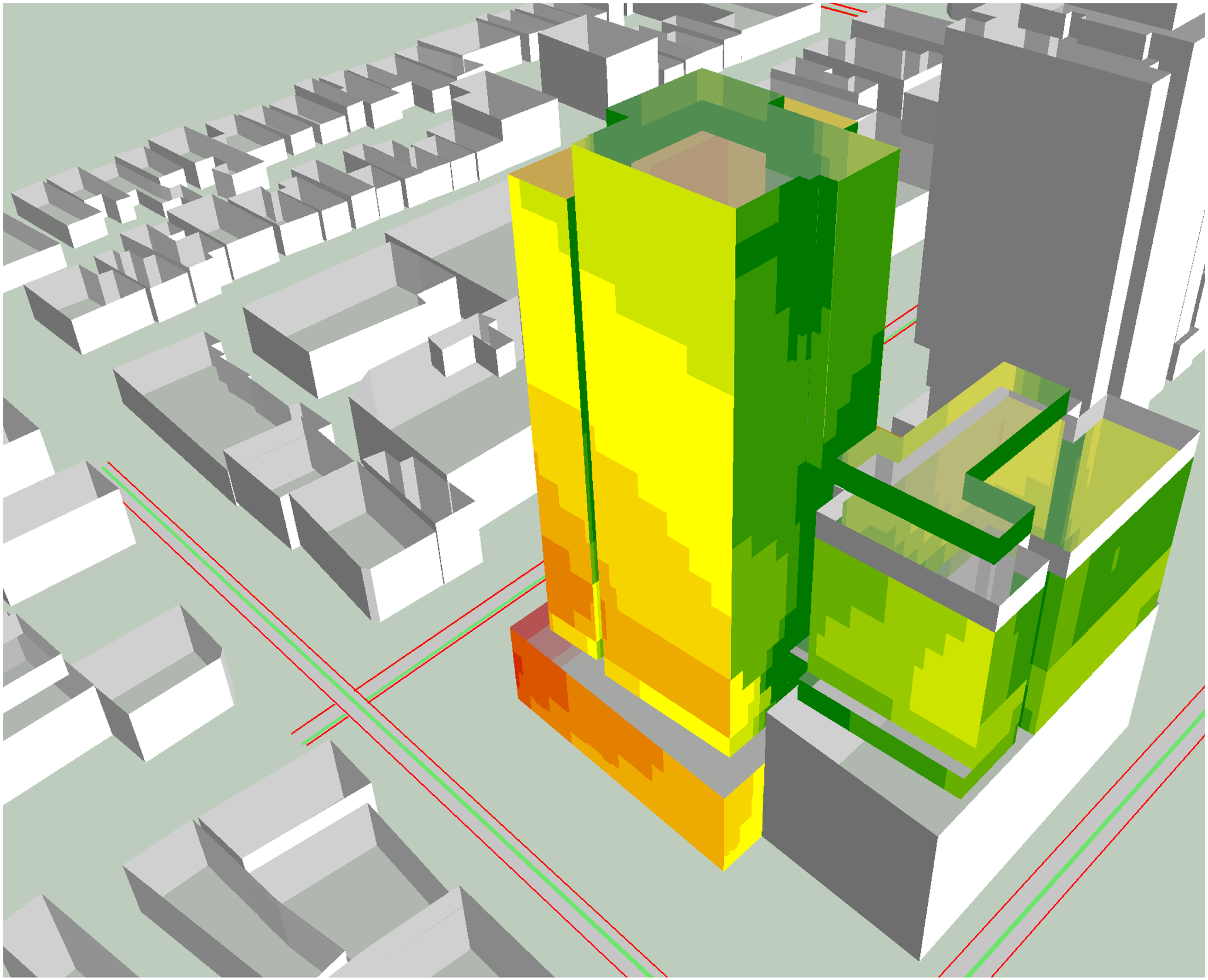

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REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

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PROJECT	TITLE
WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT	FACADE NOISE MAP NIGHT-TIME SYDNEY DCP 2012 - NOISIEST 1 HOUR

Stantec

Noise Model

Day-time Model

Noise & Vibration

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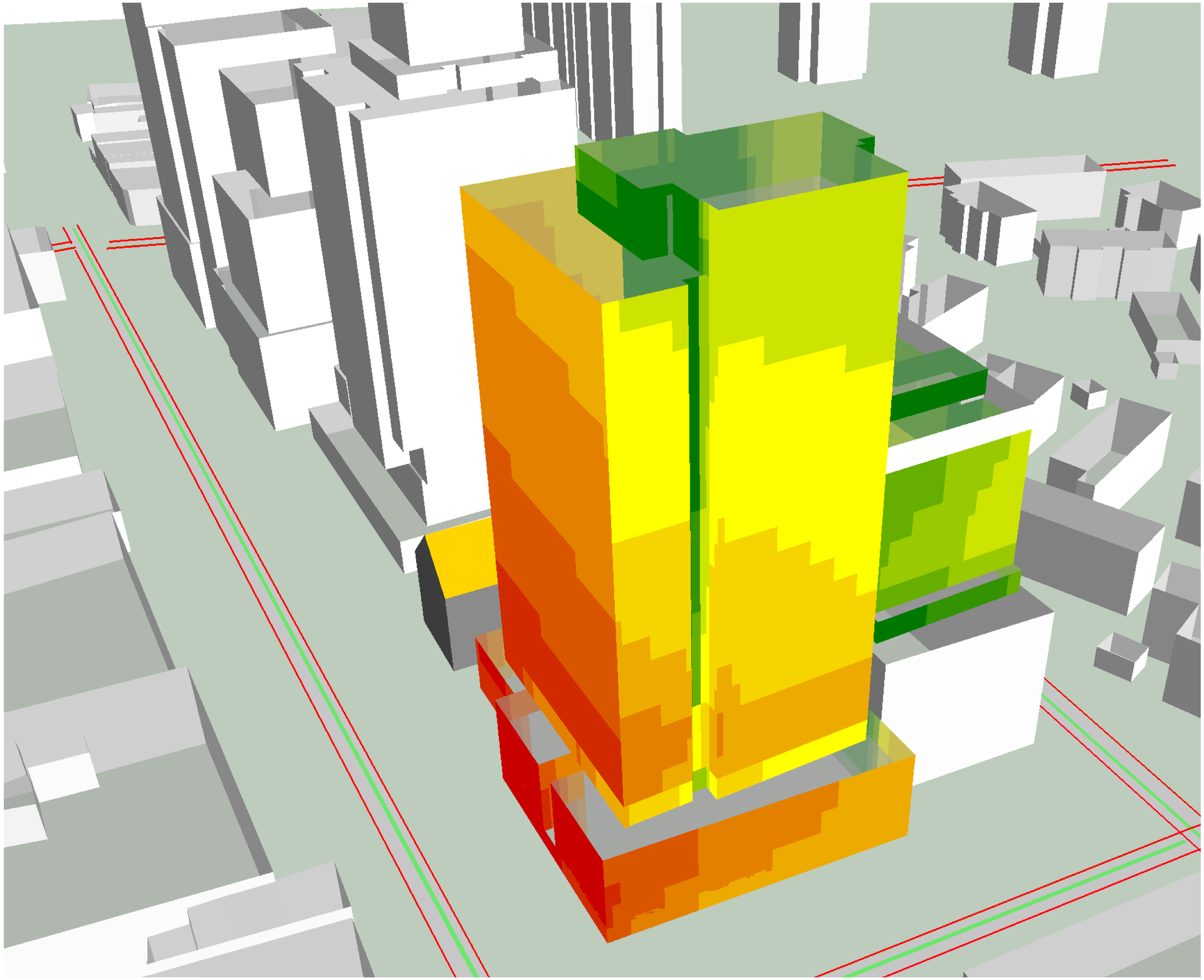

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REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

	< 45		49-51		55-57		61-63		67-69
	45-47		51-53		57-59		63-65		69-71
	47-49		53-55		59-61		65-67		> 71

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A Joint Venture Project
JOHN HOLLAND mirvac

ARCHITECT/CLIENT

WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
NIGHT-TIME
SYDNEY DCP 2012 - NOISIEST 1 HOUR

TITLE

Stantec

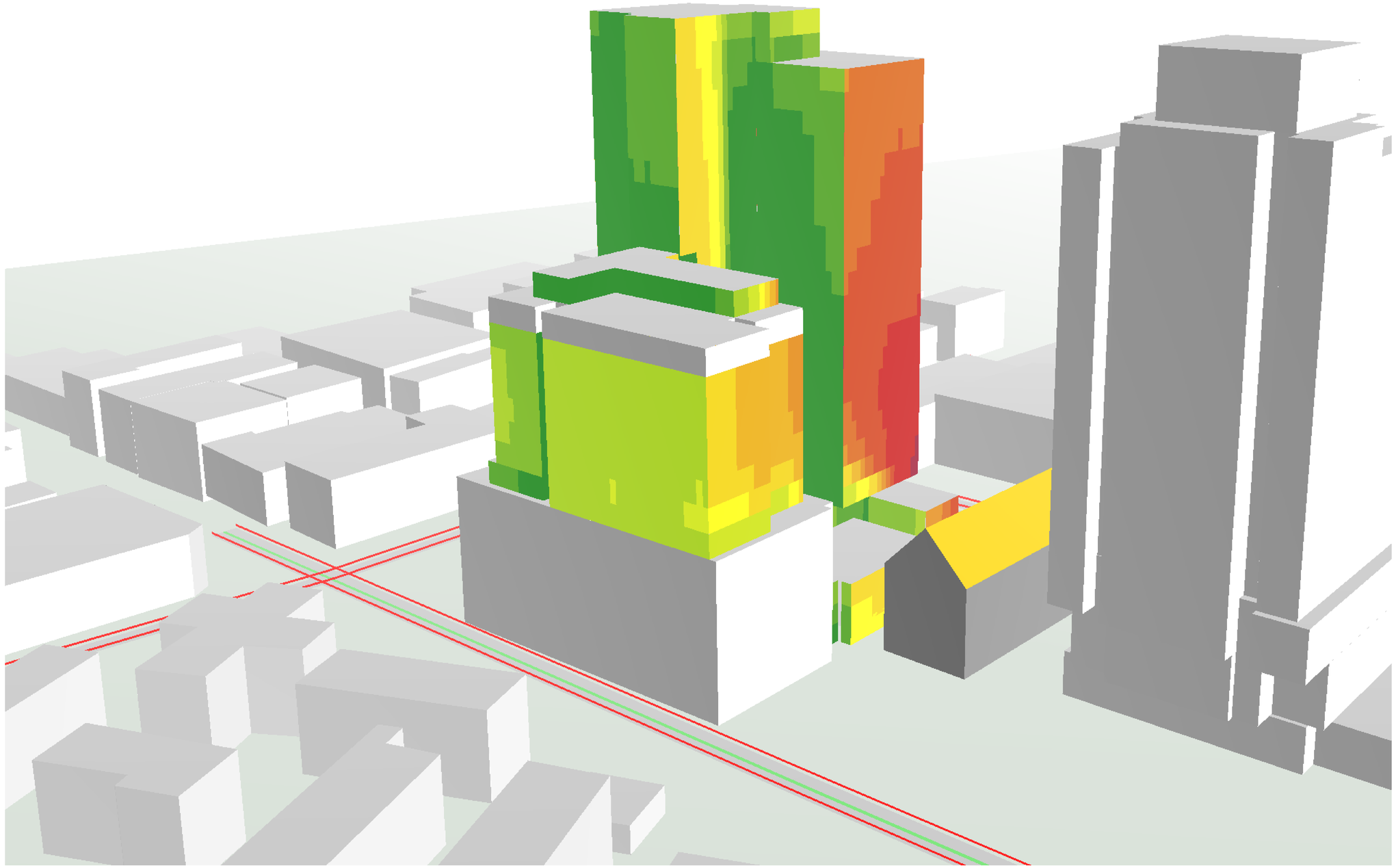
Noise Model

Day-time Model

Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001

15.2.2 DoP Interim Guideline – 15h and 9h Daily Averaged Period $L_{Aeq,15h,day}$ and $L_{Aeq,9h,night}$



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REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

< 45	49-51	55-57	61-63	67-69
45-47	51-53	57-59	63-65	69-71
47-49	53-55	59-61	65-67	> 71

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
DAYTIME
DoP INTERIM GUIDELINE - AVERAGE 15 HOUR

TITLE

Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001

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REV	DESCRIPTION	DRAWN	APPD	DATE
001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

< 45	49-51	55-57	61-63	67-69
45-47	51-53	57-59	63-65	69-71
47-49	53-55	59-61	65-67	> 71

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PROJECT: WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

TITLE: FACADE NOISE MAP
DAYTIME
DoP INTERIM GUIDELINE - AVERAGE 15 HOUR

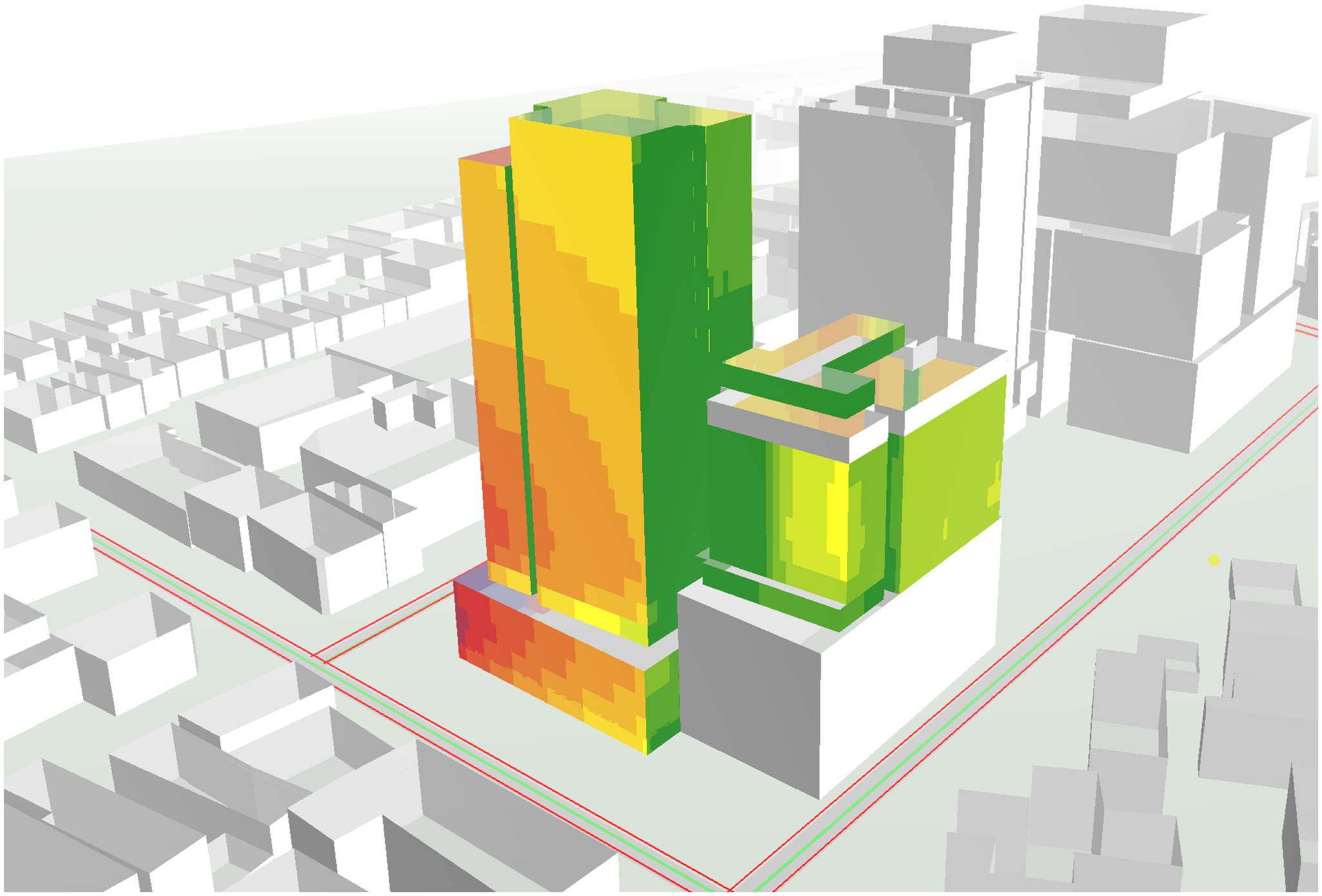
Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34AC-FNM	001



Noise Level Legend - L_{Aeq} in dB(A)

< 45	49-51	55-57	61-63	67-69
45-47	51-53	57-59	63-65	69-71
47-49	53-55	59-61	65-67	> 71

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
DAYTIME
DoP INTERIM GUIDELINE - AVERAGE 15 HOUR

TITLE

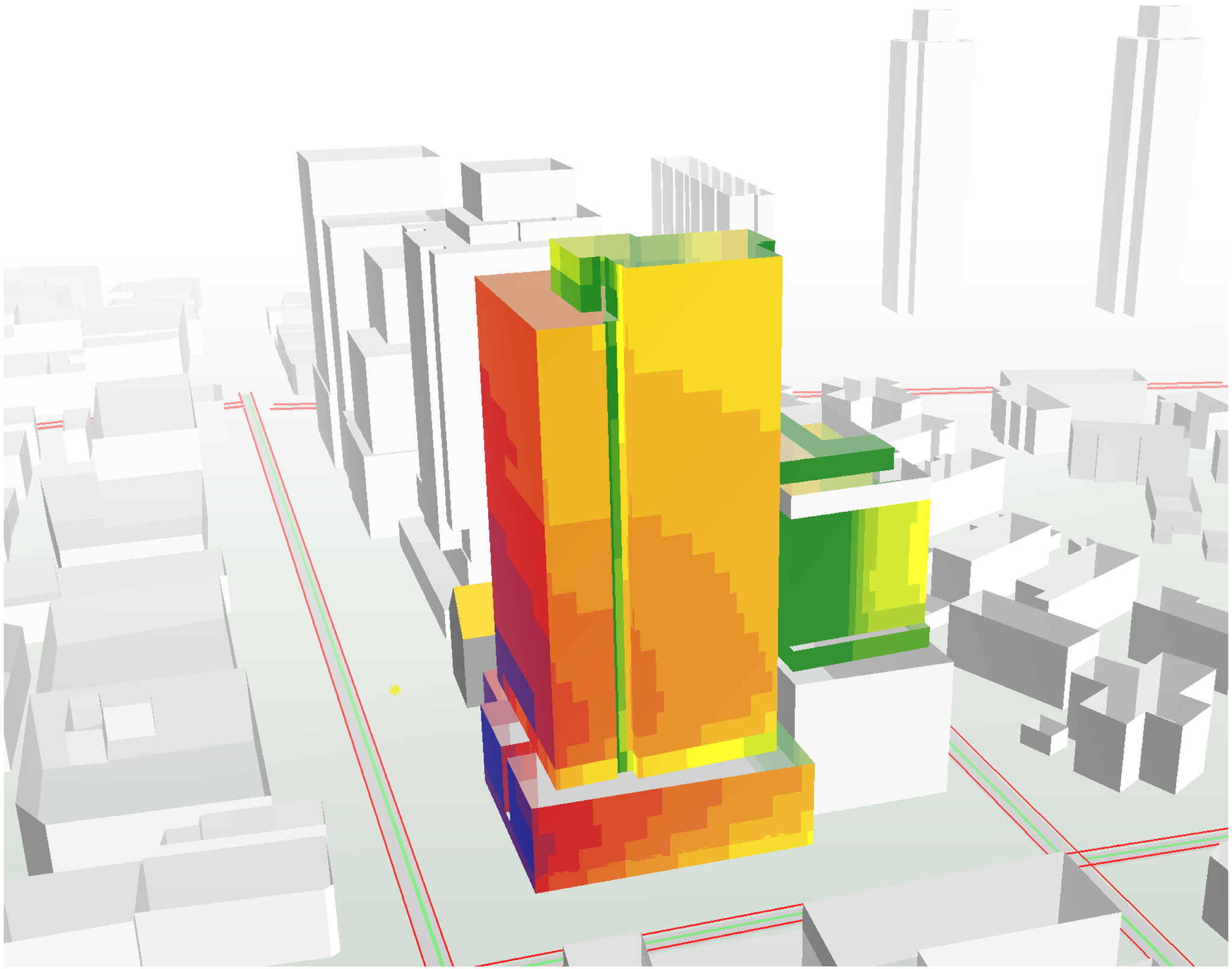
Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001



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001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
DAYTIME
DoP INTERIM GUIDELINE - AVERAGE 15 HOUR

TITLE

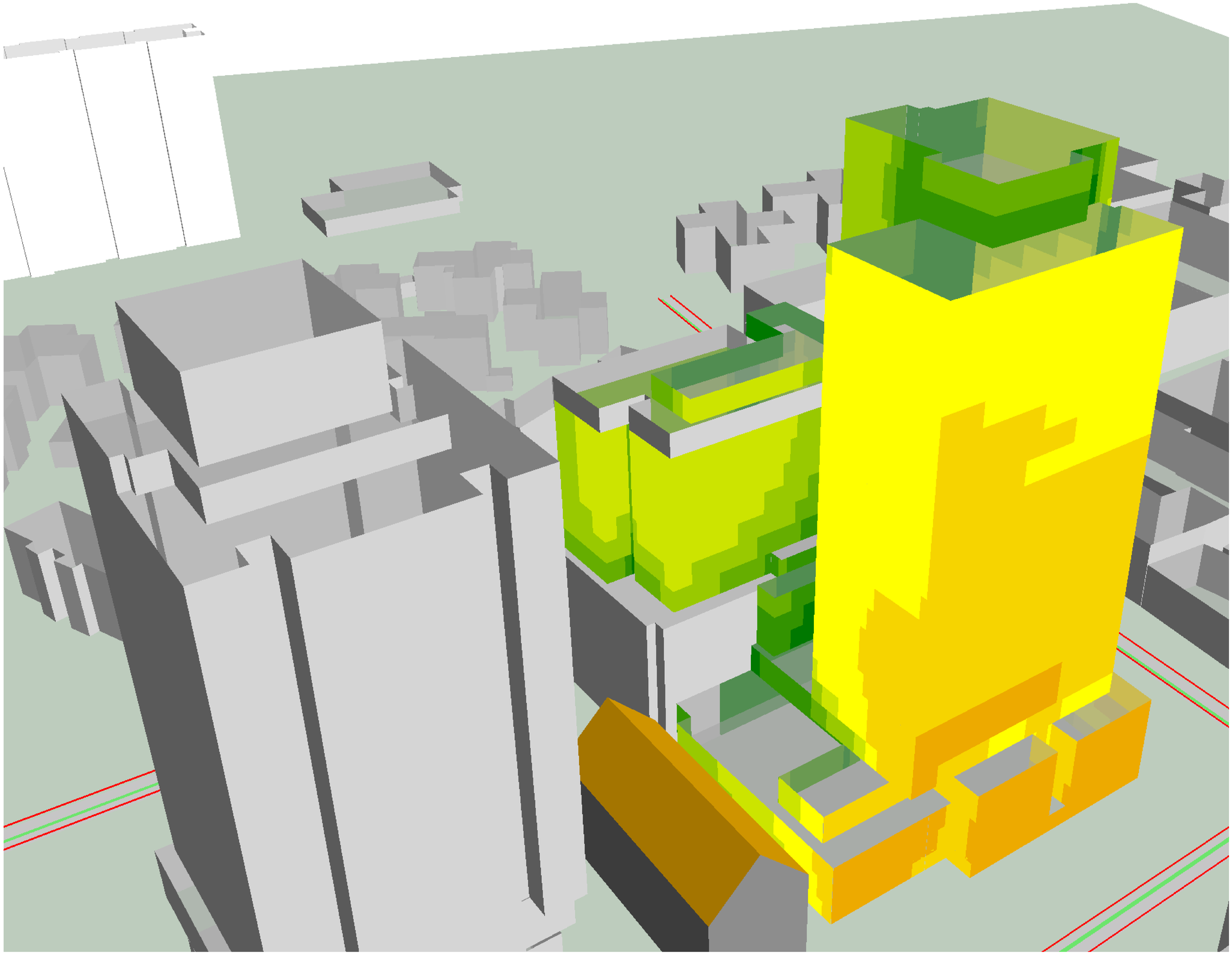
Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001



Noise Level Legend - L_{Aeq} in dB(A)

	< 45		49-51		55-57		61-63		67-69
	45-47		51-53		57-59		63-65		69-71
	47-49		53-55		59-61		65-67		> 71

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

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PROJECT: WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

TITLE: FACADE NOISE MAP
NIGHT-TIME
DoP INTERIM GUIDELINE - AVERAGE 9 HOUR

Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001

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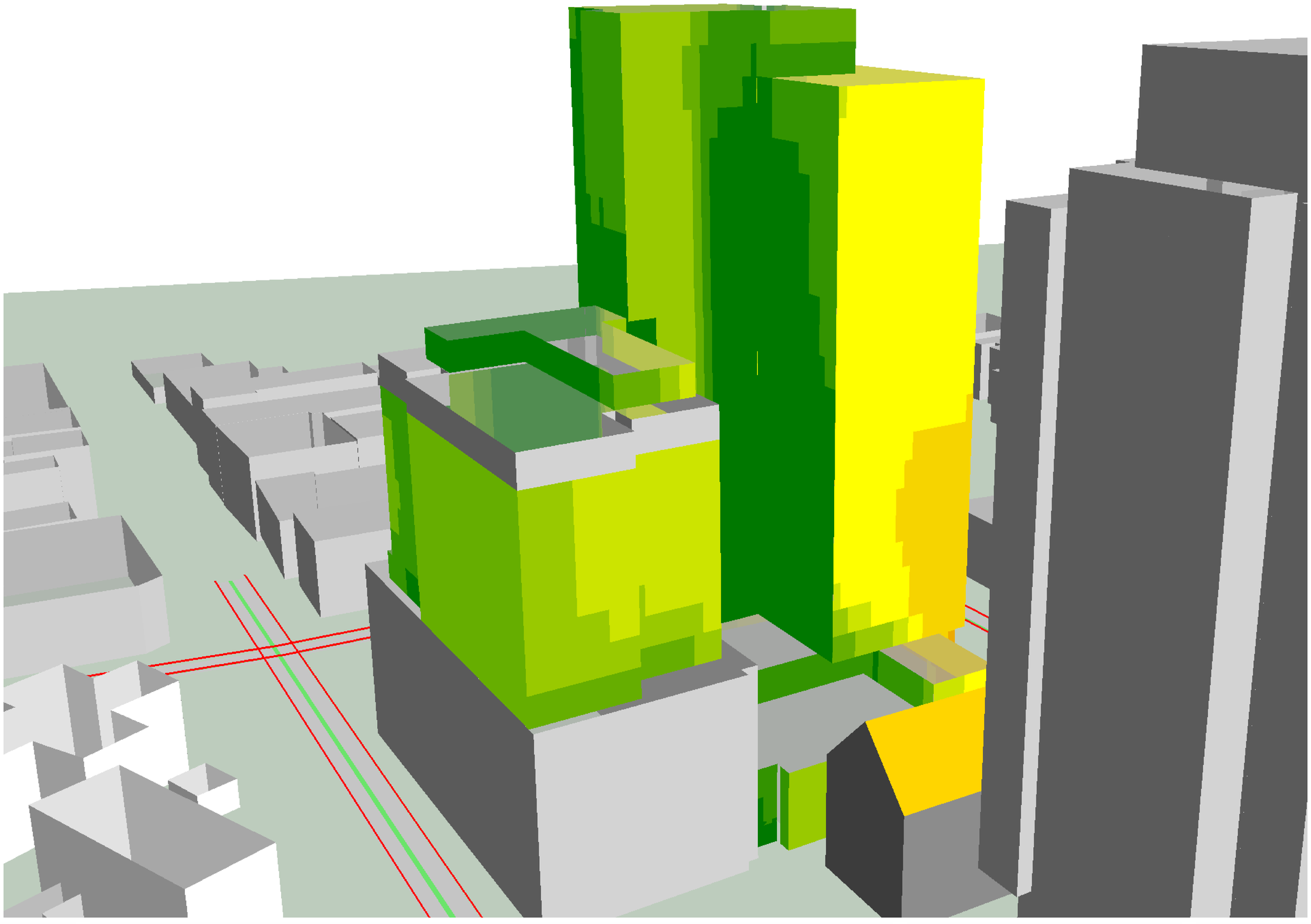

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

< 45	49-51	55-57	61-63	67-69
45-47	51-53	57-59	63-65	69-71
47-49	53-55	59-61	65-67	> 71

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
NIGHT-TIME
DoP INTERIM GUIDELINE - AVERAGE 9 HOUR

TITLE

Stantec

Noise Model
Day-time Model
Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001

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REV	DESCRIPTION	DRAWN	APP'D	DATE
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	47-49		53-55		59-61		65-67		> 71	

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PROJECT

WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

TITLE

FACADE NOISE MAP
NIGHT-TIME
DoP INTERIM GUIDELINE - AVERAGE 9 HOUR

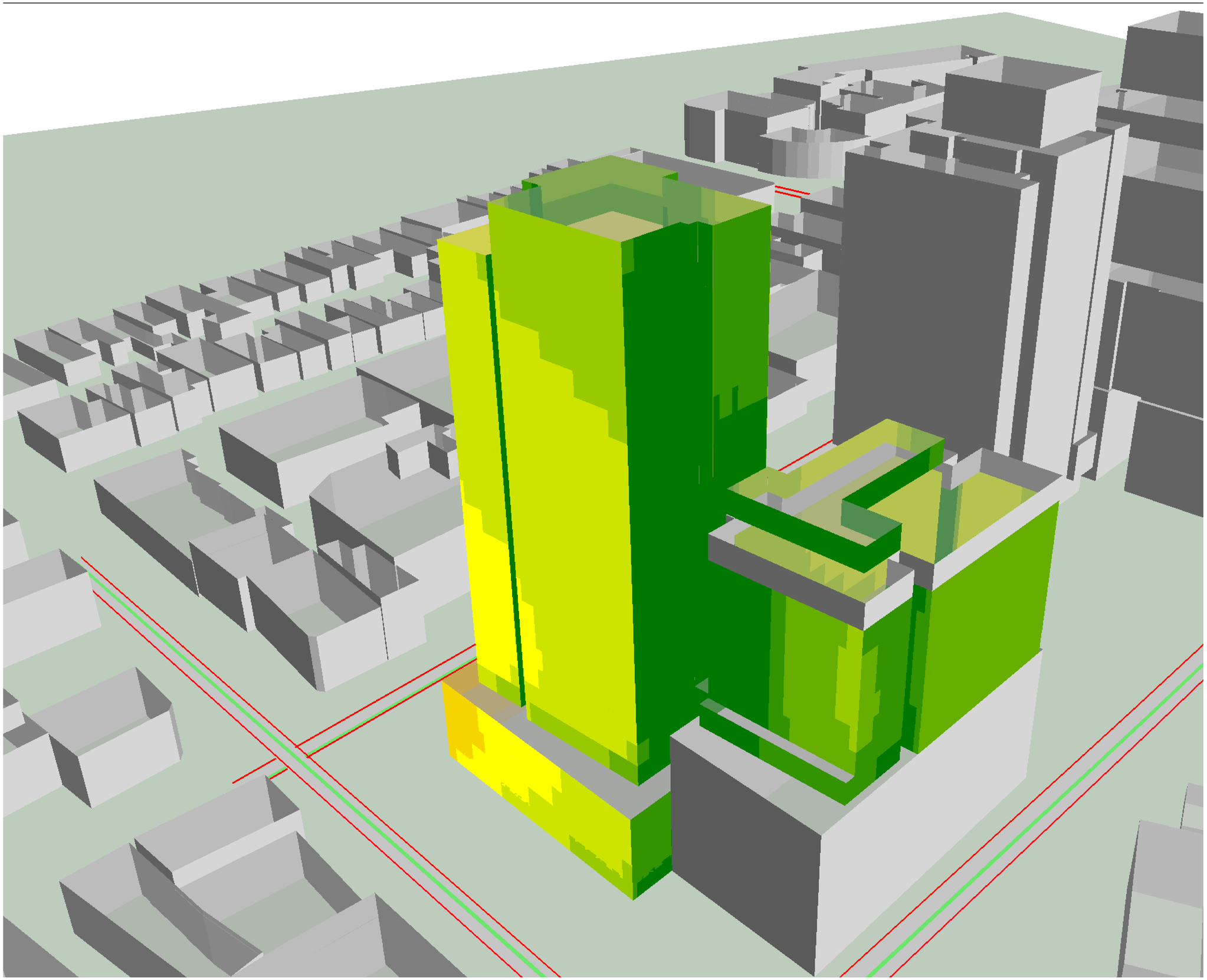
Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001



REV	DESCRIPTION	DRAWN	APP'D	DATE
001	DA Package	MIS	BN	19/06/20

Noise Level Legend - L_{Aeq} in dB(A)

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WATERLOO OVER-STATION DEVELOPMENT - SOUTHERN PRECINCT

PROJECT

FACADE NOISE MAP
NIGHT-TIME
DoP INTERIM GUIDELINE - AVERAGE 9 HOUR

TITLE

Stantec

Noise Model

Day-time Model

Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:200	46198	BLD34-AC-FNM	001

15.3 Appendix 3 – Acoustic Demand Ratings of Façade

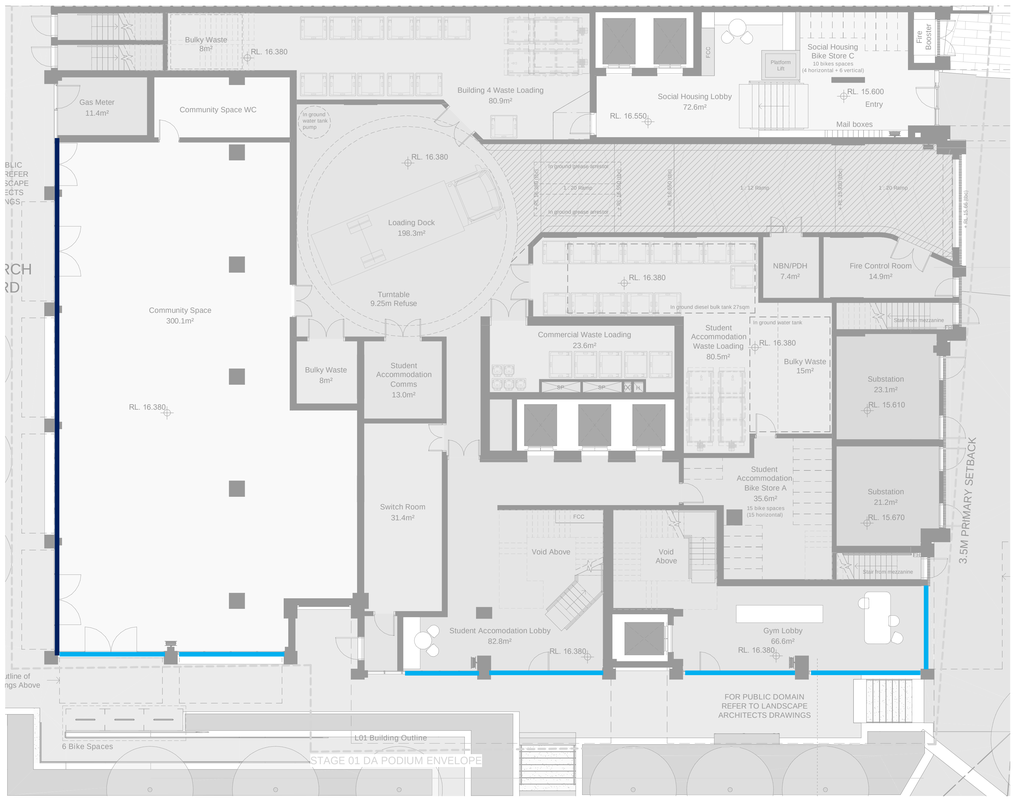
Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.



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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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ARCHITECT/CLIENT

WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, GROUND FLOOR

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7800	4

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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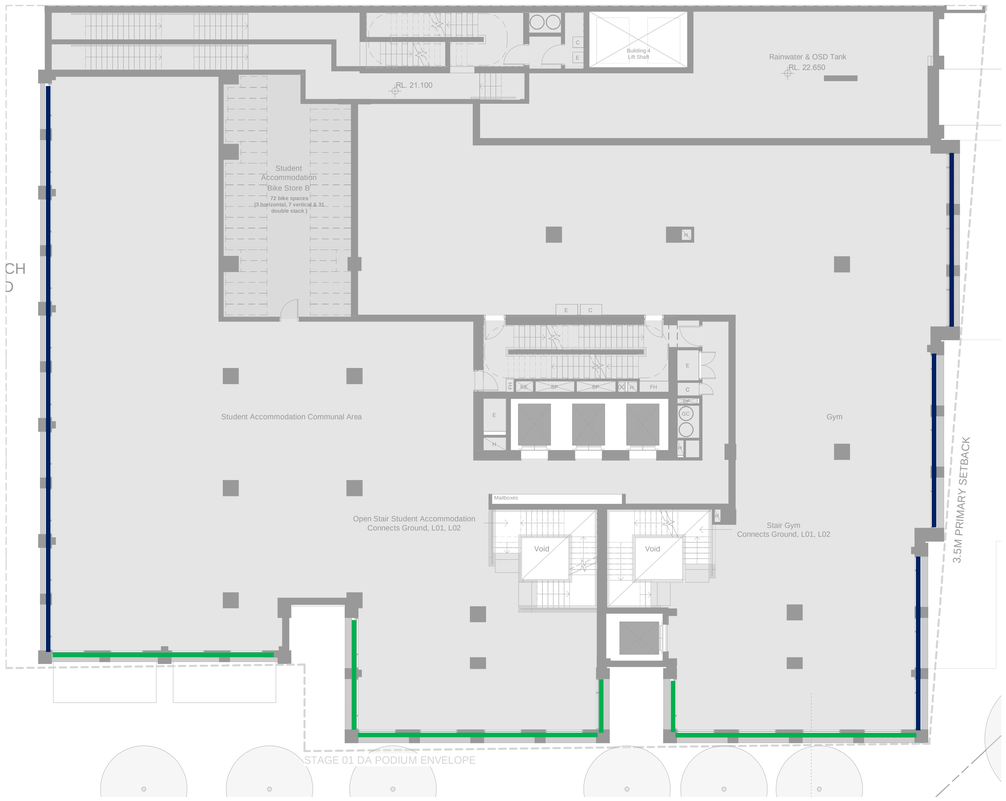

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Miletsone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 01

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7801	4
SCALE @ A0	PROJECT No	DRAWING No	REV

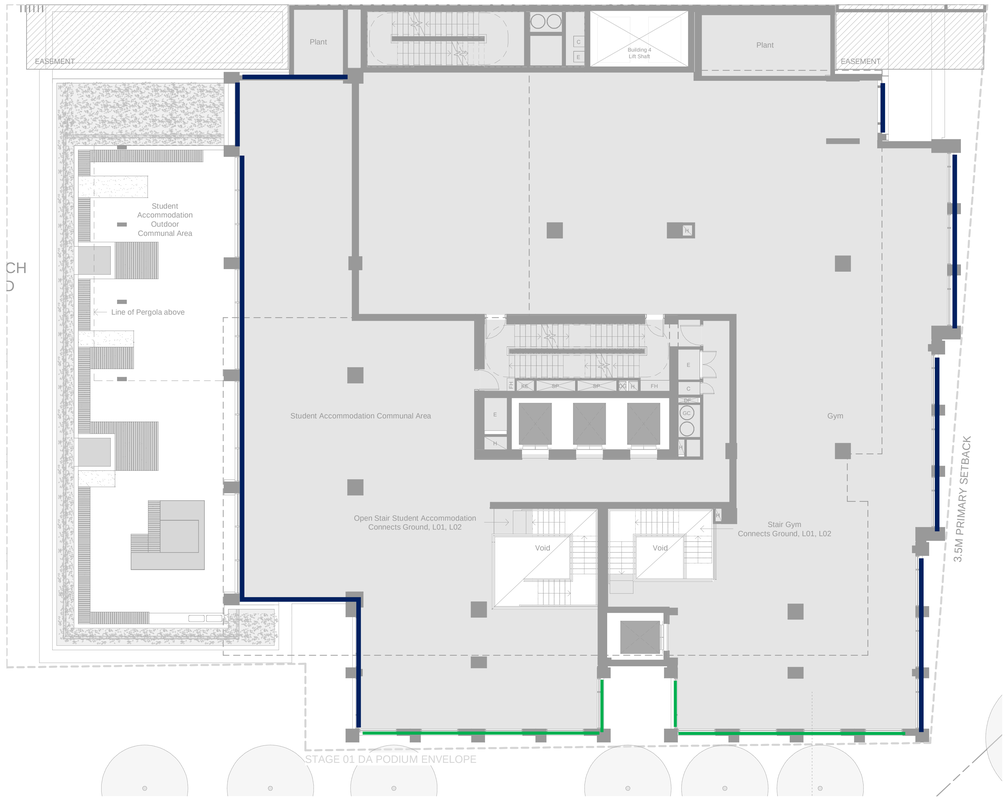
Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.



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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 02

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7802	4

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 03

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7803	4

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	31/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 04

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7804	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 05

PROJECT | TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7805	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 06

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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ARCHITECT/CLIENT

PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 07

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7807	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

THIS DRAWING HAS BEEN DOCUMENTED IN COLOUR
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FAILURE TO DO SO MAY RESULT IN LOSS OF INFORMATION
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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 08

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7808	3
SCALE @ A0	PROJECT No	DRAWING No	REV

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 09

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7809	2
SCALE @ A0	PROJECT No	DRAWING No	REV

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 10

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7810	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 11

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7811	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 12

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7812	2
SCALE @ A0	PROJECT No	DRAWING No	REV

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Miletsone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 13

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7813	3

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 14

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PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7814	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 15

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7815	4
SCALE @ A0	PROJECT No	DRAWING No	REV

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 16

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7816	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 17

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7817	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 18

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7818	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 19

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7819	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 20

TITLE

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PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7820	3
SCALE @ A3	PROJECT No	DRAWING No	REV

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 20

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7820	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 22

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7822	2

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 23

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7823	4

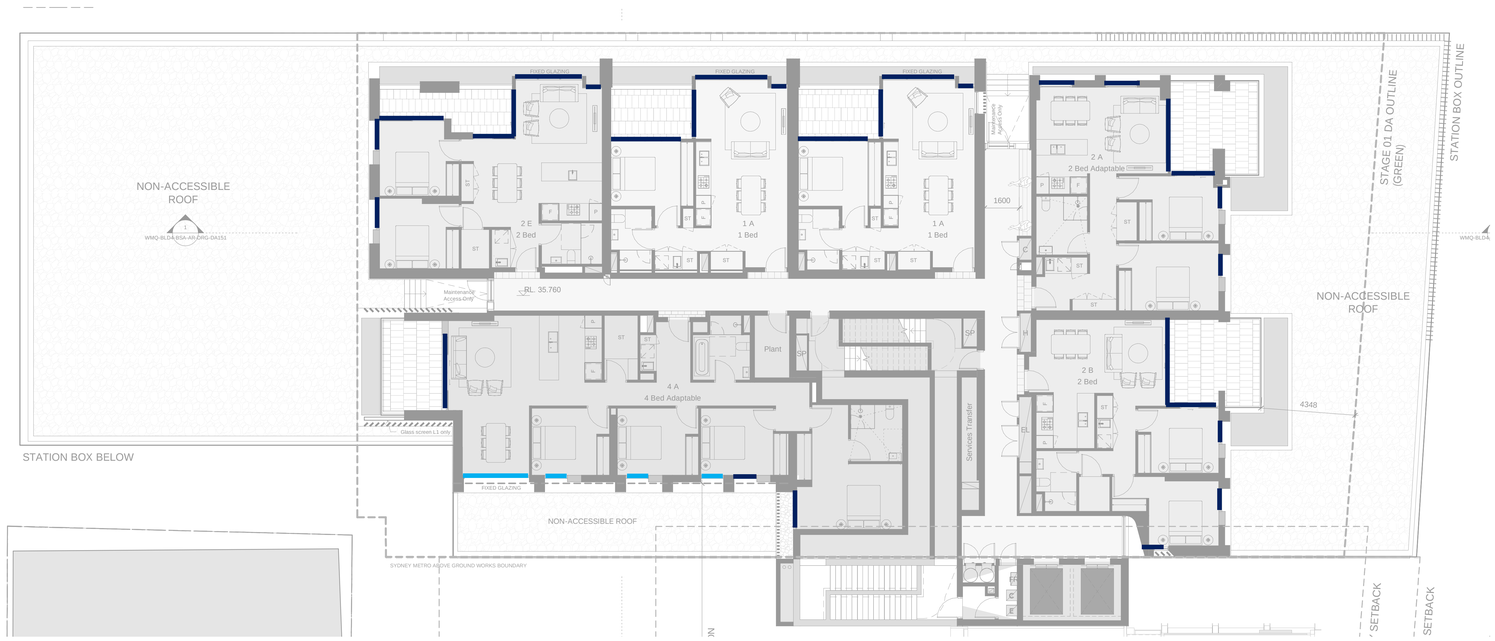
Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.



REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 01

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION

Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7806	4
SCALE @ A0	PROJECT No	DRAWING No	REV

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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
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DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
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001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 02

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PRELIMINARY
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Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 03

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 04

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PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 05

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 06

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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002	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
001	Milestone Package 3	MIS	BN	10/07/20

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WATERLOO METRO QUARTER DEVELOPMENT	GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 07

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Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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004	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 08

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Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

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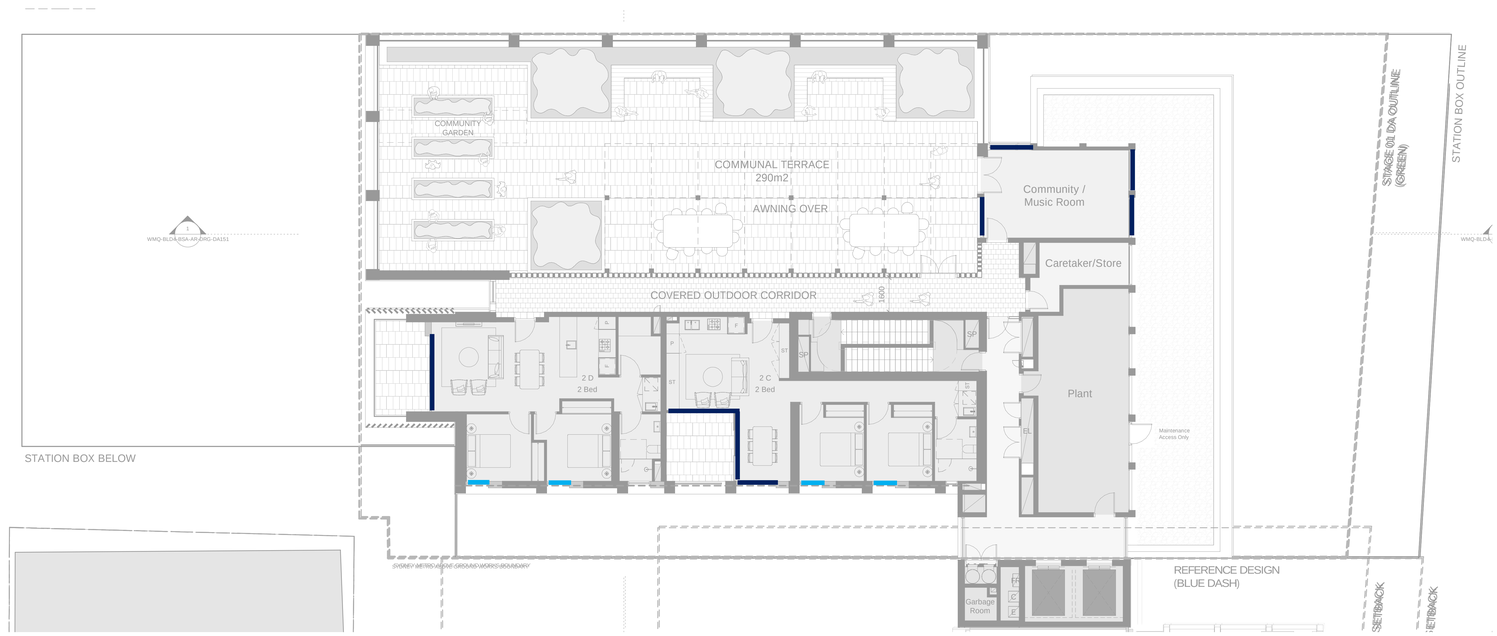

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004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: GLAZING PERFORMANCE REQUIREMENTS - BUILDING 3, LEVEL 09

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Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7814	4

15.4 Appendix 4 – Noise Affected Habitable Spaces

Noise Affected Space	

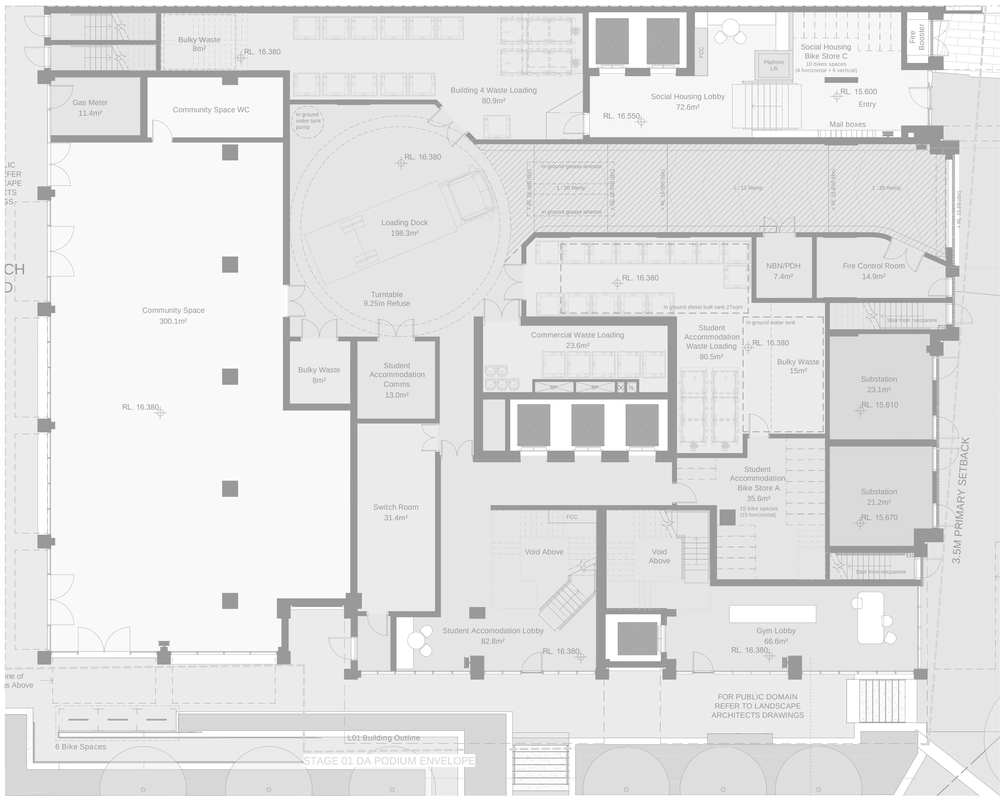
DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

3. Where the space is classified as Class 3, an alternative means of natural or mechanical ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the NCC.

4. Consideration should be given to the requirements for each Class 2 space to achieve the "purge" requirements of the ADG when calculated in accordance with the City of Sydney's methods (each space must be served by a minimum effective open area of 5% of the floor area of the space). This does not need to be achieved simultaneously with the acoustic requirements.



REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 3, GROUND FLOOR

TITLE

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PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

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SCALE @ A0	PROJECT No	DRAWING No	REV

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Noise Affected Space	

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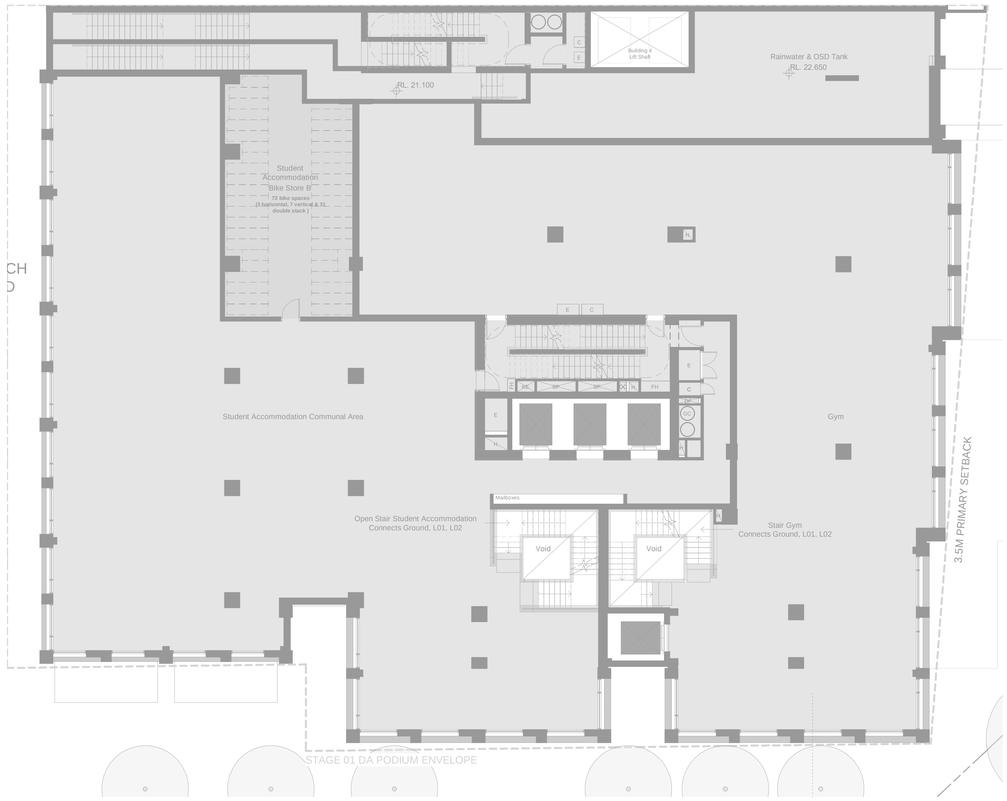

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 01

TITLE

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NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
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Noise Affected Space	

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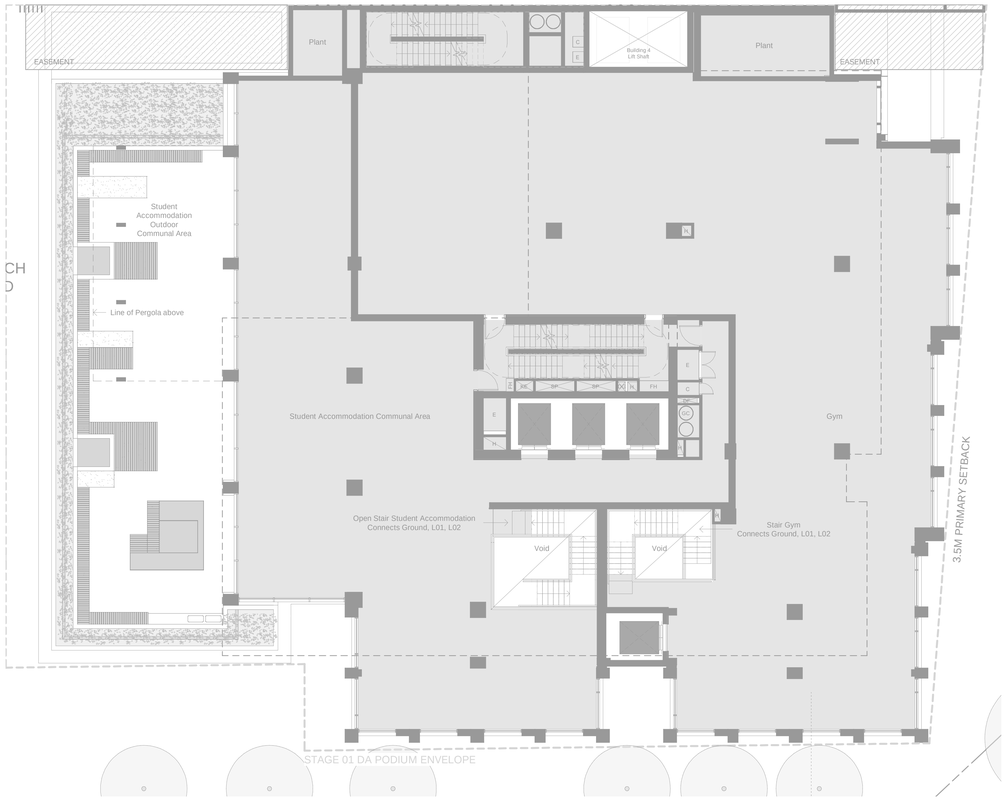

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001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 02

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Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV.
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Noise Affected Space	

DRAWING NOTES

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002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 03

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
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Noise Affected Space	

DRAWING NOTES

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2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

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4. Consideration should be given to the requirements for each Class 2 space to achieve the "purge" requirements of the ADG when calculated in accordance with the City of Sydney's methods (each space must be served by a minimum effective open area of 5% of the floor area of the space). This does not need to be achieved simultaneously with the acoustic requirements.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNERS CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 04

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7864	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 05

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7865	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 06

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7866	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 07

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7867	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 08

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7868	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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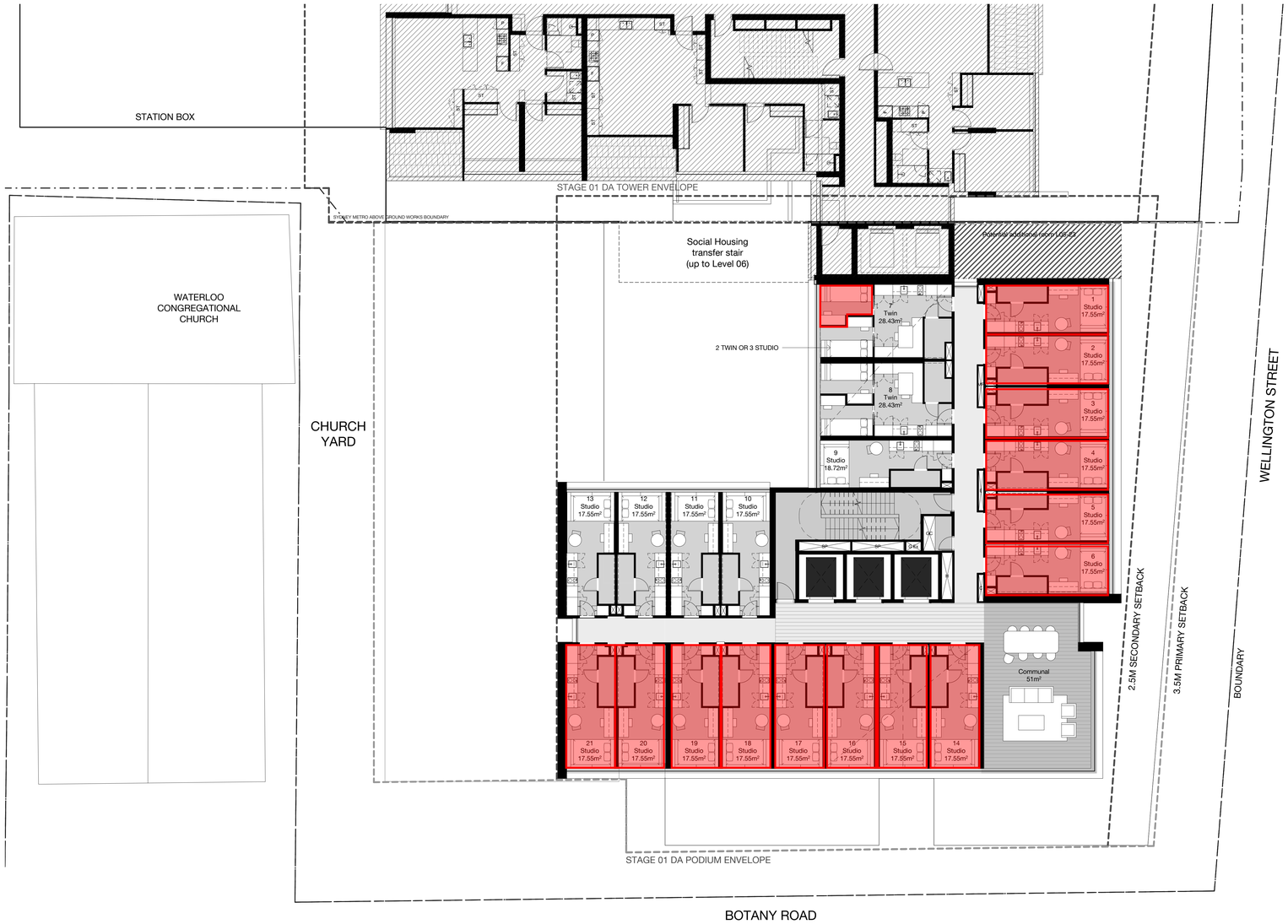

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 09

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7869	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	20/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 10

PROJECT | TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7870	3
SCALE @ A0	PROJECT No	DRAWING No	REV

Noise Affected Space	

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 11

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7871	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 12

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7872	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 13

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7873	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 14

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7874	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 15

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7875	4

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 16

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PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7876	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APPD	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 17

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7877	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

2. Where the space is classified as Class 2 (residential apartments), an alternative means of natural ventilation shall be provided to the noise affected space such that when open, meets both the acoustic requirements and the requirements of the City of Sydney's "Draft Alternative natural ventilation of apartments in noisy environments - Performance pathway guideline".

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4. Consideration should be given to the requirements for each Class 2 space to achieve the "purge" requirements of the ADG when calculated in accordance with the City of Sydney's methods (each space must be served by a minimum effective open area of 5% of the floor area of the space). This does not need to be achieved simultaneously with the acoustic requirements.

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REV	DESCRIPTION	DRAWN	APPD	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 18

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7878	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APPD	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 19

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7879	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APPD	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 20

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7880	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APPD	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 21

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7881	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT: WATERLOO METRO QUARTER DEVELOPMENT

TITLE: NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 22

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7882	3

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.

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004	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 3, LEVEL 23

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD3-WGE-AC-SK-AC7883	4

Noise Affected Space	

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/10
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 01

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7866	4
SCALE @ A0	PROJECT No	DRAWING No	REV

Noise Affected Space	

DRAWING NOTES

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004	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
003	Milestone Package 3	MIS	BN	10/07/20
002	Milestone Package 2	MIS	BN	22/05/20
001	Milestone Package 1	MIS	BN	1/04/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 02

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7867	4
SCALE @ A0	PROJECT No	DRAWING No	REV

Noise Affected Space	

DRAWING NOTES

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REV	DESCRIPTION	DRAWN	APP'D	DATE
003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 03

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7868	3

Noise Affected Space	

DRAWING NOTES

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003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 04

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7869	3

Noise Affected Space	

DRAWING NOTES

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003	SSDA ISSUE - FOR LANDOWNER'S ISSUE	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 2	MIS	BN	22/05/20

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PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 05

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7870	3

Noise Affected Space	

DRAWING NOTES

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003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 06

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7871	3
SCALE @ A0	PROJECT No	DRAWING No	REV

Noise Affected Space	

DRAWING NOTES

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003	SSDA ISSUE - FOR LANDOWNER'S CONSENT	MIS	BN	29/07/20
002	Milestone Package 3	MIS	BN	10/07/20
001	Milestone Package 1	MIS	BN	22/05/20

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WATERLOO METRO QUARTER DEVELOPMENT

PROJECT

NOISE AFFECTED LOCATIONS - BUILDING 4, LEVEL 07

TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

1:100	46198	WMQ-BLD4-WGE-AC-SK-AC7872	3
SCALE @ A0	PROJECT No	DRAWING No	REV