



WATERLOO METRO QUARTER OVERSTATION DEVELOPMENT

Environmental Impact Statement Appendix K – Noise and Vibration Impact Assessment

SSD-10441 Amending Concept DA

State Significant Development

Development Application

Prepared for **WL Developer Pty Ltd**

30 September 2020

Reference	Description
Applicable SSD Applications	SSD-10441 Amending Concept DA
Author	Stantec (Australia) Pty Ltd Brandon Notaras
Reviewed	Waterloo Developer Pty Ltd Nick Owen
Document Number	WMQ-SITE-WGE-AC-RPT-SSD DA-Amending DA
Status	For Approval
Version	2
Date of Issue	30 July 2020
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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

Reference	Description
ESD	ecologically sustainable design
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

Reference	Description
The site	The site which is the subject of the detailed SSD DA
VIA	Visual Impact Assessment
WMQ	Waterloo Metro Quarter
WMP	Waste Management Plan
WSUD	water sensitive urban design

2. Executive summary

This report has been prepared by Stantec (Australia) Pty Ltd to accompany a concept State significant development (SSD) development application (DA) for the Waterloo Metro Quarter over station development (OSD). This concept SSD DA is submitted as an 'amending DA', that modifies the previously approved concept SSD DA issued for the site (SSD 9393). The modifications contained within the amending DA relate to the northern precinct and central building only. No change is proposed to the original concept SSD DA as it relates to the southern precinct of the Waterloo Metro Quarter site.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the amending concept SSD DA (SSD 10441).

The proposed amending changes to the concept DA include a change in envelope and change in the use of some spaces within the Northern and Southern Precinct. Noise and vibration impacts that have not been affected by proposed changes and have been previously addressed in the first concept approval are not included in this report. This report concludes that the proposed amending concept DA for the Waterloo Metro Quarter OSD is suitable and warrants approval subject to the implementation of the following mitigation measures:

- A detailed assessment of the industrial noise emissions from the proposed development should be conducted for the Detailed SSD DA once the technical specifications and layout of proposed mechanical plant and equipment is further defined;
 - Further analysis of acoustic façade treatment to amended spaces to ensure permissible uses can comply with the relevant guidelines;
 - An alternative means of ventilation will need to be integrated into the design of the proposed development for the Detailed SSD DA; and
- A detailed assessment of the construction noise and vibration emissions to the surrounding sensitive receivers will be required for the Detailed SSD DA.

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

3. Introduction

This report has been prepared to accompany a concept SSD DA for the over station development (OSD) at the Waterloo Metro Quarter site. The concept DA seeks consent for an amended building envelope and description of development for the northern precinct and central building of the Waterloo Quarter site approved under SSD 9393. For clarity, this concept DA (formerly referred to as a 'Stage 1' DA) is made under Section 4.22 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

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 concept DA seeks to modify the approved building envelope for the northern precinct (previously comprising 'Building A', 'Building B', 'Building C' and 'Building D' under SSD 9393) through:

- increasing the maximum building height for the southern portion of the building envelope from RL56.2 to RL72.60
- removing the 'tower component' of the northern precinct, reducing the overall height of the tower envelope from RL116.9 to RL90.40, to enable the redistribution of floor space to commercial office floor plates
- amending the description of development to refer to a mid-rise (approximately 17 storey) commercial office building, comprising approximately 34,125sqm of commercial office floor space within the northern portion of the site, rather than a third residential tower.

The concept DA seeks to modify the central building approved building envelope (previously comprising 'Building E' under SSD 9393) through:

- modifying the eastern extent of the podium envelope.

This proposal will not exceed the permissible building height for the site under the Sydney Local Environmental Plan 2012 (SLEP) or the maximum height approved under SSD 9393. Separate detailed SSD DA (s) will be lodged concurrently for the detailed design, construction and operation of the northern precinct and central building. No changes are proposed to the original concept DA as it relates to the southern precinct.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 9 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)
Plans and Documents	Noise and Vibration Report	Section 8 – 13

Table 1 - SEARs Requirements

4. The site

The site is located within the City of Sydney Local Government Area (LGA). The site is situated approximately 3.3 kilometres south of Sydney CBD and approximately 8 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 located 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 (the site) is a rectangular shaped allotment and 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 boundaries of the site the subject of the amending concept DA is identified at Figure 5.1. 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 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.

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 in Figure 2.

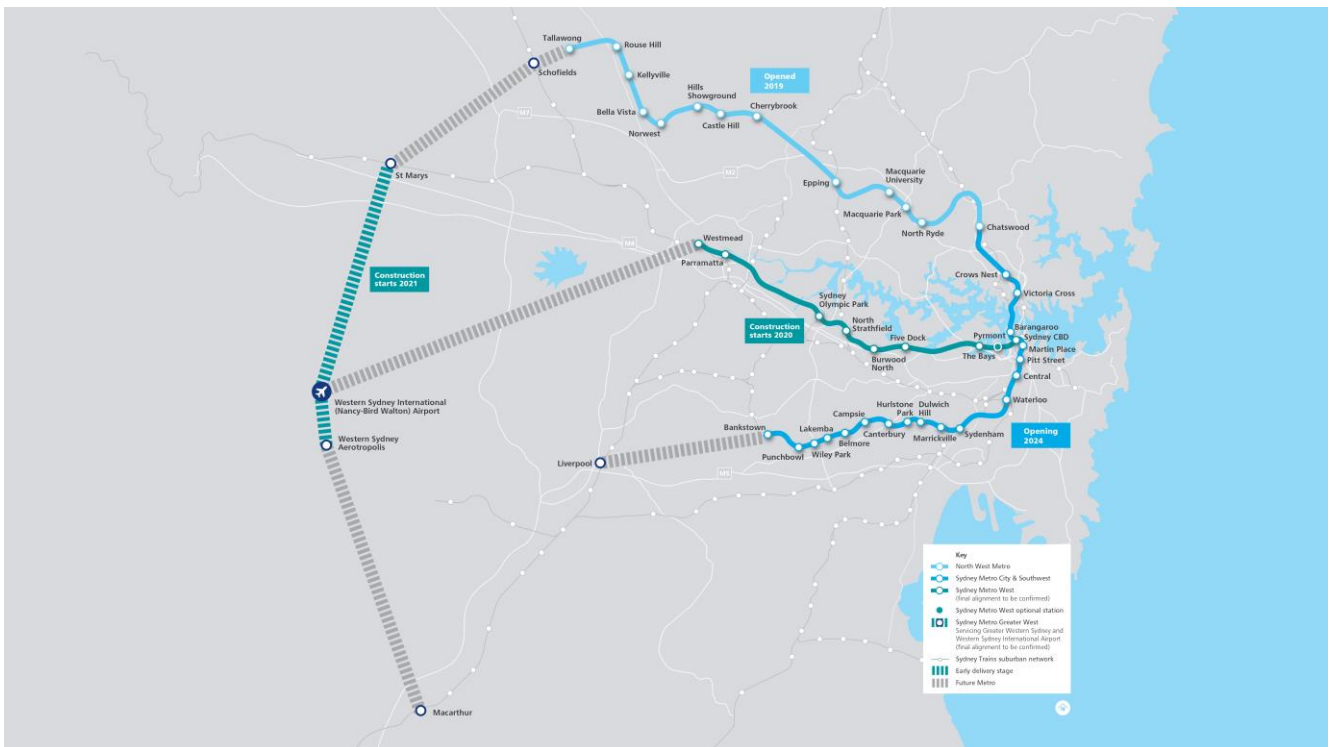


Figure 2 - Sydney Metro alignment map
Source: Sydney Metro

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 3.

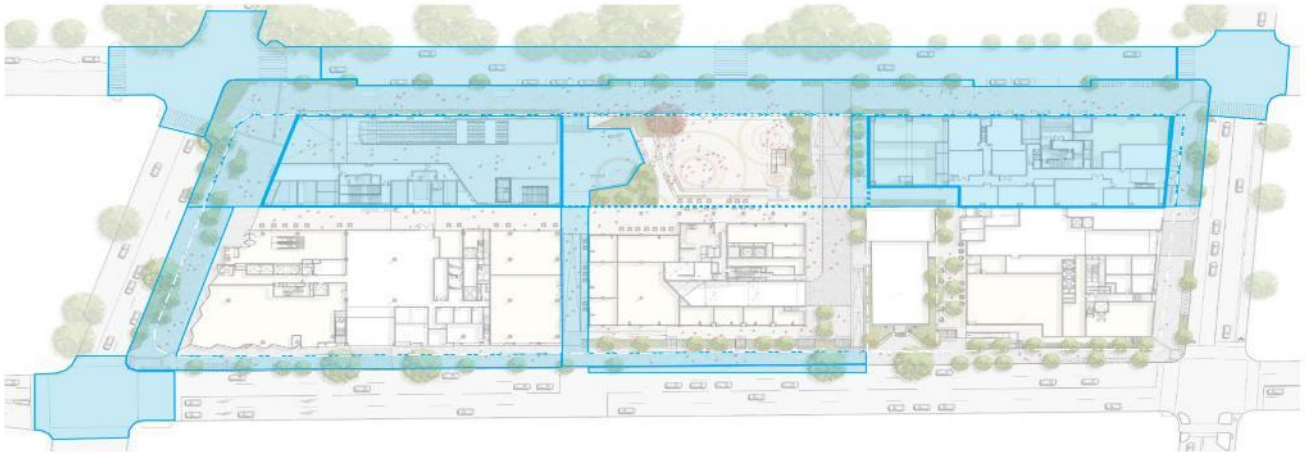


Figure 3 - CSSI Approval scope of works
Source: WL Developer Pty Ltd

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.

This concept DA has been prepared and submitted to the DPIE and proposes 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.

A concurrent detailed SSD DA will seek development consent for the OSD located within the southern precinct of the site, consistent with the parameters of the original concept approval. Separate SSD DAs have been prepared and will be submitted for the northern precinct, central building, and basement proposed across the Waterloo Metro Quarter site consistent with the amending concept DA.

6. Proposed development

The amending concept DA seeks consent for an amended building envelope and description of development for the northern precinct of the Waterloo Metro Quarter site approved under SSD 9393. Specifically, the proposal seeks to modify the approved building envelope for the northern precinct (previously comprising 'Building A', 'Building B', 'Building C' and 'Building D' under SSD 9393) through:

- increasing the maximum building height for the southern portion of the Northern Precinct from RL56.2 to RL72.60
- removing the 'tower component' of the Northern Precinct, reducing the overall height of the tower envelope from RL116.9 to RL90.40, to enable the redistribution of floor space to commercial office floor plates
- amending the description of development to refer to a mid-rise (approximately 17 storey) commercial office building, comprising approximately 34,125sqm of commercial office floor space within the northern portion of the site, rather than a third residential tower.

The concept DA seeks to modify the central building approved building envelope (previously comprising 'Building E' under SSD 9393) through:

- modifying the eastern extent of the podium envelope.

The modification of the approved concept SSD DA will enable the detailed design of a new commercial building (comprising office and retail premises) to be pursued on the site, significantly increasing the proportion of employment generating floor space on the Waterloo Metro Quarter site. This new commercial building is proposed in replacement of four building envelopes approved under SSD 9393, which comprised one residential tower, and three mid-rise residential buildings.

This proposal will not exceed the permissible building height for the site under the SLEP or the maximum height approved under SSD 9393. As noted above, separate detailed SSD DA(s) will be lodged concurrently for the detailed design, construction and operation of the northern precinct, and central building.

This amending concept DA does not propose to amend the original concept approval as it relates to the southern precinct.

7. Methodology

To assess the noise and vibration impacts of the amendments to the existing Concept Approval forming part of the Amending Concept Proposal, the following process was carried out:

- Determine the project noise and vibration criteria applicable to the amendments to the approved development in accordance with the requirements listed in the Secretary's Environmental Assessment Requirements (SEARs), Noise and Vibration Impact Assessment prepared by SLR Consulting dated 09 November 2018 accompanying the existing Concept Approval (SSD 9393), Waterloo Design and Amenity Guidelines dated March 2020 and Concept DA Conditions (SSD 9393), together with the requirements in Appendix B8 of the Station Delivery Deed Schedule C1. This includes criteria for the assessment of operational noise and vibration, as well as construction noise and vibration;
- Assess the operational and construction noise and vibration impacts of the noise and vibration sources generated by the amendments to the approved development where these sources have been introduced by amendments to the existing Concept Approval; and
- Provide details of mitigation measures and further analysis required to alleviate noise and vibration impacts to achieve the project noise and vibration criteria for the Detailed SSD DA.

The noise and vibration assessments conducted as part of this report have also been assessed to the noise and vibration criteria established by NSW Environment Protection Authority (EPA) and Transport for NSW (TfNSW) outlined in Appendix B8 of the Station Delivery Deed Schedule C1.

8. Noise and Vibration Baseline 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 existing 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.

The purpose of these baseline investigations were to collect results that could confirm the existing environment for the additional assessment required for the amendments to the proposed development.

8.1 Existing Baseline Investigations (Existing Concept Approval)

Forming part of the existing 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 and listed in Table 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 1 - SLR Consulting long-term noise measurement locations

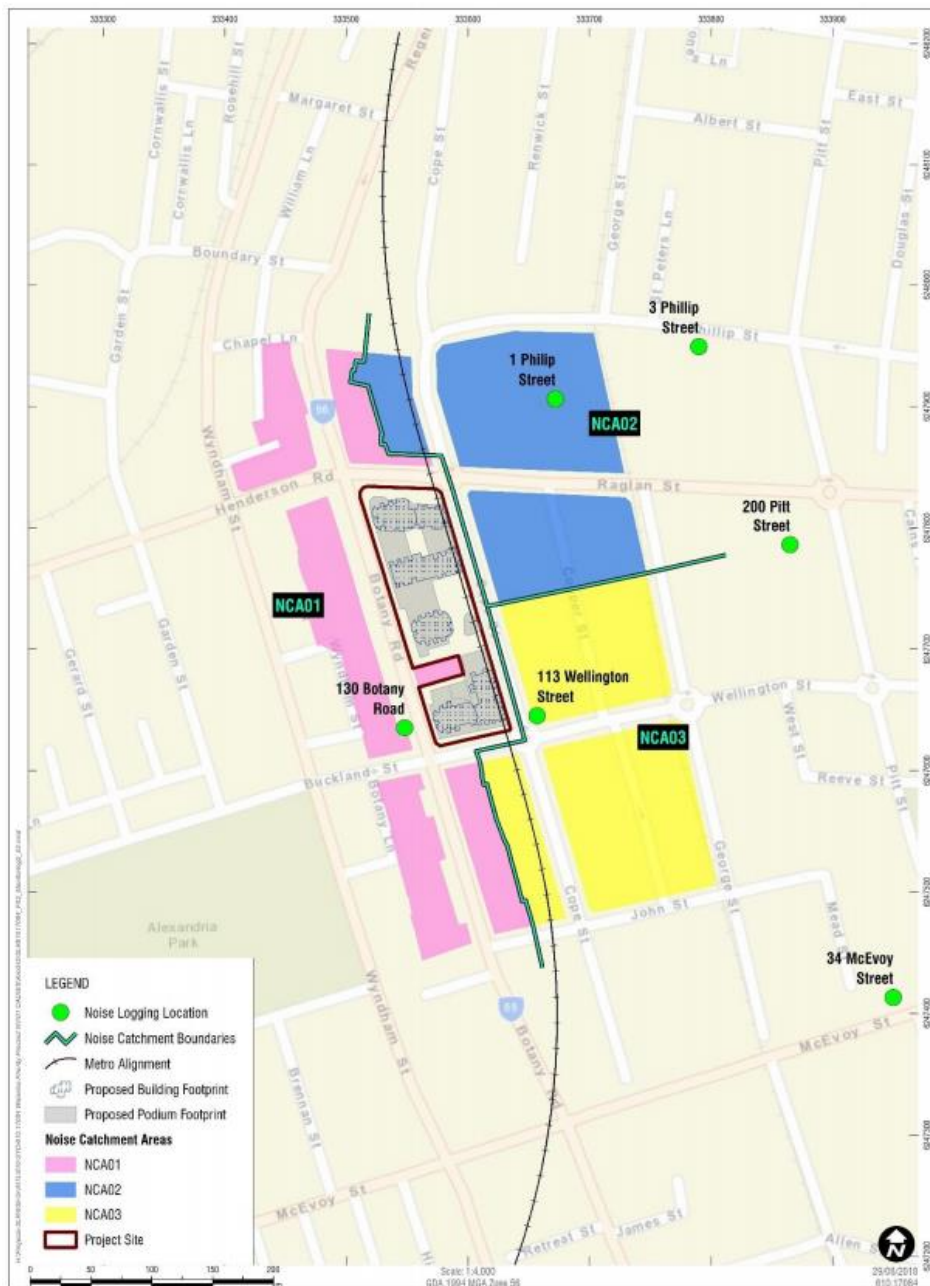


Figure 1 - Measurement locations conducted by SLR Consulting

8.1.3 Long-Term (Unattended) Noise Surveys

Outlined in SLR Consulting report, the results of the unattended ambient surveys are summarised in Table 2 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 12.4.1 (Appendix 4) 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 2 - 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 3.

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 3 - Short-term noise measurement summary conducted by SLR Consulting

Note1: 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 Additional Baseline Investigations (Amending Concept Proposal)

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.

The purpose of conducting additional baseline investigations was to certify and support the original baseline results recorded.

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 to 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 4 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 4 - 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.

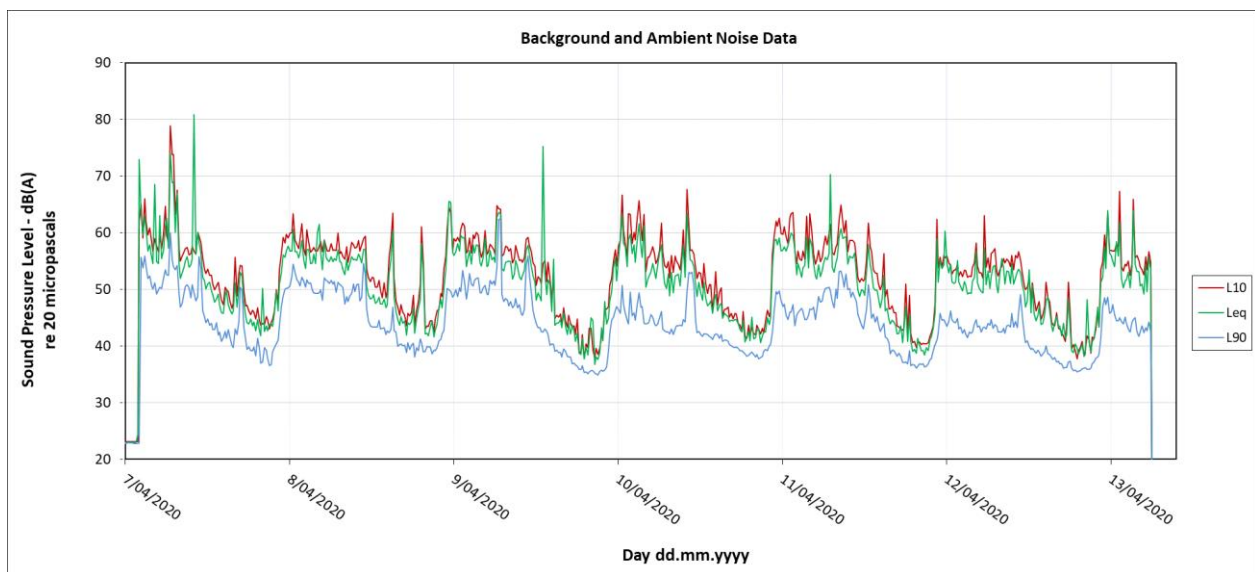


Figure 3 - Long-term background noise monitoring data – L1

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 5 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 5 - 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.

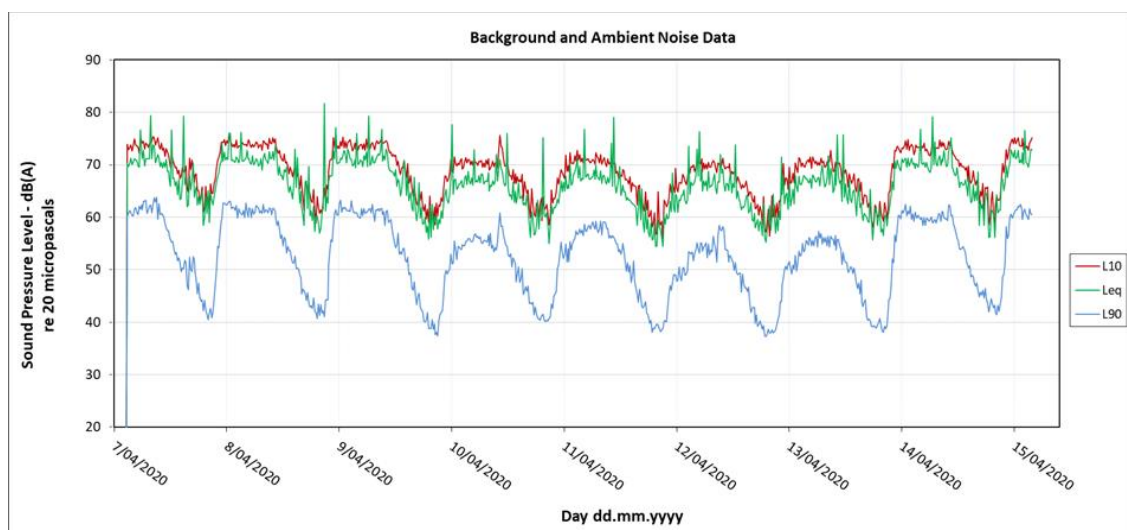


Figure 4 - Long-term traffic noise monitoring data – L3

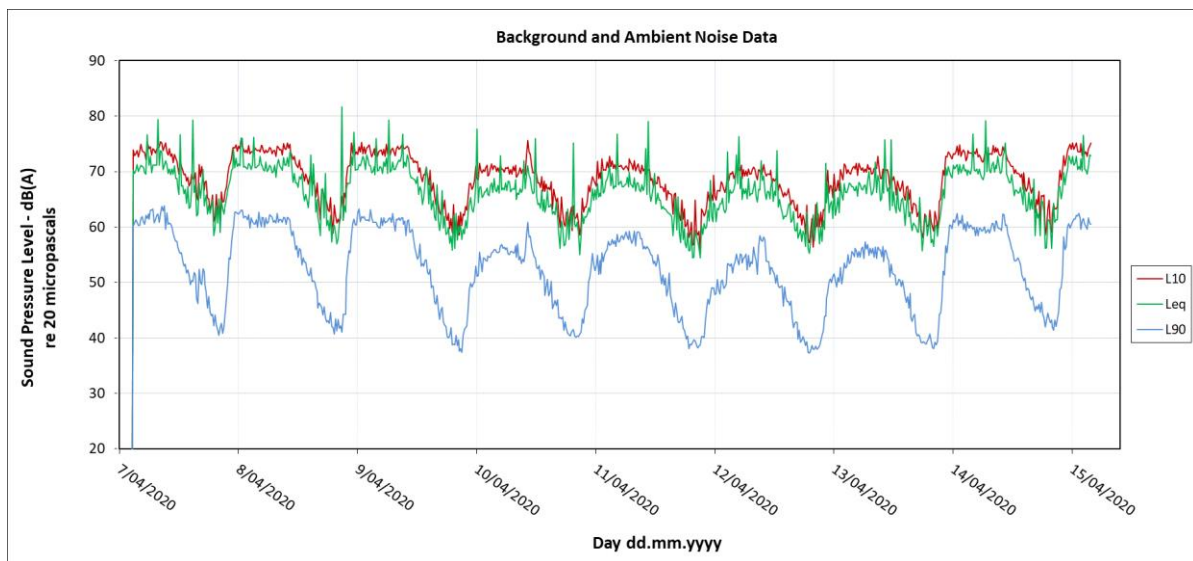


Figure 5 - Long-term traffic noise monitoring data – L4

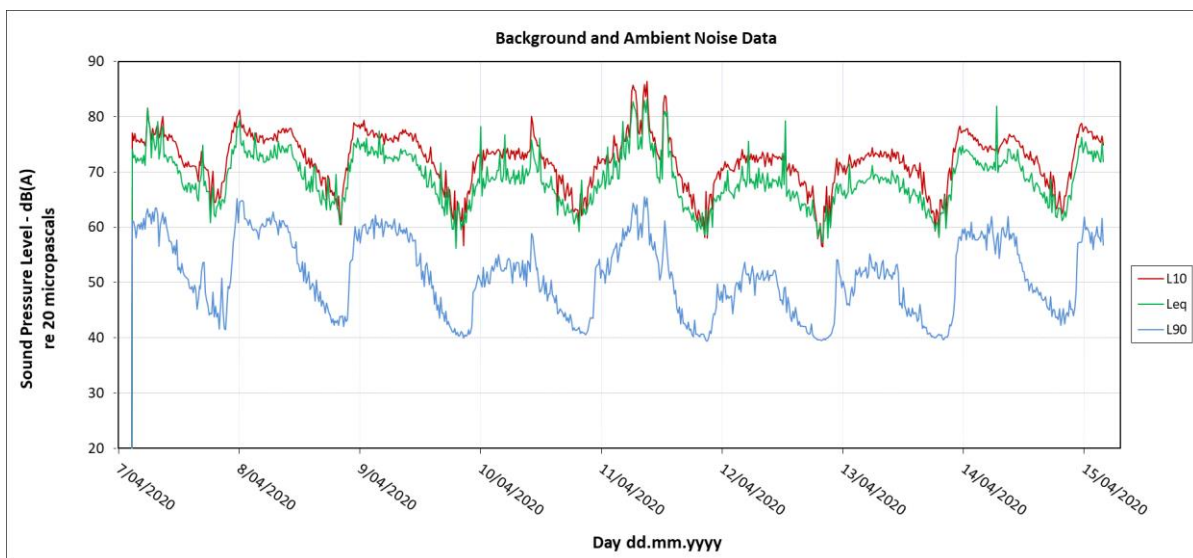


Figure 6 - Long-term traffic noise monitoring data – L5

The 24 hour daily noise levels at each monitoring location are presented in Section **Error! Reference source not found.** (Appendix B) 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 6.

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 6 - 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 7.

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 7 - Short-term noise measurement summary conducted by Stantec

9. Project Noise and Vibration Criteria

The proposed project noise and vibration criteria proposed for the purposes of the Amending Concept Proposal is generally in-line with the proposed criteria outlined within the Acoustic Impact Assessment Report prepared by SLR Consulting for the Waterloo Station Development EIS (Appendix N) dated 9 November 2019.

Any amendments to the proposed noise and vibration criteria are discussed in the ensuing sub-sections for each requirement.

9.1 Operational Noise Criteria

9.1.1 Industrial Noise Emissions

The criteria proposed for the assessment of noise emissions from industrial noise sources (such as mechanical plant and equipment) is in-line with the criteria established in the SLR Consulting report, except for the noise criterion established for NCA03.

Outlined in NSW Government, Sydney Metro, Station Delivery Deed Schedule C – Appendix B8, there is a requirement for each of the elements of the Waterloo Metro Quarter Development, namely the OSD, ISD and Line-wide (trackform) to achieve a combined external noise emissions objective. This is mentioned in the development consent for the Integrated Station Development and trackform design. The combined external noise emissions objectives for the Metro Quarter Development have been developed on the basis of the noise criteria established in the SLR Consulting report.

An ISD/OSD Integration Noise and Vibration report, prepared by Renzo Tonin and Associates dated 28 April 2020, proposes noise budgets for each design team (OSD, ISD and Line-wide). These budgets have been established to ensure the overall external noise emissions from each of the precincts within the Metro Quarter Development achieve the combined external noise emissions objectives.

In summary, the ISD has been granted a larger external noise emissions contribution allowance to noise-sensitive receivers that are horizontally in-line with the height of the ISD (Level 5 of Southern Precinct) and below. Anything above this height, the OSD has been granted a larger external noise emissions contribution allowance. This is because the majority of the noise emissions from the ISD (and Line-wide) will be concentrated to noise-sensitive receivers lower in elevation, and the noise emissions from the OSD will be concentrated to noise-sensitive receivers higher in elevation (because the majority of noise emitted from the OSD will be generated by rooftop plant and equipment).

Industrial noise (mechanical/electrical plant and equipment, loading dock operations, etc.) generated by the Waterloo Over Station Development will be assessed at the surrounding noise catchment areas using the OSD adjusted PNTLs, presented in Table 8. These noise budgets and resulting adjustments have been discussed with the ISD design team and agreed to. It should be noted that the noise budgets only affect receivers NCA03 and the Waterloo Congregational Church (in close proximity to the South Metro box).

Receiver	Period	Descriptor	OSD Adjusted PNTL
NCA03 (Below RL of Southern Precinct Level 5)	Day (7:00am to 6:00pm)	L _{Aeq,15min}	52 - 13dB = 39 dB(A)
	Evening (6:00pm to 10:00pm)	L _{Aeq,15min}	48 - 13dB = 35 dB(A)
	Night (10:00pm to 7:00am)	L _{Aeq,15min}	42 - 13dB = 29 dB(A)
NCA03 (Above RL of Southern Precinct Level 5)	Day (7:00am to 6:00pm)	L _{Aeq,15min}	52 - 3dB = 49 dB(A)
	Evening (6:00pm to 10:00pm)	L _{Aeq,15min}	48 - 3dB = 45 dB(A)
	Night (10:00pm to 7:00am)	L _{Aeq,15min}	42 - 3dB = 39 dB(A)
Waterloo Congregational Church	When in use – Day	L _{Aeq,15min}	60 - 13dB = 47 dB(A)
	When in use – Evening	L _{Aeq,15min}	58 - 13dB = 45 dB(A)
	When in use – Night	L _{Aeq,15min}	57 - 13dB = 44 dB(A)

Table 8– Adjusted project noise trigger levels for OSD to achieve

9.1.2 Internal Noise Levels

The criteria proposed for the internal noise levels for each type of space within the proposed development is in-line with the criteria established in the SLR Consulting report, except for the internal noise criterion established for non-residential uses.

The criteria established for non-residential uses established in the SLR Consulting report was based on a guideline (AS 2107:2016), and not a strict standard. The internal noise level ranges outlined in AS 2107:2016 are to be followed as a guideline only and cannot be relied upon in their entirety. The proponent should be given the opportunity to decrease or increase internal noise levels within non-residential spaces not governed by statutory requirements based on the proponent's standard of delivery.

In summary, no specific criteria is proposed for internal noise levels for non-residential uses which are not governed by statutory requirements. For example, non-residential spaces consisting of commercial, retail and/or fitness uses should not be restricted to a specific internal noise criterion. Non-residential spaces such as child care centres and student accommodation/serviced apartments are governed by statutory requirements and will be designed to the relevant internal noise criteria.

It should be noted that the SLR Consulting report outlines internal noise level criteria in-line with the Waterloo Metro Quarter Design and Amenity Guidelines (March 2020).

9.2 Operational Vibration Criteria

The criteria proposed for vibration limits for the assessment of vibration generated from the operation of the proposed development to various types of spaces within the proposed development is in-line with the criteria established in the SLR Consulting report.

9.3 Construction Noise Criteria

The proposed noise management levels proposed at each of the surrounding noise-sensitive receivers for the purposes of assessing construction noise emissions from the proposed development's site works are in-line with the noise management levels established in the SLR Consulting report.

9.4 Construction Vibration Criteria

The criteria proposed for vibration limits for the assessment of vibration generated from the construction of the proposed development to various types of spaces within the proposed development is in-line with the criteria established in the SLR Consulting report.

10. Noise and Vibration Impact Assessment

10.1 Noise Model

The noise model developed for the assessment of the existing Concept Approval has been updated to reflect the form of the proposed development. The results of the noise modelling for the road noise emissions and the construction noise emissions are provided in Section 1.1 and Section 12.3, respectively.

10.2 Operational Noise and Vibration Impacts

10.2.1 Industrial Noise Emissions

In-line with the assessment and findings reported in the SLR Consulting report, the technical specifications and layout of the proposed mechanical plant and other equipment have not been defined and potential impacts from these sources should be assessed in the Noise and Vibration Impact Assessment prepared for the detailed SSD DA.

Similarly, in-line with the recommendations of the SLR Consulting report, the operational noise emissions from mechanical plant associated with the project should be controlled to reduce noise impacts upon neighbouring residential receivers and occupants within the proposed development. Detailed assessment and verification of mechanical noise emissions should be carried out during the detailed design stage of the project ensuring that the nominated criteria for mechanical plant emissions are met.

As noted in SLR Consulting report, the industrial noise sources will be able to achieve compliance with the nominated criteria through common engineering methods that may consist of:

- Selection of low-noise mechanical plant and other noise generated equipment;
- judicious location of mechanical plant and equipment with respect to nearby noise-sensitive receivers;
- barriers/enclosures (e.g. plant rooms); and
- silencers and acoustically lined ductwork.

10.2.2 Road Noise Ingress

Closed Windows

The results of the internal noise predictions for receivers with their windows closed were similar to the results discussed in the SLR Consulting report. To achieve the “windows closed” criteria for each of the sensitive spaces, standard construction materials (including acoustic laminated glass) will be suitable for reducing the incident façade noise levels (shown in Appendix B).

Open Windows

Within the precinct under the existing Concept Approval, approximately 70% of the 700 (approximate) residential dwellings exceeded the open windows criteria and were

considered noise-affected. This amounted to approximately 490 noise-affected dwellings where an alternative means of ventilation would need to be provided to maintain the acoustic amenity of the occupants of the dwellings.

Within the proposed precinct under the Amending Concept Proposal, approximately 50% of the 220 (approximate) residential dwellings are predicted to be noise-affected (requiring an alternative means of ventilation). This translates to an approximate 110 residential dwellings predicted to require an alternative means of ventilation, an improvement of 380 dwellings.

An alternative means of ventilation shall be investigated and integrated into the design of the proposed development during the detailed design stages of the project.

10.2.3 Sydney Metro

The general analysis provided in the SLR Consulting report is relatively appropriate for the amended concept design, with the exception of the following elements:

- The basement structure for Building 2 is not resiliently connected to the bounding walls of the underground basement. This means there will be further vibration attenuation through the interface between both structures (basement and station); and
- The proposed use of the building as part of this Amending Concept Proposal situated above the North Metro station box is now commercial and no longer residential. This removes the risk of potentially affecting residential dwellings with unwanted noise and vibration (from the operation of the track) in this location.

The amendments to the existing Concept Approval discussed are an improvement to the existing (reference) design from a rail noise and vibration perspective, for the reasons mentioned above.

Notwithstanding the above, further investigation of the impacts from trains on the Over Station Development should be completed during the detailed design stages of the project. It is anticipated that the criteria can be met through the use of resilient trackforms (potentially higher performing than high attenuation / Delkor Eggs) trackforms.

It should be noted that within the document “NSW Government, Sydney Metro, Station Delivery Deed Schedule C – Appendix B8”, it states the trackform will be delivered by an Interface Contractor to ensure compliance with the requirements of the Planning Approval based on residential usage and standard forms of construction for the Station and OSD. That is, the Over Station Development should not need to rely open alternative methods of construction to attenuate structure-borne noise and vibration from the operation of the track (building isolation bearings within the structure, etc.).

10.3 Construction Noise and Vibration Impacts

10.3.1 Construction Noise

The construction noise emissions predicted during the construction works for the proposed development are generally in-line with the assessment conducted by SLR Consulting. This is because the information available regarding the construction methodology for the Amending Concept Proposal is similar in nature to the information that was available for the existing Concept Approval.

Once more specific information regarding the proposed construction methodology, equipment and staging is known, a detailed construction noise assessment will be conducted. This shall be further assessed in the Noise and Vibration Impact Assessment to be prepared for the Detailed SSD DA.

10.3.2 Construction Vibration

The construction vibration predicted at surrounding sensitive receivers during the construction works for the proposed development are generally in-line with the assessment conducted by SLR Consulting. This is because the information available regarding the construction methodology for the Amending Concept Proposal is similar in nature to the information that was available for the existing Concept Approval.

Once more specific information regarding the proposed construction methodology, equipment and staging is known, a detailed construction vibration assessment will be conducted (particularly at Waterloo Congregational Church). This shall be further assessed in the Noise and Vibration Impact Assessment to be prepared for the Detailed SSD DA.

10.4 Cumulative Impacts

10.4.1 Additional Road Traffic Noise

In-line with the criteria established in the SLR Consulting report, the NSW Road Noise Policy (RNP) has been applied to assess the impacts of increases in road traffic noise generated by the proposed development. As discussed in the SLR Consulting report, the NSW RNP requires consideration of noise mitigation where new land use developments increase road traffic noise by more than 2 dB. For a 2 dB increase in noise to be apparent, a corresponding increase in traffic volumes of approximately 60 percent is required (assuming road speeds and other factors remain unchanged).

Similar to the results of the assessment discussed in the SLR Consulting report, the cumulative increases in traffic from the over station development and wider Waterloo Metro Quarter Development is small in comparison to the high existing traffic volumes during the peak hour periods (morning and afternoon). As a consequence, potential cumulative increases in road traffic noise generated by the proposed development are expected to be significantly less than 2 dB.

10.4.2 Industrial Noise Emissions

Similar to the SLR Consulting report, the noise sources and locations within and surrounding the precinct area are unknown at this early stage in the project and as a result, a cumulative impact assessment of potential operational noise from future industrial noise sources within the precinct cannot be completed.

The potential cumulative impacts from all sources of industrial noise from the Waterloo Metro Quarter Development will be undertaken for the detailed SSD DA when more information regarding the various noise sources and locations are known.

11. Conclusion

A noise and vibration impact assessment for the Waterloo Over Station Development has been conducted. This document forms part of the documentation package to be submitted to state and local authorities as part of the Amending Concept Proposal.

In addition to the baseline site investigations carried by SLR Consulting for the existing Concept Approval, additional baseline site investigations were carried out to obtain background noise statistics within noise catchment area NCA03. This noise catchment area was not delineated in the assessment conducted for the existing Concept Approval. The purposes of refining the noise catchment areas was to ensure an accurate representation of the background noise environment surrounding the site.

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 confirmation where the proposed criteria is in-line with the criteria proposed in the Noise and Vibration Impact Assessment prepared by SLR Consulting (dated 09 November 2018) together with where we have proposed amendments to the criteria previously established.

The noise impact of Botany Road on the proposed development was assessed and modelled considering the new change in use, form and envelope forming the Amending Concept Proposal, with the results of the assessment provided in Section 10.2.2. To meet the required internal noise levels, the recommendations outlined in Section 10.2.2 shall be implemented for the Detailed SSD DA. These recommendations included implementing standard construction materials (including acoustic laminated glass) into the design scheme, together with investigating and integrating an alternative means of ventilation into the design.

A construction noise and vibration assessment has been conducted to determine the noise and vibration impacts (if any) on the surrounding sensitive receivers (including Waterloo Congregational Church). The results of the assessment are provided in Section 10.3. The recommendations outlined in Section 10.3 shall be implemented for the assessments to be conducted for the Detailed SSD DA in order to comply with the relevant noise and vibration criteria.

Having given regard to the analysis conducted within this report, it is the finding of this noise and vibration impact assessment that the Amending Concept Proposal 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.

It is recommended the Amending Concept Proposal is not rejected on the basis of noise and vibration, under the implementation of the recommendations outlined within the report.

12. Appendices

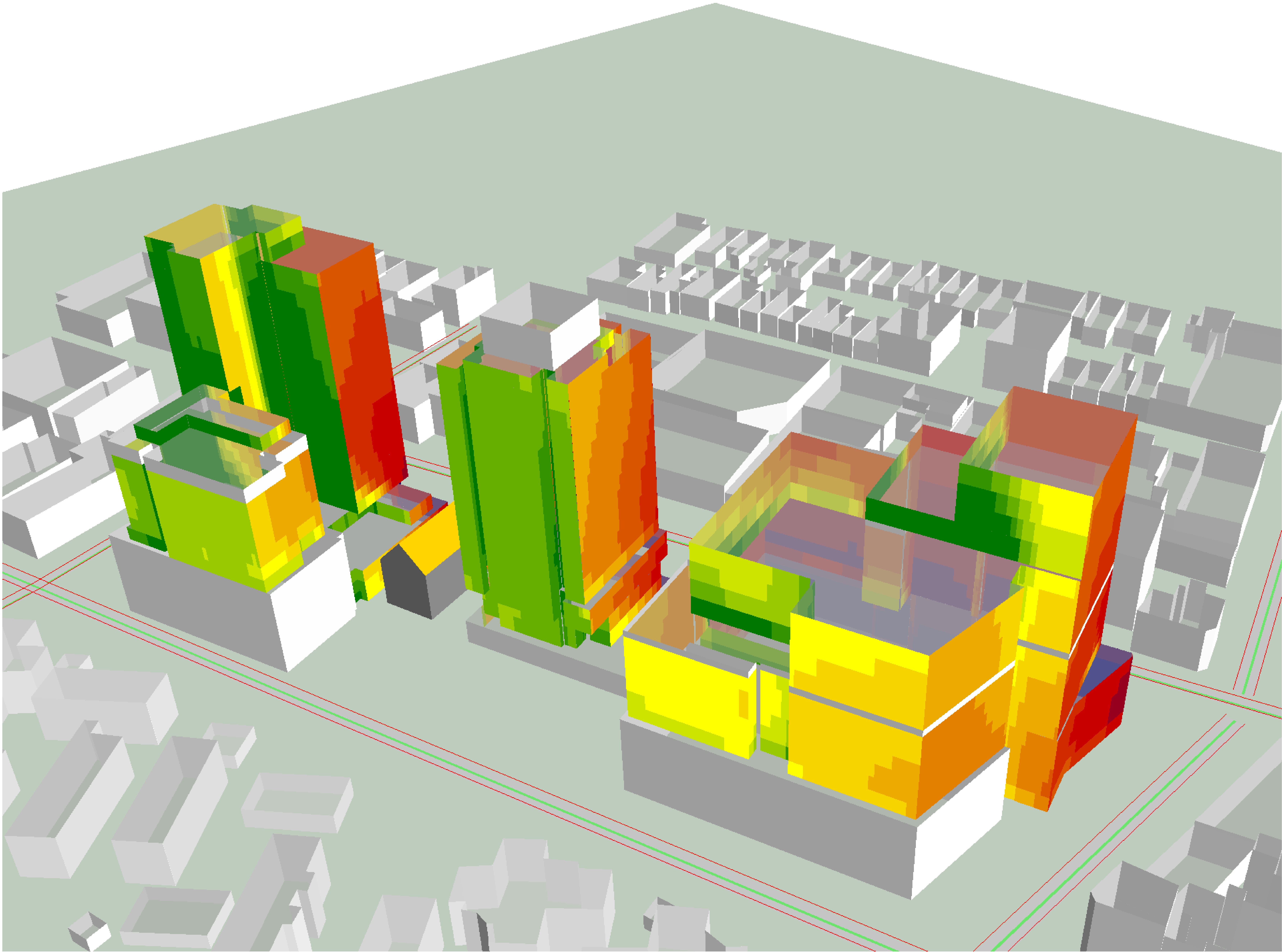
12.1 Appendix 1 – Glossary of Acoustic Terms

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

Acoustic Term	Definition
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
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.
L _{Amax}	The maximum A-weighted sound pressure level measured over a period.
L _{Amin}	The minimum A-weighted sound pressure level measured over a period.
L _{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
L _{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L _{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L _{A90} noise level expressed in units of dB(A).
L _{Aeq}	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
L _{Aeq,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.
R _w :	The Sound Insulation Rating R _w 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 L _{eq} 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.

Acoustic Term	Definition
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.
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.

12.2 Appendix 2 – Road Noise Modelling



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KEY	DESCRIPTION	DRAWN	APPD	DATE	

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	



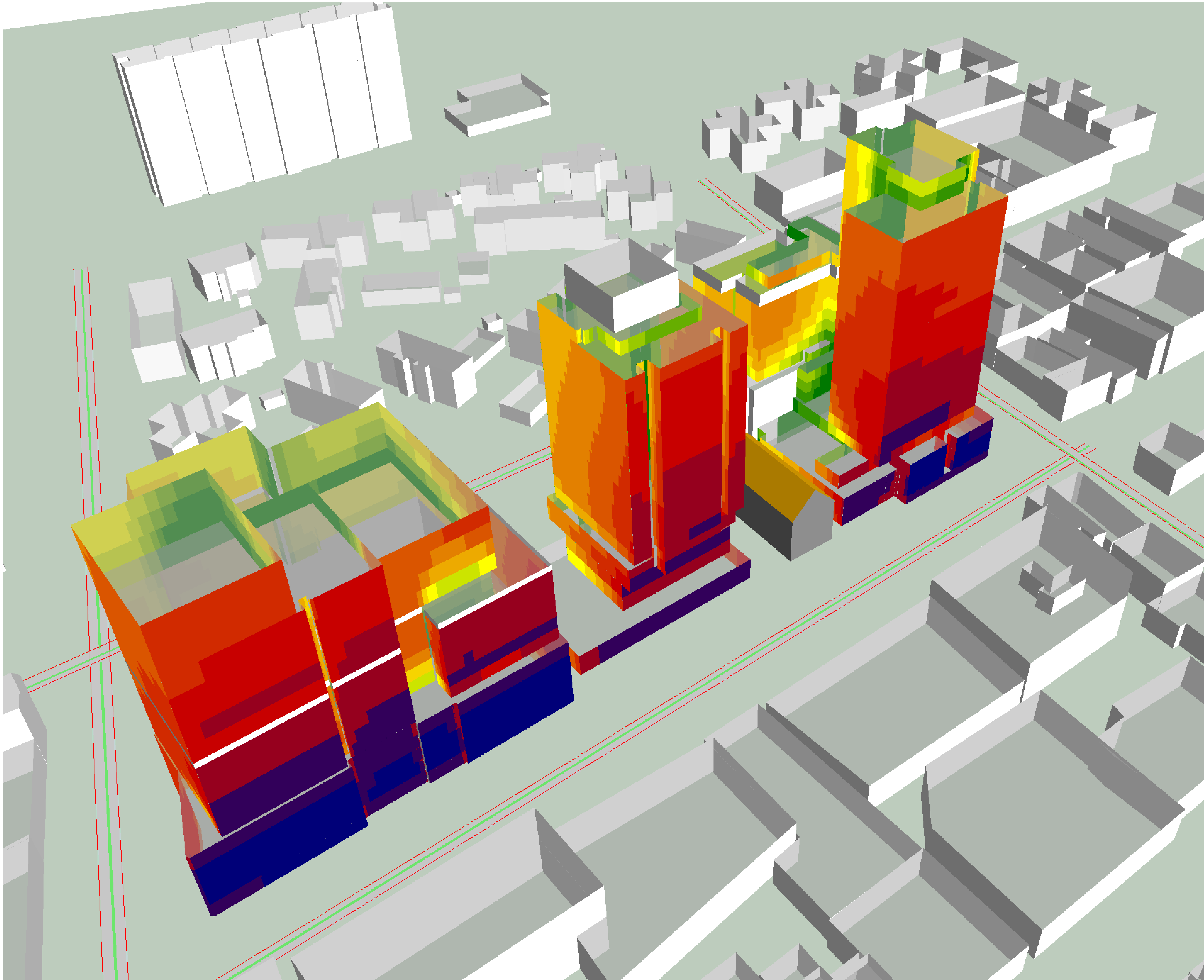
WATERLOO METRO QUARTER
DEVELOPMENT

Facade Noise Map
Day-time Model
 $L_{Aeq}(15hr)$



Noise Model
Day-time Model
Noise & Vibration

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Noise Level Legend - L_{Aeq} in dB(A)							
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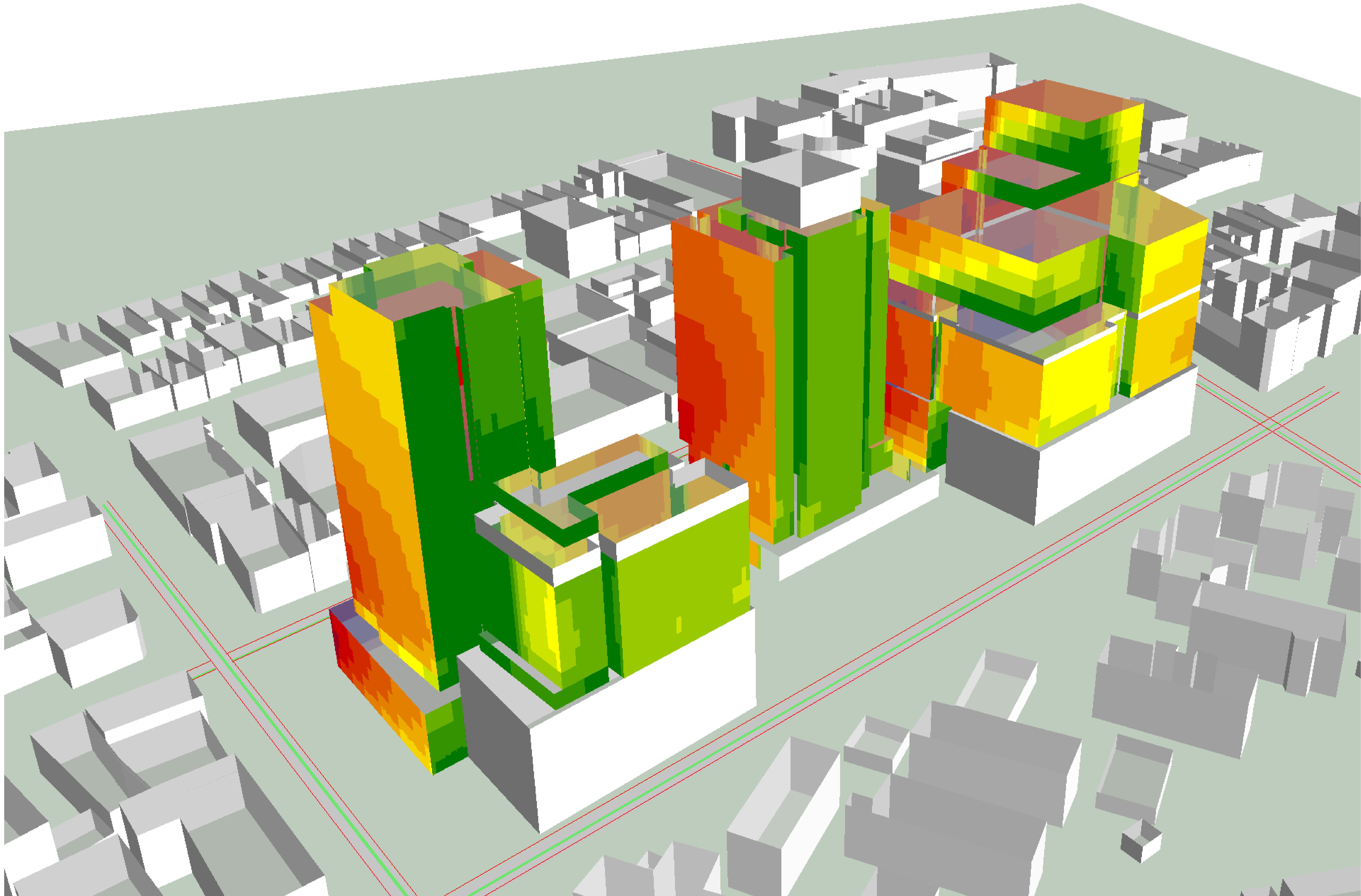
WATERLOO METRO QUARTER
DEVELOPMENT

Facade Noise Map
Day-time Model
 $L_{Aeq}(15hr)$



Noise Model
Day-time Model
Noise & Vibration

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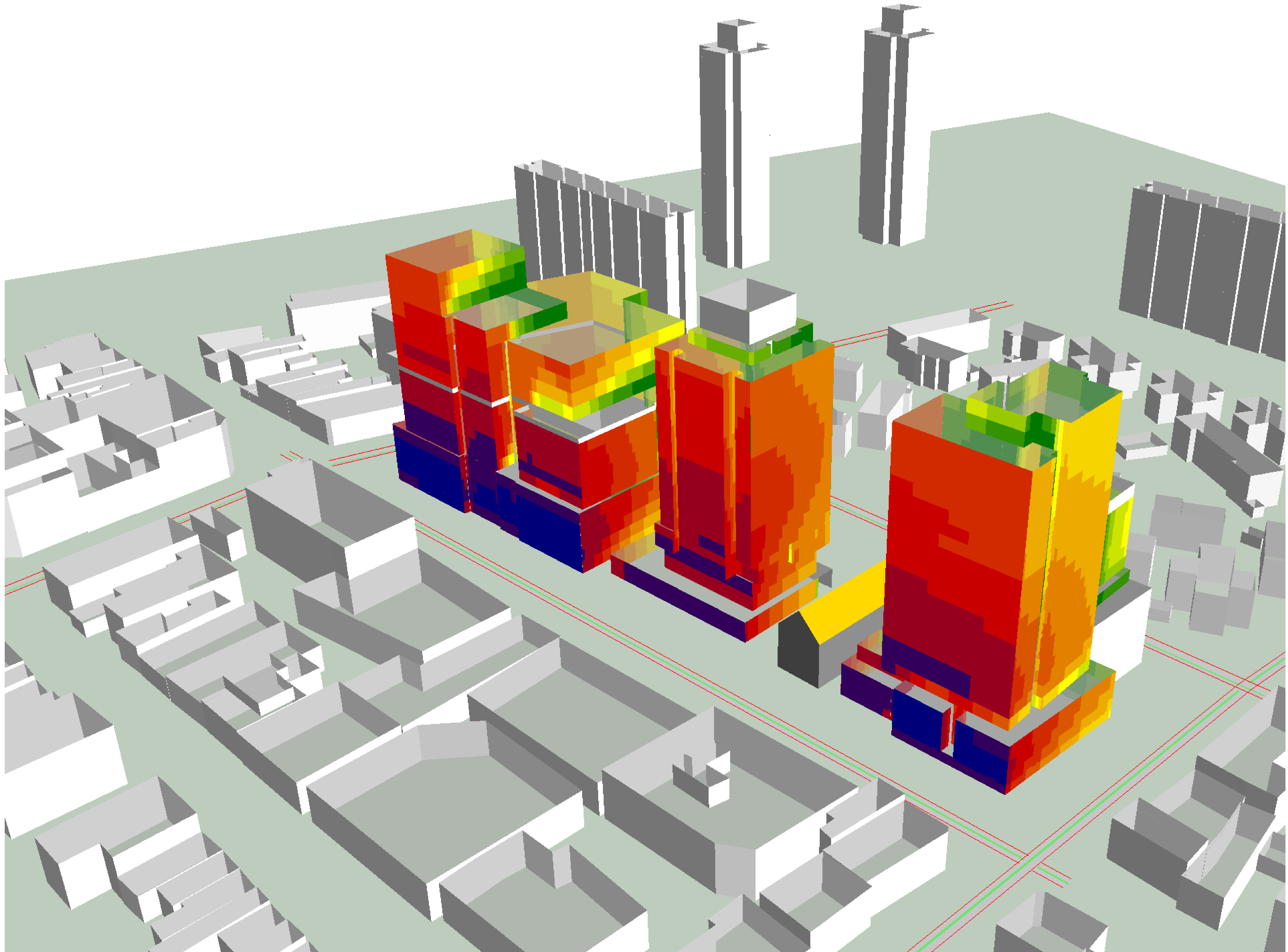
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001	DA Package	MIS	BN	19/06/20

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



PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	Facade Noise Map Day-time Model $L_{Aeq}(15hr)$

Stantec	1:200	46198	ALL-AC-FNM	001
	SCALE @ A0	PROJECT NO	DRAWING NO	REV



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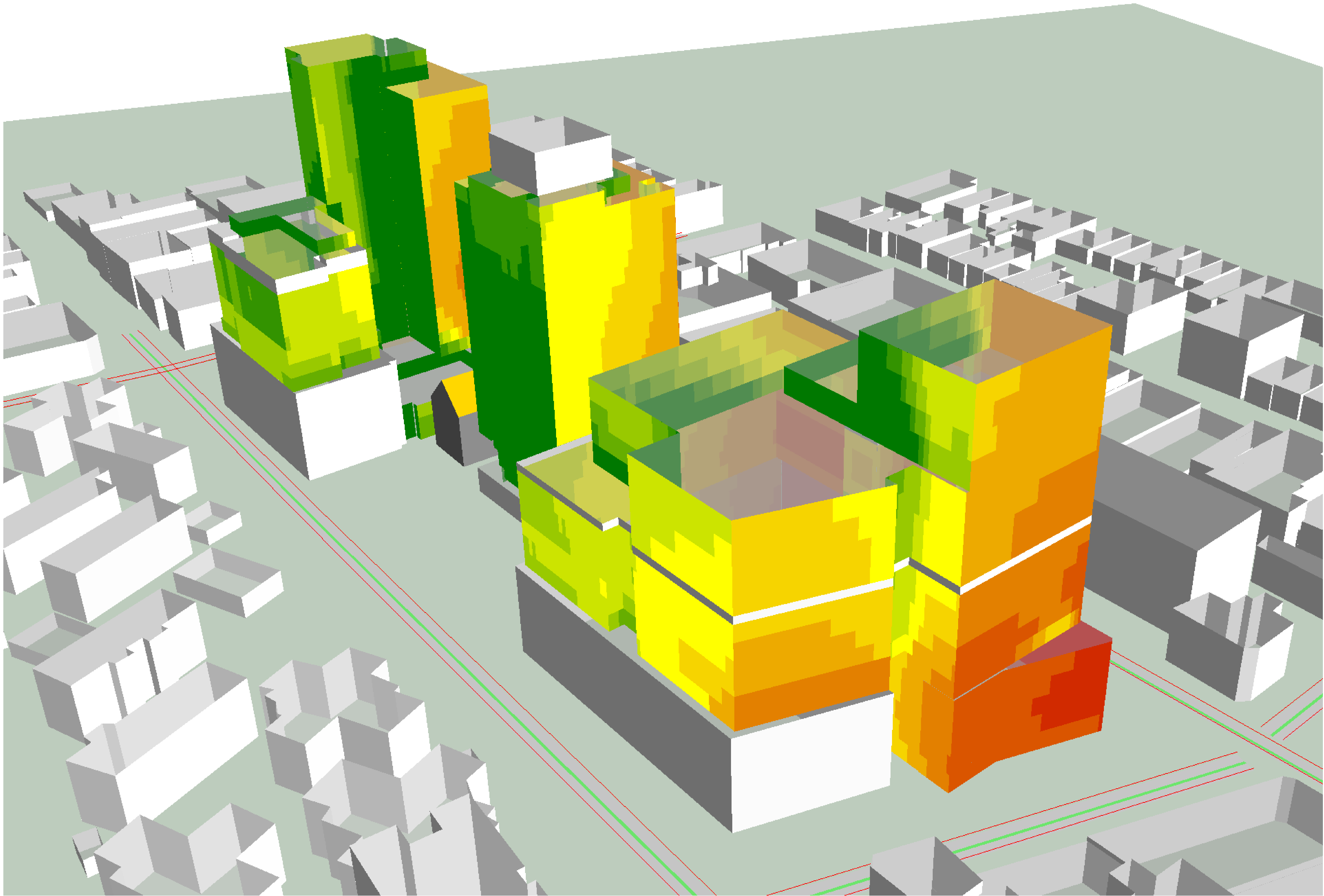
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45-47	51-53	57-59	63-65	69-71	
47-49	53-55	59-61	65-67	> 71	



WATERLOO METRO QUARTER DEVELOPMENT		Facade Noise Map Day-time Model $L_{Aeq}(15hr)$	
PROJECT		TITLE	

Stantec		Noise Model Day-time Model Noise & Vibration	
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SCALE @ A0	PROJECT NO	DRAWING NO	REV



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KEY	DESCRIPTION	DRAWN	APP'D	DATE	

Noise Level Legend - L_{Aeq} in dB(A)					
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■	45-47	■	51-53	■	57-59
■	47-49	■	53-55	■	59-61
				■	61-63
				■	63-65
				■	65-67
				■	67-69
				■	69-71
				■	> 71



Waterloo Integrated
Station Development
A Joint Venture Project
JOHN HOLLAND **mirvac**


ARCHITECT/CLIENT

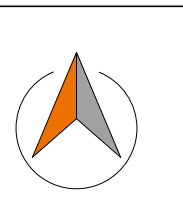
WATERLOO METRO QUARTER
DEVELOPMENT

Facade Noise Map
Night-time Model
 $L_{Aeq}(9hr)$

PROJECT

TITLE





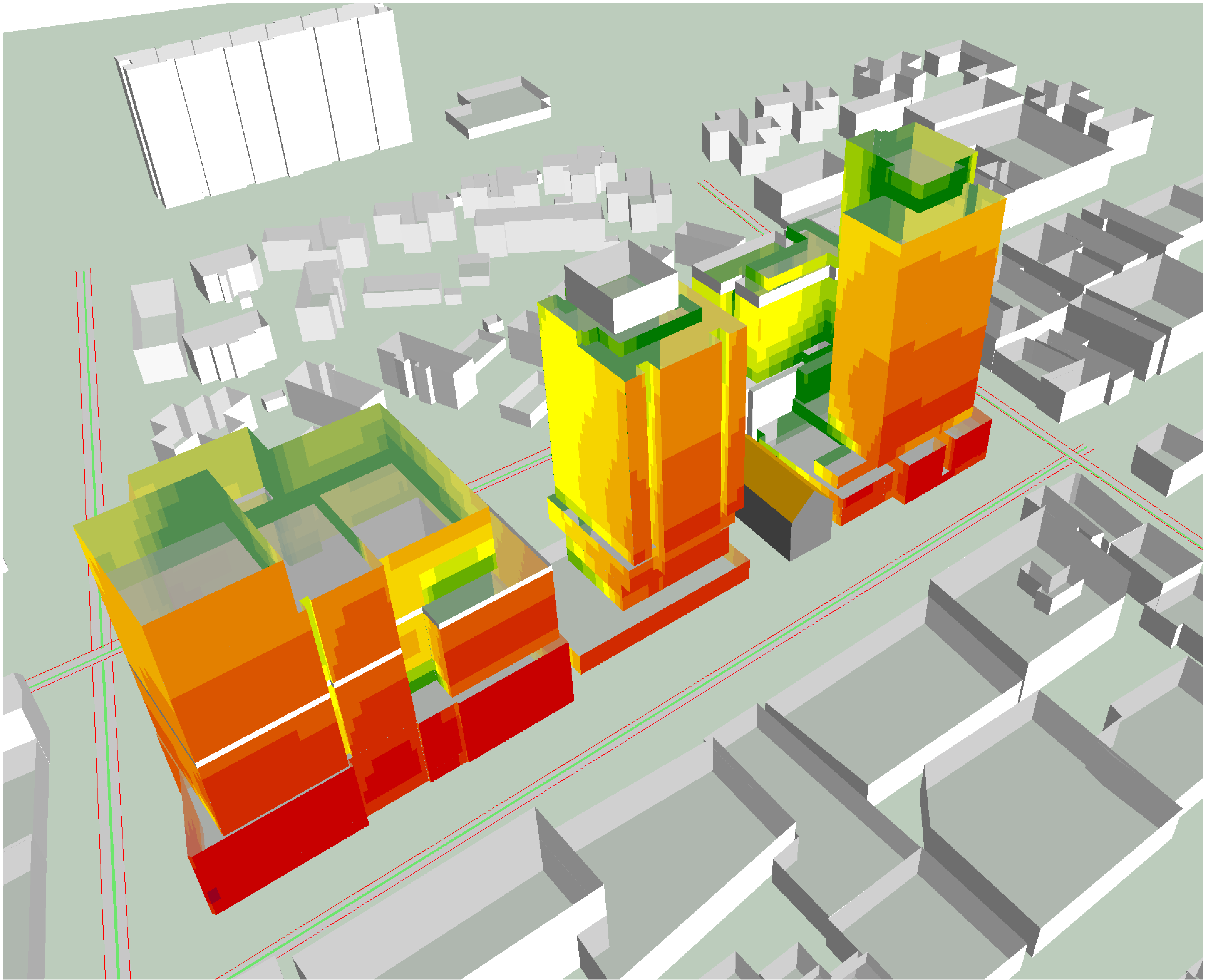
Noise Model
Night-time Model
Noise & Vibration

1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-FNM
DRAWING NO

001
REV



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002	For Approval				
001	DA Package				
REV	DESCRIPTION	DRAWN	APPD	DATE	


Noise Level Legend - L_{Aeq} in dB(A)							
45-47	47-49	49-51	51-53	53-55	55-57	57-59	59-61
61-63	63-65	65-67	67-69	69-71	71-73	73-75	75-77




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Station Development
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WATERLOO METRO QUARTER
DEVELOPMENT

Facade Noise Map
Night-time Model
 $L_{Aeq}(9hr)$



Stantec



North

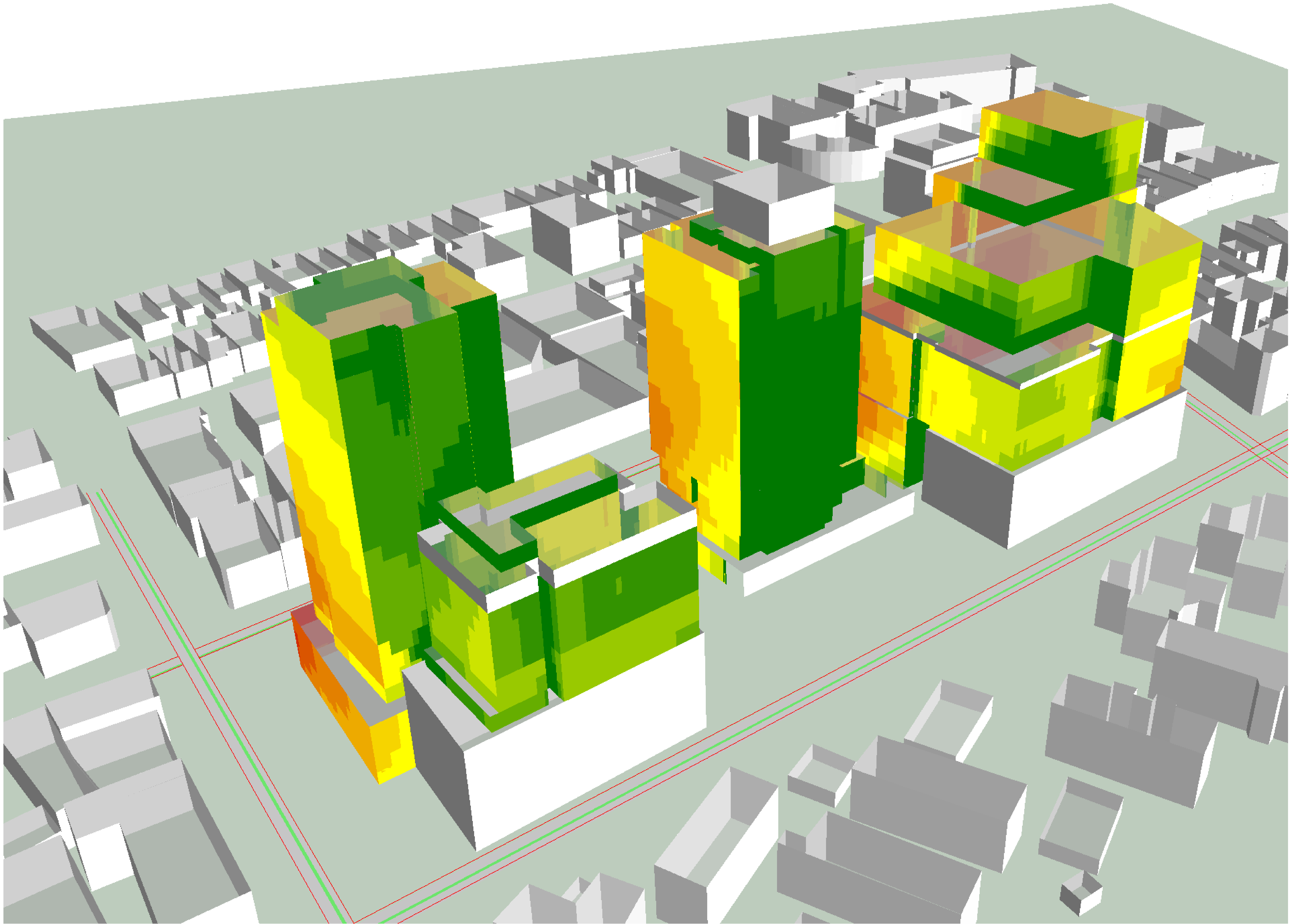
Noise Model
Night-time Model
Noise & Vibration

1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-FNM
DRAWING NO

001
REV



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DOCUMENTS HAVE BEEN OBTAINED FROM WIG.

REV	DESCRIPTION	DRAWN	APP'D	DATE
002	For Approval	MIS	BN	29/07/20
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	



WATERLOO METRO QUARTER
DEVELOPMENT

PROJECT

Facade Noise Map
Night-time Model
 $L_{Aeq}(9hr)$

TITLE



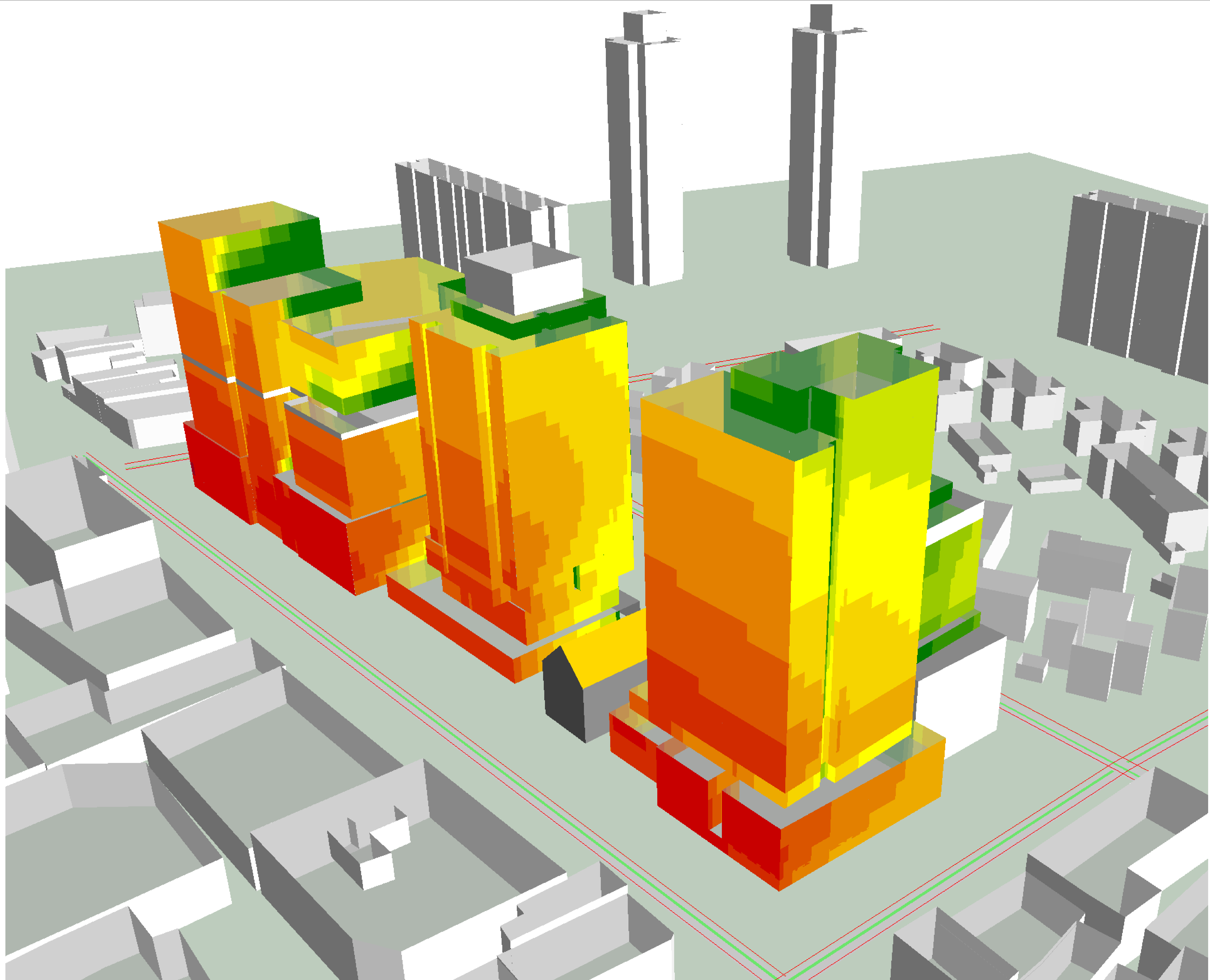
Noise Model
Night-time Model
Noise & Vibration

1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-FNM
DRAWING NO

001
REV



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DOCUMENTS HAVE BEEN OBTAINED FROM WIG.

REV	DESCRIPTION	DRAWN	APP'D	DATE
002	For Approval	MIS	BN	29/07/20
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			

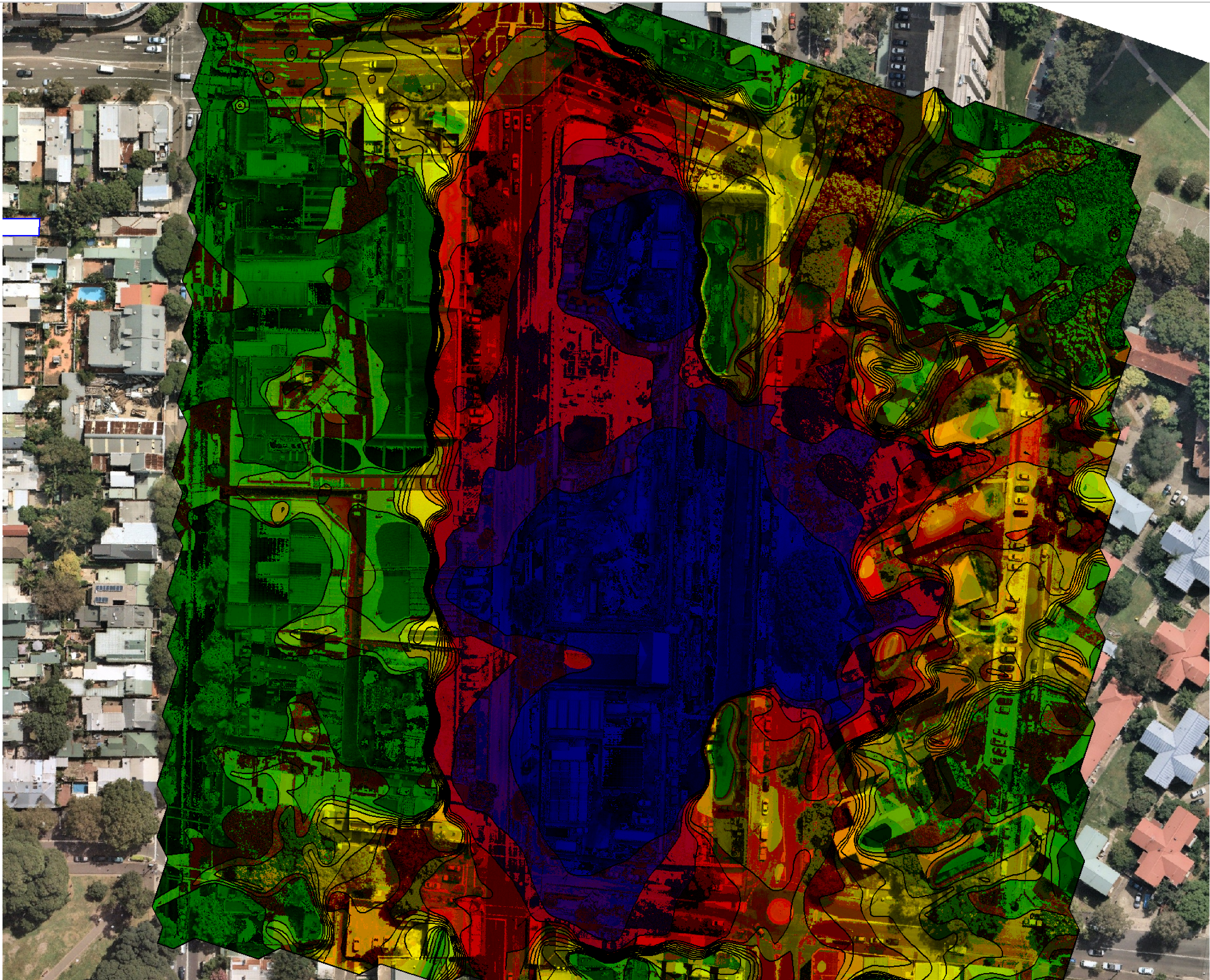


PROJECT	TITLE
WATERLOO METRO QUARTER DEVELOPMENT	Facade Noise Map Night-time Model $L_{Aeq}(9hr)$

SCALE @ A0	PROJECT NO	DRAWING NO	REV
1:200	46198	ALL-AC-FNM	2

Stantec

12.3 Appendix 3 – Construction Noise Modelling Results – Noise Contour Maps



002	Development Application	MIS	BN	29/07/20
001	DA Package	MIS	BN	10/07/20
REV	DESCRIPTION	DRAWN	APPD	DATE

Noise Level Legend - $L_{Aeq,1hr}$ in dB(A)					
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45-47	51-53	57-59	63-65	69-71	
47-49	53-55	59-61	65-67	> 71	

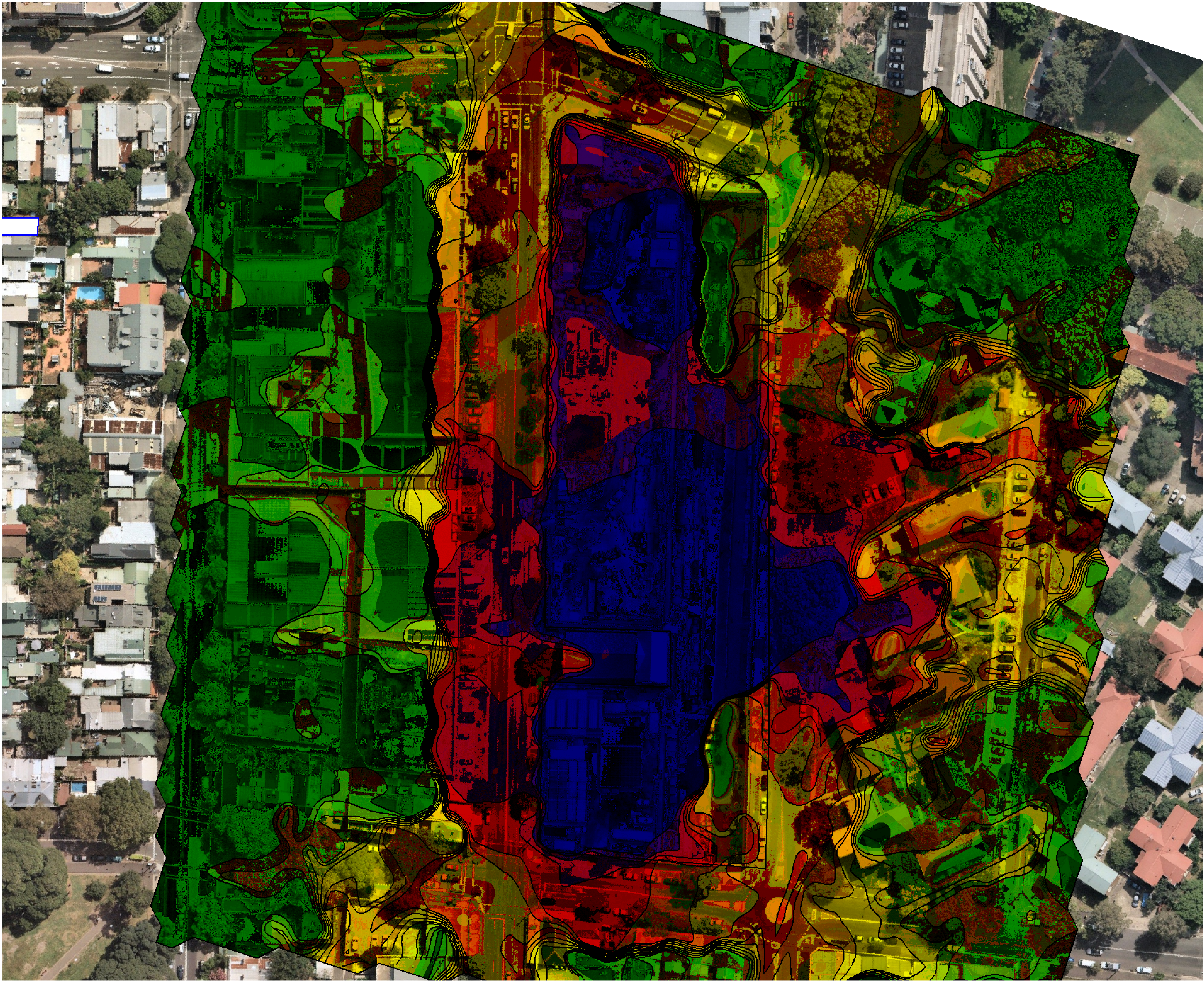


WATERLOO OVER-STATION DEVELOPMENT - CUMULATIVE ASSESSMENT		CONSTRUCTION NOISE EMISSIONS - CIVIL WORKS, NO MITIGATION	
PROJECT	ARCHITECT/CLIENT	TITLE	



1:200	46198	ALL-AC-GRM	2
SCALE @ A0	PROJECT NO	DRAWING NO	REV

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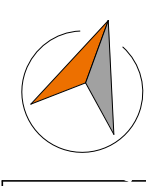
002	For Approval				
001	DA Package				
REV	DESCRIPTION	DRAWN	APP'D	DATE	

Noise Level Legend - $L_{Aeq,1hr}$ in dB(A)					
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<div></div>	45-47	<div></div>	51-53	<div></div>	57-59
<div></div>	47-49	<div></div>	53-55	<div></div>	59-61
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<div></div>		<div></div>		<div></div>	67-69
<div></div>		<div></div>		<div></div>	69-71
<div></div>		<div></div>		<div></div>	> 71



WATERLOO OVER-STATION
DEVELOPMENT - CUMULATIVE
ASSESSMENT

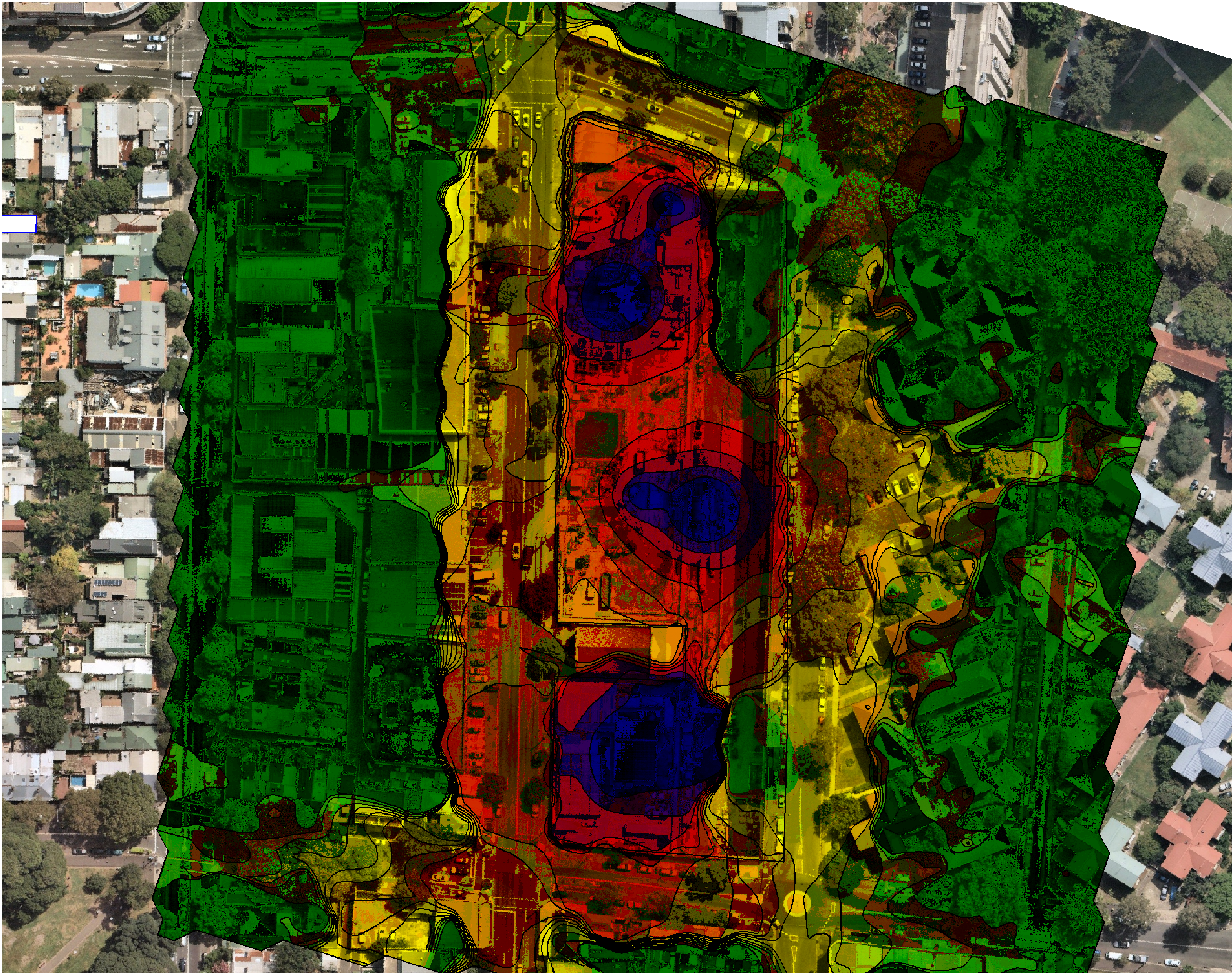
CONSTRUCTION NOISE MODEL
EMISSIONS - CIVIL WORKS, WITH
MITIGATION



Noise Model
Construction Noise Modelling Results
Noise & Vibration

1:200	46198	ALL-AC-GRM	001
SCALE @ A0	PROJECT NO	DRAWING NO	REV

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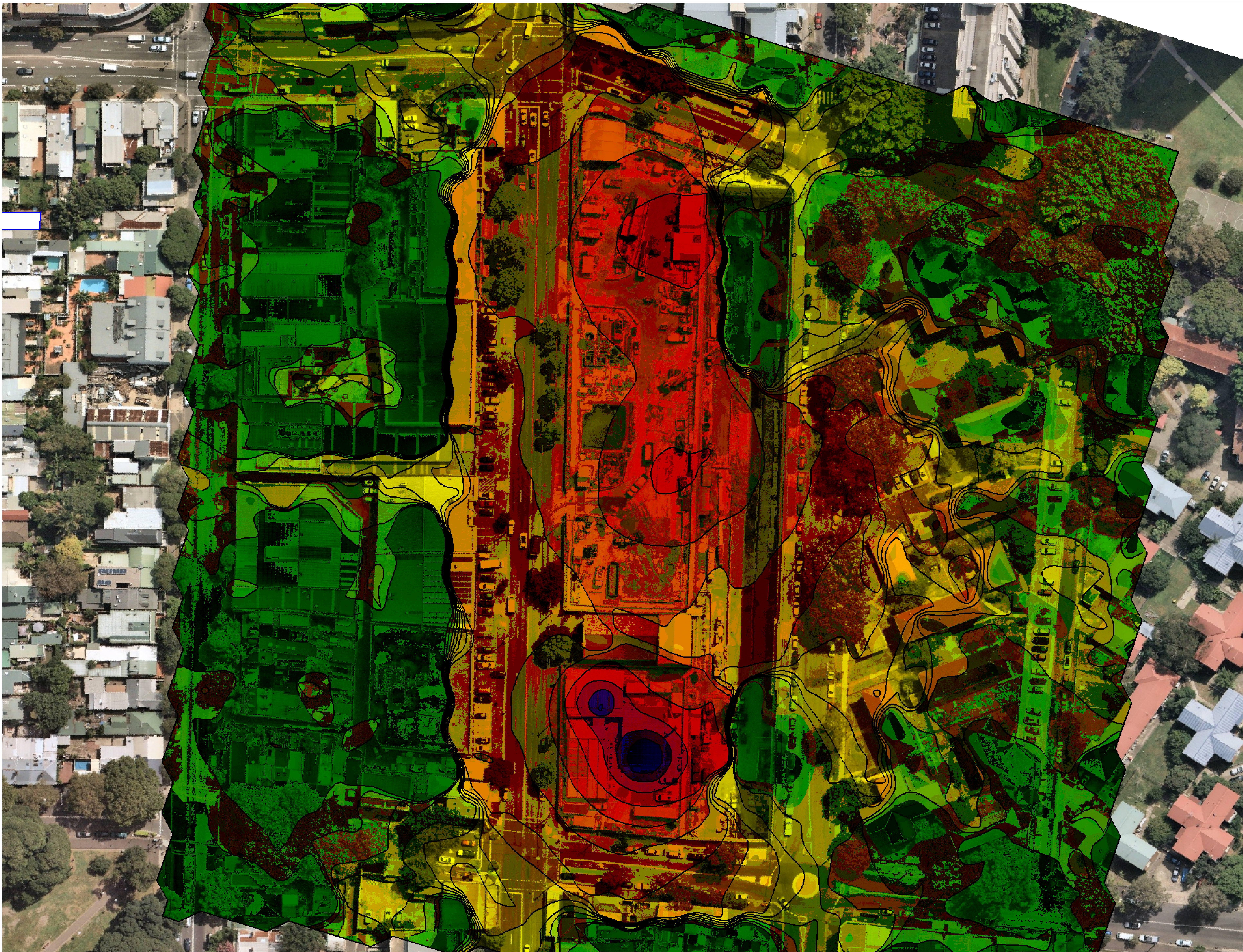
002	For Approval				
001	DA Package				
REV	DESCRIPTION	MIS	BN	29/07/20	
		MIS	BN	10/07/20	
		APPD		DATE	

Noise Level Legend - $L_{Aeq,1hr}$ 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	



WATERLOO OVER-STATION DEVELOPMENT - CUMULATIVE ASSESSMENT		CONSTRUCTION NOISE EMISSIONS - STRUCTURE GF TO L5, WITH MITIGATION	
PROJECT	ARCHITECT/CLIENT	SCALE @ A0	TITLE

Stantec		Noise Model	
Construction Noise Modelling Results		Noise & Vibration	
1:200	46198	ALL-AC-GRM	001
SCALE @ A0	PROJECT NO	DRAWING NO	REV



THIS DRAWING HAS BEEN DOCUMENTED IN COLOUR.
THIS DRAWING IS REQUIRED TO BE PRINTED IN COLOUR.
FAILING TO DO SO MAY RESULT IN LOSS OF INFORMATION.
BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE
DOCUMENTS HAVE BEEN OBTAINED FROM WIG.

REV	DESCRIPTION	MIS MIS DRAWN	BN BN APPD	29/07/20 10/07/20 DATE
002	For Approval	MIS	BN	29/07/20
001	DA Package	MIS	BN	10/07/20

Noise Level Legend - $L_{Aeq,1hr}$ 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 - CUMULATIVE
ASSESSMENT

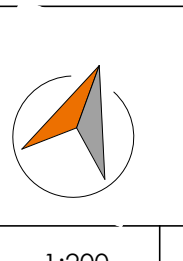
CONSTRUCTION NOISE
EMISSIONS - STRUCTURE
L6 TO L10, NO MITIGATION

PROJECT

TITLE



Stantec



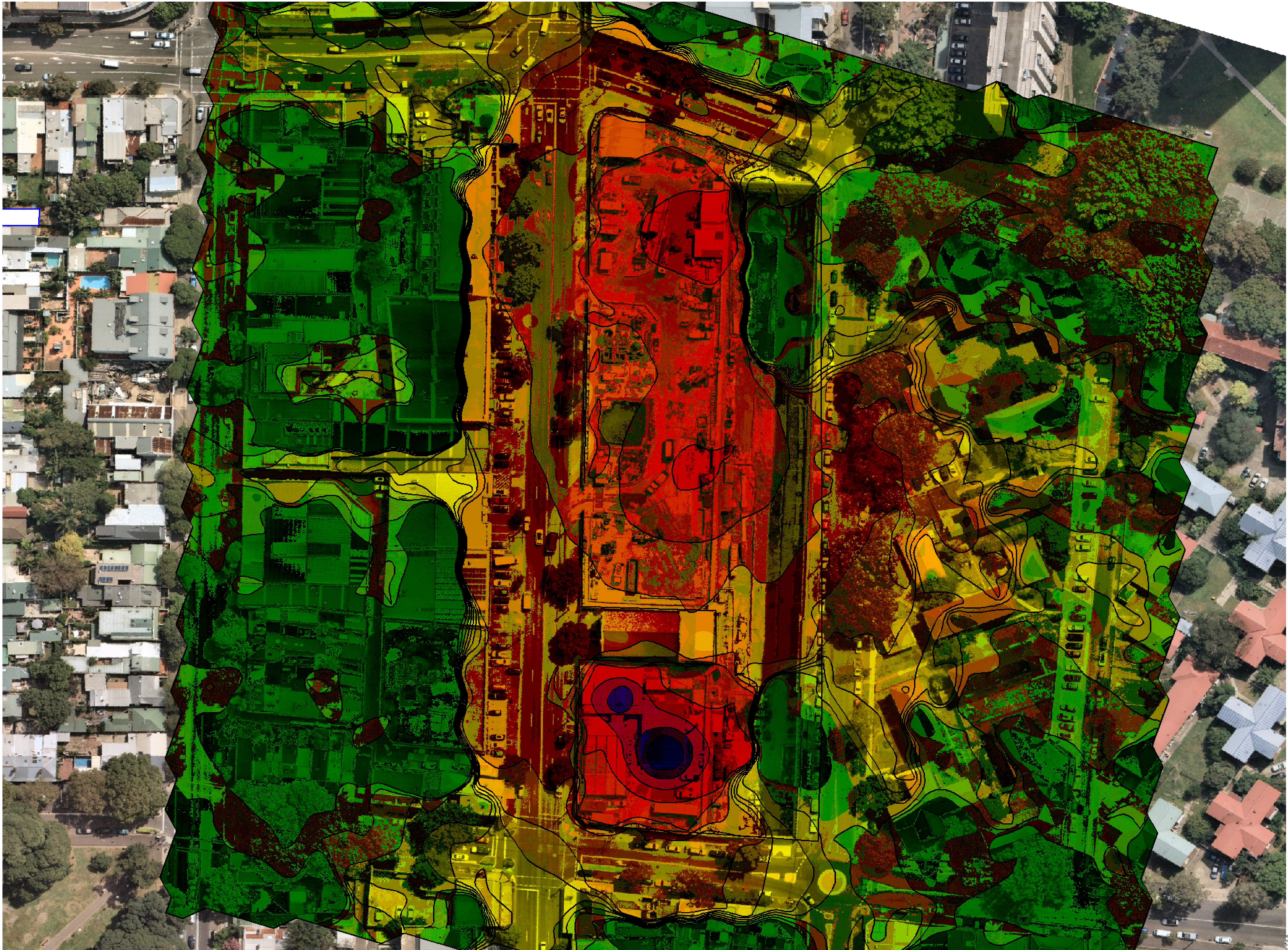
1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-GRM
DRAWING NO

001
REV

Noise Model
Construction Noise Modelling Results
Noise & Vibration



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IF PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE
DOCUMENTS HAVE BEEN OBTAINED FROM WIG.

002	For Approval				
001	DA Package				
REV	DESCRIPTION	DRAWN	APP'D	DATE	

Noise Level Legend - $L_{Aeq,1hr}$ in dB(A)					
■	< 45	■	49-51	■	55-57
■	45-47	■	51-53	■	57-59
■	47-49	■	53-55	■	59-61
■	61-63	■	63-65	■	65-67
■	67-69	■	69-71	■	> 71



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ARCHITECT/CLIENT

WATERLOO OVER-STATION
DEVELOPMENT - CUMULATIVE
ASSESSMENT

CONSTRUCTION NOISE
EMISSIONS - STRUCTURE
L6 TO L10, WITH MITIGATION

PROJECT

TITLE



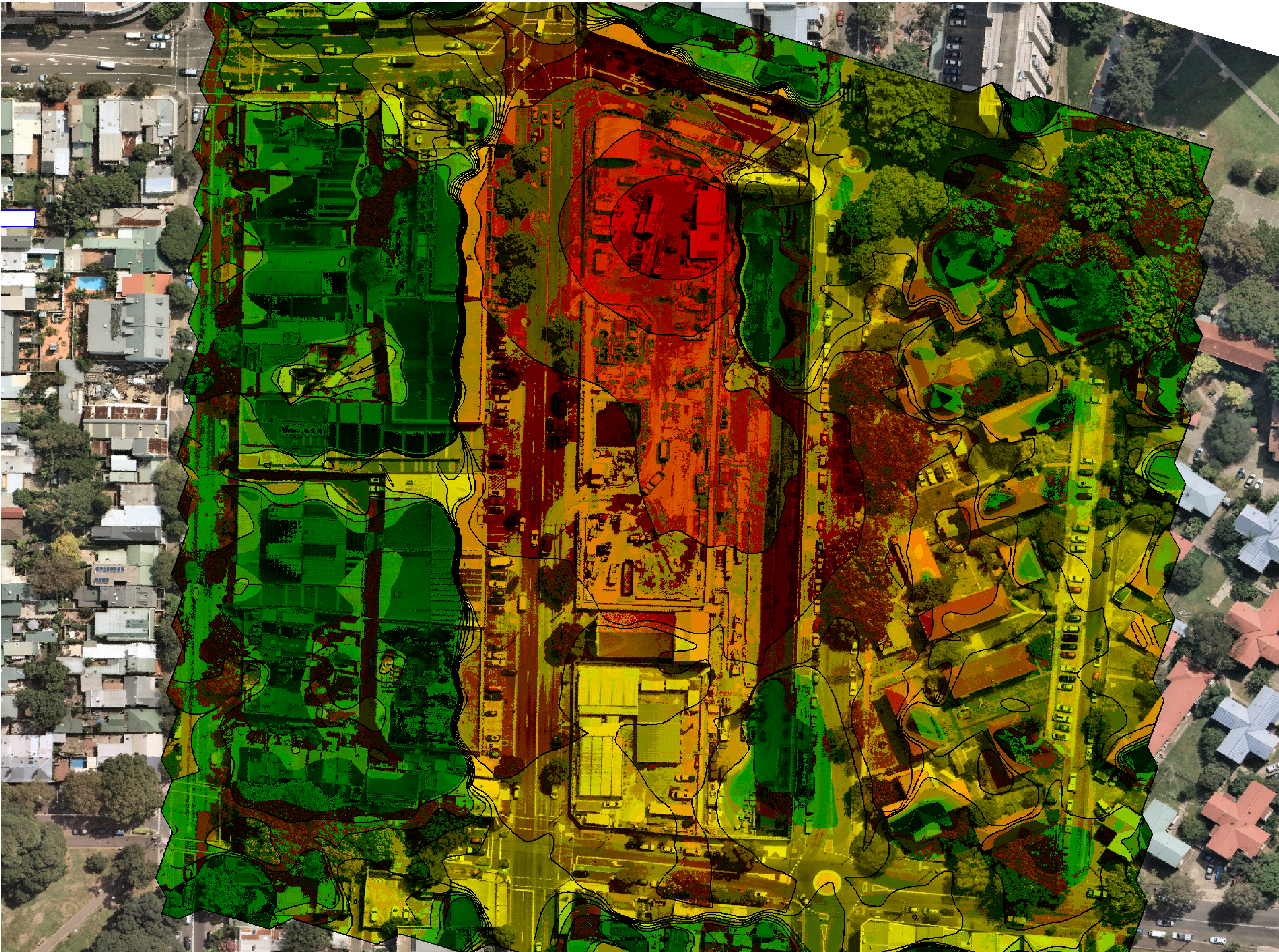
Noise Model
Construction Noise Modelling Results
Noise & Vibration

1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-GRM
DRAWING NO

001
REV



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DOCUMENTS HAVE BEEN OBTAINED FROM WIG.

002	For Approval				
001	DA Package				
REV	DESCRIPTION				
		MIS	BN	29/07/20	
		MIS	BN	10/07/20	
		DRAWN	APPD	DATE	

Noise Level Legend - $L_{Aeq,1hr}$ in dB(A)					
■	< 45	■	49-51	■	55-57
■	45-47	■	51-53	■	57-59
■	47-49	■	53-55	■	59-61
■	61-63	■	63-65	■	65-67
■	67-69	■	69-71	■	> 71



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ARCHITECT/CLIENT

WATERLOO OVER-STATION
DEVELOPMENT - CUMULATIVE
ASSESSMENT

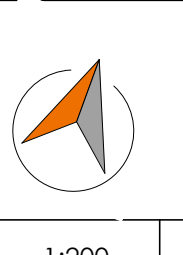
CONSTRUCTION NOISE
EMISSIONS - STRUCTURE
L11 TO L15, NO MITIGATION

PROJECT

TITLE



Stantec



1:200
SCALE @ A0

46198
PROJECT NO

ALL-AC-GRM
DRAWING NO

001
REV

Noise Model
Construction Noise Modelling Results
Noise & Vibration