Waterloo Estate (South)

Noise and Vibration Impact Assessment

Project No.	P03145
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Client	Stockland

E-LAB Consulting

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Document QA and Revisions

ISSUE	DATE	COMMENTS	ENGINEER	REVIEWER
1	12/12/2025	Draft Issue	Artie Rattananikom	Brandon Notaras
2	06/02/2026	Final Draft Issue	Artie Rattananikom	Brandon Notaras
3	18/02/2026	For Submission to Homes NSW	Artie Rattananikom	Brandon Notaras
4	30/03/2026	Update for DPHI & Homes NSW Comments	Artie Rattananikom	Brandon Notaras

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Acoustics & Vibration

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1 EXECUTIVE SUMMARY

This Noise and Vibration Impact Assessment (NVIA) is submitted to the Department on behalf of Stockland and NSW Land and Housing Corporation (the Applicant) in support of a concept State Significant Development Application (SSDA) for the redevelopment of the site within the Waterloo Estate (South) Precinct Area, hereby known as "Waterloo South".

In this report reference to "Homes NSW" or "the Applicant" shall also be taken to mean "New South Wales Land and Housing Corporation (LAHC)" who is the registered owner of 93 per cent of land within the Waterloo South Precinct Area. Any reference to "Waterloo South" in this report should be read as the redevelopment of land owned by LAHC and associated public land (such as roads) throughout the Precinct Area.

The concept development is categorised as State Significant Development (SSD) as per Section 26, Schedule 1 of *State Environmental Planning Policy Planning Systems 2021* (Planning Systems SEPP) as the project includes housing development carried out by or on behalf of the LAHC, with an estimated development cost (EDC) of more than $30 million.

The concept, in summary, aims to deliver:

- High quality mixed tenure housing in the context of a rapidly transforming area.
- Approximately 3,300 new dwellings, of which a minimum 30% will be social housing, approximately 20% will be affordable housing, and a maximum 50% will be market housing (measured as a percentage of the total residential gross floor area).
- Publicly accessible open space and public realm activation.
- An authentic mixed-use precinct, with housing co-located with non-residential uses, community facilities, essential services, and access to public transport.

The concept SSDA will guide the detailed design of future buildings, open spaces, and the public realm within the Waterloo South site. The concept SSDA seeks development consent for key planning metrics, including maximum building envelopes, building heights, setbacks, vehicular access points and road network, and the distribution of floor area across different land uses and residential tenure types.

A state-assessed rezoning application has also been prepared and submitted concurrently to give effect to this concept SSDA. The state-assessed rezoning application seeks amendments to the Sydney Local Environmental Plan 2012 (SLEP 2012) and the Waterloo Estate (South): Design Guide 2022 (2022 Design Guide) to align with the maximum building envelopes sought in this concept SSDA. Notably no additional gross floor area (GFA) or density is sought under the state-assessed rezoning application than is currently permissible on the site under the SLEP 2012.

This report concludes that the proposed development is acceptable and warrants approval subject to the implementation of the mitigation measures outlined in Section 9.

Following implementation of the mitigation measures, the remaining noise and vibration impacts are appropriate.

2 INTRODUCTION

2.1 DOCUMENT PURPOSE

This Noise and Vibration Impact Assessment has been prepared by E-LAB Consulting to support a concept State Significant Development Application (SSD-93222706) for the redevelopment of the site within the Waterloo Estate (South), hereby known as 'Waterloo South'.

This Noise and Vibration Impact Assessment specifically responds to the requirements of Item 9 of the SEARS (SSD-93222706) issued for the project by DPHI on 8th October 2025.

In summary, the purpose of this report is to:

- Identify surrounding noise-sensitive receivers;
- Identify relevant standards and guidelines and to establish noise and vibration project requirements for the construction and operation of the site;
- Provide a noise and vibration assessment for the construction of the site, which discusses the expected construction stages, expected machinery / activities involved;
- Provide a noise and vibration assessment for the operation of the site, which discusses both noise emissions from the proposed development, and noise intruding into the development from external road, rail or aircraft; and
- Outline mitigation measures and recommendations to ensure project noise and vibration requirements are satisfied.

2.2 RELEVANT DOCUMENTS

The following standards, guidelines and drawings have been used to establish the project specific acoustic design requirements for the development.

- SJB Architects Concept SSDA Plans February 2026;
- NSW DPHI *Waterloo Estate (South) Design Guide* 2022;
- NSW DPHI State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021;
- NSW DPHI Development Near Rail Corridors and Busy Roads – Interim Guideline;
- NSW EPA Noise Policy for Industry (NPI) 2017;
- NSW EPA Road Noise Policy (RNP) 2011;
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009;
- NSW EPA Assessing vibration: A Technical Guideline 2006;
- NSW Office of Liquor and Gaming Liquor Act 2007;
- City of Sydney Council Development Control Plan (DCP) 2012;
- 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"; and
- German Standard DIN4150 – Part 3: "Structural vibration in buildings – Effects on structures".

3 PROJECT SITE

3.1 SITE DESCRIPTION

The Waterloo South Precinct Area comprises approximately 123,149m^2 across 10 street blocks in the City of Sydney Local Government Area (LGA), generally bounded by Cope, Raglan, George, Wellington, Gibson, Kellick, Pitt and McEvoy Streets.

The Waterloo South site area, excluding any privately owned properties within the Waterloo South Precinct Area, comprises approximately 114,822m^2, or just over 93 per cent of the land within the Precinct Area. The legal description of Waterloo South Precinct Area is detailed in Table 1.

Table 1: Legal description of Waterloo South

ADDRESS	**Lot/DP**
Lots owned by NSW Land and Housing Corporation (land is subject to both the rezoning and the concept SSDA)	
209-219 Cope Street, Waterloo	Lot 1 DP 217386
238-246 George Street, Waterloo	Lot 1 DP 225159
229-231 Cope Street Waterloo	Lot 3 DP 10721
6 John Street, Waterloo	Lot 1 DP 533762
97-109 Cooper Street, Waterloo	Lot A DP 105916, Lot B DP 105916, Lot C DP 105916, Lot 14 DP 10721,
248-254 George Street, Waterloo	Lot 2 DP 533678
232 Pitt Street, Waterloo	Lot 11 DP 635663, Lot 10 DP 635663
74-76 Wellington Street, Waterloo	Lot 1 DP 224728
331-337 George Street, Waterloo	Lot 3 DP 533680
247-251 Cope Street, Waterloo	Lot 1 DP 533679
339-341 George Street, Waterloo	Lot 1 DP 77168
250 Pitt Street, Waterloo	Lot 313 DP 606576
Cooper Street, Waterloo	Lot 3 DP 217386
Lots owned by others (land that does not form a part of the concept SSDA)	
221-223 Cope Street, Waterloo	Lot 6 DP 10721, Lot 7 DP 10721, Lot 9 DP 10721, Lot 8 DP 1147179
225-227 Cope Street, Waterloo	Lot 5 DP 10721, Lot 4 DP 10721

ADDRESS	**Lot/DP**
233 Cope Street, Waterloo	Lot 12 DP 1099410, Lots 1-41 SP 79210
116 Wellington Street, Waterloo	Lot 10 DP 10721, Lot 11 DP 10721
111 Cooper Street, Waterloo	Lot 15 DP 10721
291 George Street, Waterloo	Lot 10 DP 1238631, Lots 1-20 SP 96906
110 Wellington Street, Waterloo	Lot 101 DP 1044801, Lots 1-58 SP 69476
336 George Street, Waterloo	Lot 3 DP 10686
213-215 Cope Street, Waterloo	Lot 2 DP 217386

3.2 SITE AND SURROUNDING CONTEXT

The suburb of Waterloo is located with the City of Sydney Local Government Area (LGA) and is located 3km south of Sydney CBD. The site is part of the broader Waterloo Estate, which comprises the northern, central, and southern precincts and accommodates a significant community residing in social housing.

The Waterloo South Precinct Area is predominantly owned by LAHC, however, as outlined in Table 1, the site, the subject of this report, excludes several privately owned lots located within the boundary of the broader Waterloo South precinct outlined in Figure 1. The privately owned lots are currently used for residential, office, light industrial, and infrastructure uses. The LAHC owned sites are currently used almost exclusively for the provision of social housing, with ancillary offices and community facilities. Overall, Waterloo South currently contains a total of 750 social housing dwellings and 120 private dwellings.

As shown in Figure 1, surrounding suburbs include Redfern to the north, Green Square to the south, Alexandria to the west and Zetland to the east. This broader area has been subject to significant change over the last 10 years with projects such as South Eveleigh, Redfern North Eveleigh Precinct Renewal, Waterloo Metro Quarter and Over Station Development (OSD) all contributing to the changing character of the area.

These broader renewal projects are supported by proximity to a range of public transport services, including Redfern Station, Green Square Station, and Waterloo Metro Station, all of which are within walking distance of Waterloo South.

Figure 1: Aerial view of the Waterloo Estate and the Waterloo Estate (South) Precinct Area (Source: Six Maps, modified by Beam Planning)

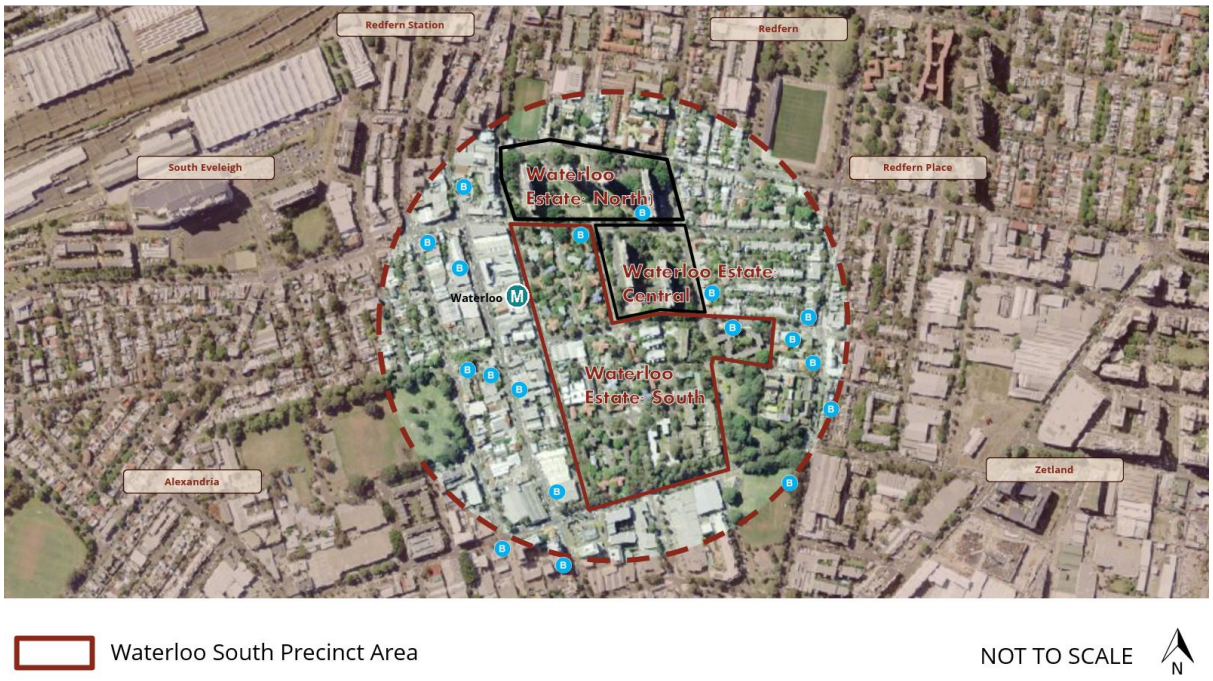


Figure 2: Waterloo South Project Area, Source: SJB

The location of the proposal, noise monitoring and measurement positions, and the surrounding noise-sensitive receivers are shown in Figure 3. The noise-sensitive receivers have been delineated into receiver catchments (RCs) as noted in Table 2 Receiver catchments have been identified with a detailed description in Table 2 below.

Table 2: Description of nearby noise sensitive receiver catchments

RECEIVER CATCHMENT	DESCRIPTION
RC1 – Residential	Existing residential use development along Cope Street situated west of the project site, including a mix of terrace dwellings and residential flat buildings. This includes future mixed-used development on the corner of Cope Street and Buckland Street as part of the Waterloo Metro Quarter.
RC2 – Residential	Existing multi-storey residential flat buildings along McEvoy Street situated south of the project site.
RC3 – Residential	Existing residential use development along Wellington Street, Pitt Street, Raglan Street, Phillip Street, Elizabeth Street and Kellick Street. This includes a mix of residential flat buildings, standalone dwellings, and terrace dwellings.
RC4 – Residential	Existing residential flat buildings along Cope Street situated north-west of the project site.
RC5 – Residential	Existing multi-storey residential use buildings to be redeveloped in future as part of the Waterloo Estate (Central) site.
RC7 - Residential	Existing multi-storey residential use buildings to be redeveloped in future as part of the Waterloo Estate (North) site.
RC7 – School	Existing elementary school (Our Lady of Mt Carmel Catholic Primary) situated east of the project site on the corner of Kellick Street and Elizabeth Street.
RC8 – Active Recreation	Existing active recreation use development (Waterloo Park and Waterloo Oval) situated east of the project site along Pitt Street and Elizabeth Street.
RC9 – Commercial	Existing commercial use development along McEvoy Street, George Street and Allen Street, situated south of the project site.
RC10 - Commercial	Existing commercial use development along Cope Street, situated west of the project site.
RC11 – Commercial	Existing commercial use development on the corner of Botany Road and Raglan Street, situated north-west of the project site.
RC12 - Residential	Existing residential use development along Wellington, Cooper and Cope Street within the boundaries of the precinct. These privately owned properties will not be redeveloped within the proposed concept SSDA.
RC13 – Residential	Existing residential use development along Wellington, West and George Street within the boundaries of the precinct. These privately owned properties will not be redeveloped within the proposed concept SSDA.

Figure 3: Acoustic site plan identifying the surrounding noise-sensitive receivers and noise monitoring locations

3.3 DEVELOPMENT PROPOSAL

The concept SSDA seeks concept approval in accordance with section 4.22 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the comprehensive redevelopment of the Waterloo South site.

The concept proposal, if approved, will guide the detailed design of future buildings, public open spaces, and the public realm within Waterloo South. It will seek concept development consent for key planning metrics for the precinct as generally described in Table 3 (indicative figures).

Table 3: Key development metrics

DESCRIPTOR	PROJECT DETAILS
Project Area	▪ Waterloo South has a developable site area of 114,822sqm / 11.5ha ▪ The broader Waterloo South Precinct Area, which includes all LAHC owned and privately owned properties and roads within the precinct, has a site area of 123,149sqm / 12.3ha
Project Description	▪ Maximum building envelopes, including maximum building heights, street-wall heights and setbacks. ▪ Distribution of gross floor area (GFA) across the Waterloo South development blocks. ▪ Indicative allocation of floor space between social, affordable and market housing, as well as non-residential and community uses across the Waterloo South Precinct Area. ▪ Loading, vehicular, pedestrian, and active transport access arrangements. ▪ Public domain upgrades and new public domain and publicly accessible areas. ▪ Indicative subdivision plan, staging plan and delivery sequencing for development. ▪ Approval of the following management plans and strategies to inform future stages of the development: o Updated Design Excellence Strategy o Design with Country Strategy o Preliminary Public Art Strategy o Contamination Strategy o Flood Management Strategy o Stormwater Management and Drainage Strategy o ESD Strategy o Strategies for utilities and service provision including service infrastructure lead-in enabling works o Tree Retention Strategy
Land Uses	**Residential** ▪ Social housing: no less than 30% of residential GFA ▪ Affordable housing: ~20% of residential GFA (balance between the delivery of minimum 30% social housing and the maximum 50% market housing) ▪ Market housing: no greater than 50% of residential GFA

DESCRIPTOR	PROJECT DETAILS
	Non-residential ▪ A total of 15,000m2 of GFA, of which at least 5,000m2 of GFA is to be delivered as 'Community Uses' (which can include childcare, health, education or community facilities).
Gross Floor Area	Up to 282,485m^2
Building Heights	Between 2 and 33 storeys
Car Parking	Up to 1,500 spaces (across all land uses), excluding on-street car parking spaces
Staging/ Phasing	It is expected that the redevelopment will occur in seven (7) stages (inclusive of the delivery of the large park on Block 1), however this staging remains indicative.

4 METHODOLOGY

To assess the noise and vibration impacts of the proposed development, 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;
- Carry out 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 relevant standards and guidelines;
- 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, 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 report:

- Road noise intrusion into the development from traffic movement on surrounding local roads;
- Vibration impacts from nearby underground rail and metro infrastructure;
- Noise and vibration impact of mechanical plant and equipment serving the proposed development on surrounding noise and vibration sensitive receivers; 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 report:

- 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.

5 NOISE MONITORING

5.1 INSTRUMENTATION

The equipment used for the noise survey was the following:

- Bruel and Kjaer 2250 Integrating Sound Level Meter (S/N: 3031115)
- Bruel and Kjaer type 1 microphone – comprising of:
  - ZC 0032 preamplifier (S/N: 31930)
  - 4189 capsule (S/N: 3334640)
- Bruel and Kjaer Sound calibrator Type 4231 (S/N: 3029638)
- 7 x NSRT mk3 Sentry Noise Loggers

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.

5.2 LONG-TERM NOISE MONITORING

Long term noise monitoring has been undertaken for the project site at locations shown in Figure 3 to measure the background and ambient noise that is representative of the surrounding noise and vibration sensitive receivers. Monitoring was conducted from Tuesday 18th November 2025 to Thursday 27th November 2025 for monitors LT1 to LT6, and from Friday 4th April 2026 to Thursday 10th April 2025 for LT7. Detailed graphical noise monitoring data is presented in Appendix A. Where required, additional noise monitoring shall be considered during future detailed applications.

5.2.1 Background Noise

Background noise levels and subsequent Rating Background Noise Level (RBL) have been established in accordance with the Noise Policy for Industry 2017 using the results of the noise monitoring at locations LT1-LT7 as indicated in Figure 3. The local ambient noise environment is typical of an Urban residential environment (as described by the NPfI).

Table 4: Unattended noise monitoring results

LOCATION	MEASURED EQUILAVENT CONTINUOUS NOISE LEVEL – L_{EQ} dB(A)			MEASURED RATING BACKGROUND NOISE LEVELS – L_{90} dB(A)		
	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT
LT1	55	52	50	42	40	36
LT2	58	56	51	48	47	45
LT3	56	53	50	44	43	37
LT4	54	52	49	43	41	37
LT5	57	54	50	46	43	38
LT6	71	72	67	50	56	42
LT7	69	67	64	60	57	47

General Note: Noise Policy for Industry (NPfI) 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 8:00 am Monday to Saturday, 10:00 pm to 8:00 am Sundays and Public Holidays.

5.2.2 Traffic Noise

In addition to background noise, long-term noise monitoring was also conducted at the project site to establish traffic noise levels for the site and have been summarised in Table 5.

Table 5: Long-term traffic noise monitoring results

LOCATION	MEASURED NOISE LEVELS, $L_{Aeq,period}$ dB(A)	
	DAY (7AM – 10PM)	NIGHT (10PM – 7AM)
LT1	56	49
LT2	59	51
LT3	56	50
LT4	55	49
LT5	57	50
LT6	70	66
LT7	68	64

5.3 SHORT-TERM (ATTENDED) NOISE MONITORING

Short-term noise measurements were conducted at the subject site to determine the environmental noise characteristics on Thursday 27th November between the hours of 4:00pm to 6:00pm. The results of the measurements are presented in Table 6.

Table 6: Short-term noise measurement summary

MEASUREMENT LOCATION	MEASUREMENT TIME	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	COMMENTS
ST1	Thursday 27th November 2025, 4:00pm to 6:00pm	58	41	58	Intermittent traffic noise from nearby and distant roads. Other urban noise sources including park activities and birds.
ST2		57	48	59	Moderately continuous traffic noise from nearby and distant roads. Other urban noise sources including park activities and birds.
ST3		52	44	54	Intermittent traffic noise from nearby and distant roads. Other urban noise sources including commercial activity along Cope Street and Botany Road.
ST4		54	43	56	Intermittent traffic noise from nearby and distant roads.
ST5		50	44	52	Continuous traffic noise from McEvoy Street.

6 PROJECT NOISE AND VIBRATION CRITERIA

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

- NSW DPHI *Waterloo Estate (South) Design Guide* 2022;
- NSW DPHI State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021;
- NSW DPHI Development Near Rail Corridors and Busy Roads – Interim Guideline;
- NSW EPA Road Noise Policy (RNP), 2011;
- NSW EPA Noise Policy for Industry (NPI) 2017;
- NSW Office of Liquor and Gaming Liquor Act 2007;
- City of Sydney Council Development Control Plan (DCP) Part 3 (General Provisions) 2012;
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009;
- NSW EPA 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"; and
- German Standard DIN4150 – Part 3: "Structural vibration in buildings – Effects on structures".

6.1 PLANNING SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

The SEARs acoustic requirements for the development are as follows:

9. Noise & Vibration

Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.

6.2 INTERNAL NOISE LEVELS

6.2.1 Waterloo Estate (South) Design Guide 2022

Section 8 of the 2022 Design Guide provides objectives and controls for building layout, form and design for the Waterloo South redevelopment. Specifically, Section 8.11 provides controls for noise and ventilation, however we highlight the following clauses below in procedurally establishing suitable internal noise targets for the development:

> ***1.3 Relationship to the Sydney LEP 2012, Sydney DCP 2012 and other policies***
>
> *This Design Guide adopts the provision of Sydney Development Control Plan 2012 (Sydney DCP2012) in accordance with 3.43(3() of the Act. If there is an inconsistency between this Design Guide and the provisions of Sydney DCP 2012, this Design Guide prevails to the extent of the inconsistency.*
>
> ***1.7 How to use this guide***
>
> *This Design Guide provides a hierarchy of objectives, design guidance and other provisions to guide future development in Waterloo Estate (South).*
>
> *Any application for development is to demonstrate how it meets the objectives and guidance. The guidance sets clear and measurable benchmarks for how the objectives can be practically achieved. If it is not possible to satisfy the guidance, applications must demonstrate what other responses are used to achieve the objectives.*

8. Objectives

(k) Ensure new development can appropriately respond to noise and wind impacts.

Given the above, and the context of the project, the assessment of traffic noise for the Waterloo South redevelopment has been carried out in accordance with the SEPP (Transport and Infrastructure) 2021. SEPP 2021 is the current statutory framework provided by the NSW Government for developments affected by major roads, and therefore deemed an appropriate response to external noise impacts as required by the objectives of the Waterloo Estate (South) Design Guide.

6.2.2 SEPP (Transport and Infrastructure) 2021

Clause 2.120 of SEPP 2021 states the following requirements for the impact of road noise or vibration on non-road development:

2.120 Impact of road noise or vibration on non-road development

(1) This section applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

(a) residential accommodation,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or centre-based childcare facility.

(2) Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this section and published in the Gazette.

(3) 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—

(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,

(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

(3A) Subsection (3) does not apply to a building to which State Environmental Planning Policy (Housing) 2021, Chapter 3, Part 7 applies.

(4) In this section, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

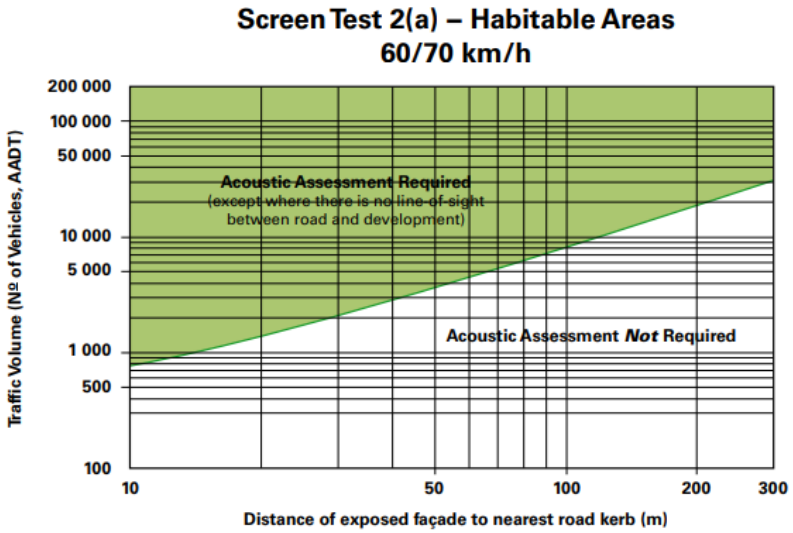
6.2.3 Development Near Rail Corridors and Busy Roads – Interim Guideline

Road Noise Assessment

Figure 4 has been extracted from the Interim Guideline and provides a screening test for noise sensitive developments that takes into account the volume of traffic and the distance between the proposed development and the busy road. Clause 2.120 of the State Environmental Planning Policy (Transport and Infrastructure) 2021, through which the Interim Guideline road noise criteria applies through, only applies for roads with an annual average daily traffic volume (AADT) of more than 20,000 vehicles, or if the road is a freeway, tollway or transitway. The screen test has been conducted to establish whether or not an acoustic assessment is required.

In this case, based on Map 12D of the Transport for NSW traffic volume maps, McEvoy Street is identified as a road carrying more than 20,000 vehicles and is mandatory for under Clause 2.120 of SEPP (Transport and Infrastructure) 2021.

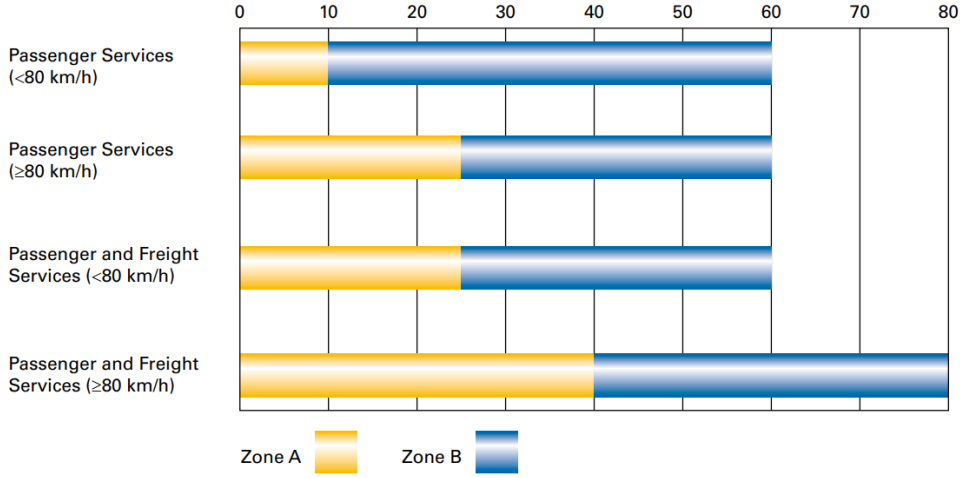
Figure 4: Screen tests for habitable areas of multiple dwellings (noting that any exposed facade is direct line-of-sight)



Rail Noise Assessment

Figure 5 which has been extracted from the Interim Guideline provides guidance as to the level of assessment required when noise sensitive developments are located in the vicinity of existing rail lines. Zones A and B are indicative acoustic assessment zones where sensitive land-uses are likely to be adversely affected.

Figure 5: Acoustic assessment zones based on distance (m) of noise-sensitive development from operation track (not corridor)



Given the proposed development boundary is located at least 500m from the nearest aboveground rail corridor serving Redfern station, an assessment of rail noise to the facades of the proposed development is not required.

Criteria – Road Noise

The Interim Guideline details the application of the SEPP 2007, which we note has been superseded by SEPP 2021. In addition, the Interim Guideline also recommends the following in relation to the assessment of ventilation by means of opened windows or doors:

> *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 7 provides a summary of the criteria established in accordance with the Interim Guideline and SEPP 2021.

Table 7: Summary of internal noise criteria from the Interim Guideline and SEPP 2021

TYPE OF HABITABLE SPACE	APPLICABLE TIME PERIOD	INTERNAL NOISE LEVEL CRITERIA – WINDOWS/DOORS CLOSED	INTERNAL NOISE LEVEL CRITERIA – WINDOWS/DOORS OPEN
Sleeping areas (bedrooms)	10:00pm – 7:00am	35 dB(A)$L_{Aeq(9hour)}$	45 dB(A)$L_{Aeq(9hour)}$
Living rooms	At any time	40 dB(A)$L_{Aeq(15hour)}$	50 dB(A)$L_{Aeq(15hour)}$

6.3 GROUNDBORNE NOISE AND VIBRATION

Internal ground/structure borne noise and vibration levels to the proposal should be controlled to within the requirements of SEPP 2021 and the AVTG.

As per the AVTG, a detailed ground borne noise and vibration impact assessment of the existing railway corridor is required in accordance with SEPP 2021 as the rail corridor is located within 40m of the project site boundary.

Recommended Vibration Dose Values (VDVs) for intermittent vibration as scheduled in the AVTG are summarised in Table 8.

Table 8: Acceptable vibration dose values (VDV) for intermittent vibration

LOCATION	PREFERRED VALUES		MAXIMUM VALUE	
	DAY	NIGHT	DAY	NIGHT
Residential areas	0.20 $m/s^{1.75}$	0.13 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.26 $m/s^{1.75}$

The DoP Guideline states in Section 3.6.2:

> *"Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne L_{Amax} noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter."*

6.4 EXTERNAL NOISE EMISSIONS

6.4.1 NSW EPA Noise Policy for Industry (NPI) 2017 – Industrial Noise (Plant and Equipment)

The NSW EPA's Noise Policy for Industry (NPI) 2017 has been implemented to assess the noise impacts of mechanical plant and equipment, as well as other industrial noise sources on the surrounding receiver catchments.

The NPI sets out a framework for the derivation of project noise trigger levels that are used to assess the potential impacts of noise from industry (and industrial noise sources) and indicate the noise level at which feasible and reasonable noise management measures should be considered.

This policy applies to noise sources from activities listed in Schedule 1 of the POEO Act and those regulated by the EPA. This includes noise sources from mechanical plant and equipment within the proposed redevelopment, for which this policy will be applied.

The project noise trigger level provides a benchmark for assessing a proposal, where if exceeded, indicates a potential noise impact on the community and so triggers a management response such as additional mitigation

measures. The project noise trigger level is the lower (the more stringent) value of the project intrusiveness noise level and project amenity noise level determined in Sections 2.3 and 2.4 of the NPI, respectively.

Project Intrusiveness Noise Level

The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (in terms of L_{Aeq}) measured over a 15-minute period does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. The project intrusiveness noise level is only applicable to surrounding residential receivers.

To account for the temporal variation of background noise levels, the method outlined in Fact Sheet A of the NPI establishes a method in determining the Rating Background Noise Level (RBL) to be used in the assessment.

The intrusiveness noise level is determined as follows:

$L_{Aeq,15min}$ (Intrusiveness Criteria) = Rating Background Noise Level (RBL) + 5 dB(A)

Table 9 provides the project intrusiveness noise levels applicable to each of the surrounding residential noise-sensitive receivers. Receiver catchments are provided in Table 2.

Table 9: Project intrusiveness noise level criteria for each residential receiver catchment

RECEIVER CATCHMENT	TIME OF DAY	MEASURED RBL - dB(A)	PROJECT INTRUSIVENESS NOISE LEVELS - $L_{Aeq,15min}$ dB(A)
RC1, RC4 & RC12[1]	Day	42	47
	Evening	40	45
	Night	36	41
RC2[2]	Day	46	51
	Evening	43	48
	Night	38	43
RC3[3]	Day	48	53
	Evening	47	52
	Night	45	50
RC5, RC6 & RC13[4]	Day	42	47
	Evening	40	45
	Night	36	41

Note 1 – Based on the results of long-term unattended noise monitoring at monitoring position LT3.

Note 2 – Based on the results of long-term unattended noise monitoring at monitoring position LT5.

Note 3 – Based on the results of long-term unattended noise monitoring at monitoring position LT2.

Note 4 - Based on the results of long-term unattended noise monitoring at monitoring position LT1.

Project Amenity Noise Level

The recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project Amenity Noise Level = Recommended Amenity Noise Level (see Table 10) – 5 dB(A)

The following exceptions to the above method to derive the project amenity noise level apply:

- In areas with high traffic noise levels. Where the level of transport noise, road traffic noise in particular is high enough to make noise from an industrial source inaudible, the project amenity noise level shall be set at 15 dB(A) below the measured $L_{Aeq,period(traffic)}$ for the particular assessment period.
- In proposed developments in major industrial clusters
- Where the resultant project amenity noise level is 10 dB(A) or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB(A) below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time
- Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development

The recommended amenity noise level, project amenity noise level, and converted project amenity noise level for comparison with the intrusiveness criteria (from time-of-day period to 15-minute) is provided for each surrounding receiver catchment in Table 10.

Table 10: Project amenity noise level criteria for each receiver catchment

RECEIVER CATCHMENT	RECEIVER TYPE	TIME OF DAY	RECOMMENDED AMENITY NOISE LEVEL - $L_{Aeq,period}$ dB(A)	PROJECT AMENITY NOISE LEVEL - $L_{Aeq,period}$ dB(A)	PROJECT AMENITY NOISE LEVEL - $L_{Aeq,15min}$ dB(A)
RC1 – RC6, RC12 & RC13	Residential – Urban[1]	Day	60	55	58
		Evening	50	45	48
		Night	45	40	43
RC7	School[3]	When in use	35 (Internal)	30 (Internal)	33 (Internal) 43 (External)
RC8	Active Recreation	When in use	55	50	53
RC9, RC10 & RC11	Commercial	When in use	65	60	63

Note 1: Urban residential as classified in Table 2.3 of the Noise Policy for Industry (NPI) 2017.

Note 2: As per Section 2.4.1, project amenity noise levels have been corrected based on the measured traffic noise levels presented in Section 5.2.2 of this report.

Note 3: As per Section 4.1.2 of the NSW EPA *Interim Construction Noise Guideline*, a conservative estimate of the difference between internal and external noise levels if 10dB for buildings other than residences.

Sleep Disturbance and Maximum Noise Level Assessment

Where the proposed redevelopment night-time noise levels generated at a residential location exceed either:

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

a detailed maximum noise level event assessment should be undertaken.

Corrections for Annoying Noise Characteristics – Noise Policy for Industry Fact Sheet C

Fact Sheet C contained within the Noise Policy for Industry outlines the correction factors to be applied to the source noise level at the receiver before comparison with the project noise trigger levels established within this report, to account for the additional annoyance caused by these modifying factors.

The modifying factor corrections should be applied having regard to:

- The contribution noise level from the premises when assessed/measured at a receiver location, and
- The nature of the noise source and its characteristics (as set out in Fact Sheet C)

Table C1 within Fact Sheet C sets out the corrections to be applied for any assessment in-line with the NPI. The corrections specified for tonal, intermittent and low-frequency noise are to be added to be added to the measured or predicted levels at the receiver before comparison with the project noise trigger levels. The adjustments for duration are to be applied to the criterion.

Project Noise Trigger Levels

Table 11 presents the project intrusiveness and project amenity noise levels for each period, and each receiver catchment, as well as the resultant project noise trigger levels (PNTLs) that shall be applied for any assessment of impacts of mechanical plant and equipment noise on the surrounding receiver catchments.

Table 11: Project noise trigger levels (PNTL) to be applied to each surrounding receiver catchment

RECEIVER CATCHMENT	RECEIVER TYPE	TIME OF DAY	PROJECT INTRUSIVENESS NOISE LEVEL - $L_{Aeq,15min}$ dB(A)	PROJECT AMENITY NOISE LEVEL - $L_{Aeq,15min}$ dB(A)	SLEEP DISTURBANCE NOISE LEVEL - dB(A)	PROJECT NOISE TRIGGER LEVEL - $L_{Aeq,15min}$ dB(A)
RC1, RC4 & RC12	Residential – Urban	Day	47	58	N/A	47
		Evening	45	48	N/A	45
		Night	41	43	41dB(A)L_{eq} and 52dB(A)L_{max}	41dB(A)L_{eq} and 52dB(A)L_{max}
RC2	Residential – Urban	Day	51	58	N/A	51
		Evening	48	52	N/A	48
		Night	43	45	43dB(A)L_{eq} and 53dB(A)L_{max}	43dB(A)L_{eq} and 53dB(A)L_{max}
RC3	Residential – Urban	Day	53	58	N/A	53
		Evening	52	48	N/A	48
		Night	50	43	50dB(A)L_{eq} and 60dB(A)L_{max}	50dB(A)L_{eq} and 60dB(A)L_{max}
RC5, RC6 & RC13	Residential – Urban	Day	47	58	N/A	47

RECEIVER CATCHMENT	RECEIVER TYPE	TIME OF DAY	PROJECT INTRUSIVENESS NOISE LEVEL - $L_{Aeq,15min}$ dB(A)	PROJECT AMENITY NOISE LEVEL - $L_{Aeq,15min}$ dB(A)	SLEEP DISTURBANCE NOISE LEVEL - dB(A)	PROJECT NOISE TRIGGER LEVEL - $L_{Aeq,15min}$ dB(A)
		Evening	45	48	N/A	45
		Night	41	43	41dB(A)L_{eq} and 52dB(A)L_{max}	41dB(A)L_{eq} and 52dB(A)L_{max}
RC7	School	When in use	N/A	33 (Internal) 43 (External)	N/A	43 (External)
RC8	Active Recreation	When in use	N/A	53	N/A	53
RC9, RC10 & RC11	Commercial	When in use	N/A	63	N/A	63

6.5 TRAFFIC NOISE GENERATION

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 NSW Road Noise Policy (RNP). 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 12.

Table 12: NSW RNP – Traffic Noise Assessment Criteria

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	ASSESSMENT CRITERIA – dB(A)	
		DAY (7AM – 10PM)	NIGHT (10PM – 7AM)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq,\ (15\ hour)}$ 55	$L_{Aeq,\ (15\ hour)}$ 50
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq,\ (15\ hour)}$ 60	$L_{Aeq,\ (15\ hour)}$ 55
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local Roads	4. Existing residences affected by noise from new local road corridors	$L_{Aeq,\ (1\ hour)}$ 55	$L_{Aeq,\ (1\ hour)}$ 50
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

In the event that 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 of the RNP 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'.

Also, the inherent quality of noise from vehicles on public roads arriving to and departing from the site would be indistinguishable from other traffic noise on public roads.

6.6 PATRON AND MUSIC NOISE EMISSIONS

In the absence of controls and objectives for patron/music noise emissions in the Waterloo Estate (South) Design Guide 2022, this assessment has adopted the following guidelines:

- NSW Office of Liquor and Gaming *NSW Liquor Act 2007* – Applied to existing residences external to the Waterloo Estate redevelopment.
- City of Sydney Council *Development Control Plan (DCP) Section 3.18 General Provisions – Acoustic Amenity* (last modified 1st December 2025) – Applied to future residences within the Waterloo Estate redevelopment to determine suitable internal noise targets within apartments (windows closed).

6.6.1 NSW Liquor Act 2007

The noise emissions criteria from the NSW Liquor Act 2007 shall be applied to noise from any music/entertainment and patrons of licensed premises and assessed to the surrounding existing residential receivers external to the Waterloo South development.

A summary of the noise emissions requirements for licensed premises within the NSW Liquor Act 2007 is provided in Table 13 for all surrounding residential receivers.

Table 13: Summary of NSW Liquor Act 2007 noise emission criteria

PERIOD	OCTAVE BAND CENTRE FREQUENCIES	NOISE CRITERIA dB(A)
7am – 12am	From 31.5 Hz to 8000 Hz	$L_{A10, oct} \leq L_{A90, oct}$ + 5 at property boundary
12am – 7am	From 31.5 Hz to 8000 Hz	$L_{A10, oct} \leq L_{A90, oct}$ + 0 at property boundary
		Inaudible in habitable rooms

6.6.2 City of Sydney DCP

Section 3.18 of the DCP provides controls for entertainment sound. This assessment adopts the "Internal criteria for entertainment sound" within future apartments as part Waterloo South with windows closed. Table 14 provides a summary of octave band and broadband noise levels in line with the DCP.

Table 14: Summary of internal noise criteria for the Waterloo South

RECEIVER	TIME OF DAY	INTERNAL CRITERIA – OCTAVE BAND CENTRE FREQUENCY (Hz)							
		31.5	63	125	250	500	1k	2k	4k
Waterloo South Apartments – Bedrooms	7am to 12am	60	50	39	30	25	20	15	13
	12am to 7am	53	43	32	23	18	13	8	6
Waterloo South Apartments – Living Areas	7am to 12am	65	55	44	35	30	25	20	18
	12am to 7am	55	48	37	28	23	18	13	11

6.7 CONSTRUCTION NOISE CRITERIA

6.7.1 Interim Construction Noise Guideline (ICNG)

The noise criteria outlined within the ICNG has been adopted for the assessment of noise emissions from the construction of the proposed redevelopment.

Airborne Noise – Residential Receiver Catchments

The airborne noise criteria for surrounding residential receiver catchments have been extracted from Table 2 in the ICNG and is presented in Table 15 below.

Table 15: NSW ICNG construction noise criteria for surrounding residential receiver catchments (RC3 and RC4)

TIME OF DAY	MANAGEMENT LEVEL $L_{Aeq,15min}$[1]	HOW TO APPLY
Recommended Standard Hours: Monday – Friday 7am – 6pm Saturday 8am – 1pm	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.
No work on Sundays or public holidays	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

TIME OF DAY	MANAGEMENT LEVEL $L_{Aeq,15min}$[1]	HOW TO APPLY
		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	▪ 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.

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 30 m 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.

Airborne Noise – Other Sensitive Land Uses

The airborne noise criteria for surrounding have been extracted from Table 3 in the ICNG and is presented in Table 16 below.

Table 16: NSW ICNG construction noise criteria for other sensitive land uses

LAND USE	MANAGEMENT LEVEL (APPLIES WHEN BEING USED) $L_{Aeq,15min}$
Classrooms at schools and other educational institutions / Hospital wards and operating theatres / Places of worship	45 dB(A) - Internal
Active Recreation Areas	65 dB(A) - External
Passive Recreation Areas	65 dB(A) - External
Commercial Premises (offices, retail outlets)	70 dB(A) - External

Ground-borne Noise – Residential Receiver Catchments

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure, such as an excavator with a hydraulic hammer attachment, or impact/bore piling. The following ground-borne noise levels for residences have been extracted from Section 4.2 of the ICNG and indicate when management actions should be implemented.

- Evening (6pm to 10pm) – Internal Noise Level: $L_{Aeq,15min}$ 40 dB(A); and
- Night-time (10pm to 7am) – Internal Noise Level: $L_{Aeq,15min}$ 35 dB(A).

An assessment of ground-borne noise to these levels is only required when the ground-borne noise levels are higher than airborne noise levels, and for surrounding residential receiver catchments. The ground-borne noise levels are for evening and night-time periods only. The levels shall be assessed at the centre of the most affected habitable room.

6.8 CONSTRUCTION VIBRATION CRITERIA

It is important for vibration emissions from vibration-intensive equipment utilized during the construction works to 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.

6.8.1 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 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 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 17. It should be noted that the human comfort for vibration is more stringent than the building damage criteria.

Table 17: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s^2) 1-80 Hz

LOCATION	ASSESSMENT PERIOD[1]	PREFERRED VALUES		MAXIMUM VALUES	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Critical areas[2]	Day- or night time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night time	0.64	0.46	1.28	0.92

Note 1: Daytime is 7:00am to 10:00pm and night time is 10:00pm to 7:00am

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

Intermittent Vibration Criteria

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.

Table 18: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

LOCATION	DAYTIME[1]		NIGHT-TIME[1]	
	PREFERRED VALUE	MAXIMUM VALUE	PREFERRED VALUE	MAXIMUM VALUE
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

Note 1: Daytime is 7:00am to 10:00pm and night time is 10:00pm to 7:00am

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

6.8.2 Cosmetic Damage

Structural vibration thresholds are set to minimize the risk of cosmetic surface cracks and lie below the levels that have the potential to cause damage to the main structure. Table 19 presents guide values for building vibration, based on the vibration thresholds above which cosmetic damage has been demonstrated outlined within BS7385-Part 2:1993. These values are evaluated to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as 95% probability of no effect.

Table 19: Transient vibration guide values for cosmetic damage – BS 7385-2:1993

TYPE OF BUILDING	PEAK PARTICLE VELOCITY IN FREQUENCY RANGE OF PREDOMINANT PULSE (PPV)	
	4 HZ TO 15 HZ	15 HZ AND ABOVE
Reinforced or framed structures Industrial or light commercial type buildings	50mm/s	N/A
Unreinforced or light framed structures, Residential or light commercial type buildings	15mm/s	20mm/s (50mm/s at 40Hz and above)

6.8.3 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 20 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn't occur.

Table 20: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration – DIN4150-3

LINE	TYPE OF STRUCTURE	VIBRATION VELOCITY, V_i, IN mm/s			
		FOUNDATION			PLANE OF FLOOR OF UPPERMOST FULL STOREY
		AT A FREQUENCY OF			
		LESS THAN 10HZ	10 TO 50HZ	50 TO 100HZ*	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					

6.8.4 Construction Vibration Impacts on Rail Infrastructure

We refer to the following guidelines with regard to vibration impacts from the construction of the proposed development on adjacent rail and metro infrastructure:

- Transport for NSW *Development Near Rail Tunnels* Version 2.0 dated 15th November 2018
- Sydney Metro *Sydney Metro Underground Corridor Protection Technical Guidelines* dated April 2021

The Sydney Metro guideline also makes reference to the *Development Near Rail Tunnels* document, which states:

> ***9.4.1 Effects of development on rail tunnels***
>
> *Any development that occurs within a distance of 25m horizontally from first reserve shall assess the vibration on the rail tunnels. The assessment criteria shall be a maximum peak particle velocity (PPV) of 15mm/s at the tunnel lining from brick or mass concrete in good condition or a maximum PPV of 20mm/s at the tunnel lining for cast iron, steel or concrete segment lining.*

Further to the above, the TfNSW guideline recommends the development of a vibration monitoring plan to measure vibration levels arising from the proposed development during construction. Trigger levels typically set at a fraction of the maximum PPV (being 15mm/s alert level) shall be determined as part of this vibration monitoring plan, in agreement with TfNSW. Any additional vibration requirements (i.e. vibration sensitive equipment) shall be advised by TfNSW as part of a future vibration monitoring plan as outlined in Section 4.2.

We understand the project site is not located adjacent to a station or commercial building associated with TfNSW where staff, tenants and customers are required to be protected from noise. On this basis, mitigation measurements for construction noise impacts on the adjacent rail and metro corridors are not deemed necessary.

7 OPERATIONAL NOISE AND VIBRATION ASSESSMENT

7.1 MECHANICAL SERVICES

At this stage of the proposed development, the design has not progressed enough for mechanical plant and equipment selections are yet to be made. During the design development stage of the project, a detailed acoustic review of mechanical plant and equipment shall be undertaken. Acoustic mitigation measures, such as those listed above and in Section 9.1, will be determined to ensure compliance with the external noise emissions criteria established in Section 6.4.1.

7.2 CARPARK USAGE

It is proposed that all carparking be situated in an enclosed carpark accessed from ground floor and continuing through basement levels. As such, it can be reasonably expected that the use of the carparking will not have noise impact on the nearest noise sensitive receivers and noise level criteria in Section 6.2.3 will be met.

7.3 LOADING DOCK

A detailed noise emissions assessment from loading docks shall be assessed as part of future detailed applications, once major retail operators are known, and parking/loading dock design are finalised.

The following mitigation measures should be considered as part of a loading dock management plan to minimise noise impacts to surrounding noise sensitive receivers:

- Loading docks will be capable of operating within enclosed spaces with the entry rollers shut to minimise noise break out.
- Where feasible, vehicles using the loading dock shall turn off their engines when not in use during vehicle loading/unloading.
- Vehicles should not travel at speeds greater than 10km/h whilst on the premises.

Allowances should be made for the structural vibration isolation of areas where trucks, pallet jacks and vehicle turn tables are operating beneath residential spaces on suspended slabs. Further detail and requirements shall be co-ordinated further throughout design development.

7.4 TRAFFIC AIRBORNE NOISE INTRUSION

7.4.1 Noise Modelling and Assumptions

To provide acoustic amenity to occupants of the proposed development and achieve the recommended internal noise limits, the noise impact of surrounding noise sources was assessed at the façade of the proposed development within the proposed development.

3D acoustic modelling for noise emissions from the surrounding roads was conducted using the software SoundPLAN (Version 9.0). Noise emissions from major roads bounding the site were modelled in accordance with the CoRTN prediction techniques and calibrated to the measurements conducted for this assessment.

Attenuation due to distances, building shielding and environmental absorption, together with additional noise incident on the façade due to façade reflections are considered within the 3D model.

7.4.2 "Windows Closed" Assessment

The results of the 3D modelling are provided in Appendix B (in the form of façade noise contours), showing the incident noise levels on the façade (daytime and night-time) as a result of external road and rail noise sources. The incident noise levels are presented as $L_{Aeq,15hour}$ and $L_{Aeq,9hour}$ statistical metrics for the purpose of demonstrating compliance with SEPP 2021 and the Interim Guideline, and mitigation measures are presented in Section 9.2.

7.4.3 "Windows Open" Assessment

A preliminary "windows open" assessment has been conducted to assess whether the habitable spaces can meet the project internal noise limits established in Section 6.2.3 with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the NCC). This assessment has been based on the façade noise levels presented in Appendix B.

If the project internal noise limits for windows/doors open is exceeded, the habitable area is considered noise-affected, and an alternative means of ventilation is required in accordance with the requirements of the NCC (i.e. an alternative ventilation system complying with AS 1668.2 and AS/NZS 3666.1).

The assessment has been conducted under the assumption the occupant has opened their windows to achieve natural ventilation (and as recommended in the 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 as part of this assessment.

In order to achieve the project internal noise limits established in Section 6.2.3 whilst simultaneously achieving the ventilation requirements, mitigation measures have been discussed in Section 9.3 for the proposed development.

7.5 RAIL STUCTURE-BORNE NOISE AND TACTILE VIBRATION IMPACTS

Criteria for rail noise and vibration impacts have been established in Section 6.2 and 6.3. A detailed assessment of rail structure-borne noise and tactile vibration impacts shall be undertaken as part of future detailed applications. Building vibration isolation requirements shall be determined following vibration measurements of the operational rail line which runs along George Street.

7.6 NOISE FROM RETAIL/COMMERCIAL USE

At the time of writing, the tenants for retail and commercial spaces have not been determined and therefore the specific usage for these spaces are unknown.

Future usage of these spaces may be subject to a separate development application and detailed assessment of their expected operation and activities may be required (i.e. if early morning or late-night trading hours are proposed). The selected tenants may be required by the certifying authority to submit a separate Development Application based on use.

7.7 PATRON AND MUSIC NOISE FROM F&B USE

Criteria for patron and music noise has been set out in Section 6.6 based on the current guidelines available. A detailed assessment shall be undertaken as part of future detailed applications for the redevelopment, upon further rationalisation of building design and internal layouts.

Preliminary mitigation measures are outlined below which will assist in ensuring operational noise emissions are capable of satisfying the established criteria:

- Operational management plans identifying trading hours, and any patron number and/or music level limits determined as part of a future detailed SSDA assessment.
- Operable façade elements to allow for a balance of ambience during day-time hours of use, and acoustic amenity during the noise sensitive night-time hours.
- Signage on display to remind patrons and minimise noise when entering and leaving the premises.
- Acoustic ceilings where patron spaces are below residential apartments (i.e. ceilings on vibration isolated hangers with insulated ceiling cavities).

7.8 TRAFFIC NOISE GENERATION

Noise from traffic generation on roads bounding the project such has been assessed by comparison against traffic volumes approved as part of a previous Planning Proposal in which there was no consideration of public transport infrastructure improvements. The ptc. *Transport Impact Assessment* prepared for the concept SSDA provides the following predicted peak hour vehicle trips for the concept SSDA, in comparison to approved traffic generation values in previous studies:

Table 21: Comparison of vehicular trip generation

PEAK HOUR	LAHC (JACOBS, 2020)	PLANNING PROPOSAL (CITY OF SYDNEY, 2020)	CONCEPT SSDA
AM	507	475	496
PM	587	520	496

We note:

- Predicted peak hour trips for the concept SSDA are less than the planning proposal prepared by Home NSW (Jacobs, 2020) during both the AM and PM peak hours.
- Predicted peak hour trips for the concept SSDA are less than the planning proposal prepared by the City of Sydney during the PM peak hour. The additional 21 vehicles during the AM peak hour represents a change in noise that would be insignificant and imperceptible, equal to less than 0.2dB.

In consideration of the above, noise from traffic generation by the proposed redevelopment is in-line with previously approved schemes and is considered to be acceptable.

7.9 TRAFFIC NOISE IMPACTS ON FUTURE PARKS

The City of Sydney has brought attention to the potential impact of traffic noise from McEvoy Street to the proposed park within Block 8. We note the following:

- The *Waterloo Estate (South) Design Guide* provides design guidance relating to traffic noise impacts and the siting of buildings. Specific criteria for external noise levels are not established within the guide.
- The *Road Noise Policy* (2011) provides noise criteria for assessing the impact when there is a new road or road development, or when there is a land use development with the potential to generate additional traffic on local, sub-arterial or arterial roads. The policy provides the following criteria for open spaces:
    - Open recreation space (active use): 60 dB(A) $L_{Aeq(15\ hour)}$
    - Open recreation space (passive use): 55 dB(A) $L_{Aeq(15\ hour)}$
- Based on the 3D noise modelling detailed in Section 7.4, predicted noise levels at the park are expected to be approximately 55dB(A), which is in-line with existing framework provided by NSW EPA in determining suitable road noise impacts to open recreation spaces, even when considering passive uses.
- Further to the above, the acoustic amenity at the proposed park within Block 8 is expected to be equivalent, if not greater, than the level of amenity achieved at nearby existing parks such as Waterloo Oval, Prince Alfred Park and Redfern Oval/Redfern Park.

8 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

8.1 PROPOSED CONSTRUCTION ACTIVITIES

Construction is expected to comprise of the following indicative major stages of works:

- Demolition
- Excavation
- Structure
- Façade, Finishes & Services

The construction works are expected to occur during the following hours (in line with the NSW ICNG):

- Monday to Friday: 7:00am to 6:00pm;
- Saturday: 8:00am to 1:00pm; and
- Sunday and public holidays: no work.

8.2 CONSTRUCTION NOISE ASSESSMENT

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 22. The equipment noise levels have been extracted from AS2436:2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites". An indicative likelihood of construction equipment exceeding the noise management levels established in Section 6.7 is provided in Table 22. It is expected that a detailed construction noise and vibration assessment will be undertaken as part of the documentation for Construction Certificate (CC).

Table 22: Cumulative impact – construction equipment noise levels

STAGES	EQUIPMENT	RISK/LIKELIHOOD OF EXCEEDING NOISE MANAGEMENT LEVELS
Site Establishment & Demolition works	Excavator (Hammers)	Very High
	Excavator (Buckets)	High
	Concrete Saw	Very High
	Trucks	Moderate
Earthworks	Excavator (Buckets)	High
	Rock Saw	Very High
	Trucks	Moderate
Structure	Concrete Truck	Moderate
	Concrete Vibrators/Helicopter	Low
	Powered Hand Tools	Low
Façade, Finishes & Services	Cranes	Low
	Trucks	Moderate
	Forklift/Front Loaders	Moderate
	Powered Hand Tools	Low

8.3 CONSTRUCTION VIBRATION ASSESSMENT

It is expected that majority of vibration intensive activities will occur during the demolition and excavation works where excavator mounted hammering may be utilised.

Safe working distances for vibration intensive plant and are quoted for both "cosmetic" damage (in accordance with BS 7385) and human comfort (in accordance with Assessing Vibration – a technical guideline), have been provided, based on the Transport for NSW's "Construction Noise Strategy (2013)". The recommended safe working distances for each of the plant listed above are provided in Table 23.

Table 23: Recommended safe working distances for vibration intensive plant

ACTIVITY	SAFE WORKING DISTANCE (METRES)	
	COSMETIC DAMAGE (BS 7385)	HUMAN RESPONSE (OH&E VIBRATION GUIDELINE)
Piling	2m (nominal)	N/A
Jackhammering	1m (nominal)	Avoid contact with structure
Rock Breaking	22m	73m
Rock Sawing	22m	73m

Attended vibration monitoring should be considered at the commencement of vibration inducing activities (rock breaking and hammering) to verify the safe working distances. If the levels are compliant with the vibration limits as listed in Section 6.8, then work may proceed based on the implementation of the measures detailed in this report. If there are exceedances, reasonable and feasible mitigation measures should be considered to lessen the impact, such as an alternative method of activity or using machinery with less capacity, and additional vibration monitoring should be conducted.

Monitoring strategies have been discussed in Section 9.5.2, which shall be reviewed as part of a future construction noise and vibration management plan once construction methodologies are known.

9 MITIGATION MEASURES

9.1 MECHANICAL PLANT AND EQUIPMENT NOISE MITIGATION

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 receiver catchments. These mitigation measures could include but not limited to the following:

- Positioning mechanical plant away from nearby receivers
- Acoustic attenuators fitted to duct work
- Screening/acoustic louvres 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.

9.2 EXTERNAL SOUND ISOLATION – BUILDING ENVELOPE

9.2.1 Glazed Façade Elements

A preliminary assessment of external traffic noise impacts on the development has been undertaken based on long-term noise monitoring conducted around the site, as detailed in Section 5. Also refer to façade noise maps provided in Appendix B for the range of predicted façade noise levels across the development. The following preliminary mitigation measures have been identified:

- Standard single glazed façade systems achieving R_w 32 (6.38mm laminated glass) will be sufficient to the majority of spaces in order to achieve project internal noise requirements established in Section 6.2.
- South facing facades along McEvoy Street are exposed to the highest relative traffic noise levels on the development. Notwithstanding, bulky double glazed façade systems are not expected to be required for acoustics. Even assuming conservatively large areas of façade glazing to habitable spaces, we expect façade glazing achieving R_w 35-37 (up to 12.76mm laminated glass) to be sufficient.
- Where small air-cavity glazing systems are required for other factors (such as thermal), acoustic system will be available that are capable of satisfying both relevant requirements.

A detailed assessment of minimum recommended building envelope constructions shall be undertaken as part of a future detailed applications once room layouts, elevations and total glazed areas are further rationalised.

9.2.2 Non-Glazed Façade Elements

Non-glazed façade elements shall be assessed as part of a future detailed applications once the design of external wall types have progressed. We note:

- External walls constructed from masonry/concrete systems will be acoustically acceptable.
- Lightweight façade systems shall be reviewed; however we expected typical systems with external cladding and insulated cavities to be sufficient across the majority of the project.

9.3 ALTERNATIVE MEANS OF VENTILATION

An open windows assessment has been conducted to assess whether the residential spaces are able to meet the internal noise level requirements of the Interim Guideline with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the NCC).

If the project internal noise limits for windows/doors open is exceeded, alternative means of ventilation is required in accordance with the requirements of the NCC (i.e. alternative ventilation system complying with AS 1668.2 and AS/NZS 3666.1) to the noise-affected spaces (noise-affected as defined in Section 5.3.2).

Based on the façade noise levels presented in Appendix B, the following is concluded:

- "Windows open" internal noise levels will be achievable across the majority of the development via natural ventilation,
- Minor exceedances of the "windows open" internal noise levels are expected at the most traffic noise affected facades , being South facing McEvoy Street and approximately up to Level 20.
- The NSW DPHI *Development Near Rail Corridors and Busy Roads – Interim Guideline* provides framework and allowance for the design of the development to utilise mechanical ventilation.
- Mechanical ventilation systems shall be detailed through design development, to ensure noise emissions from the ventilation systems satisfy project external noise limits, and to ensure the system complies with AS1668.2.

9.4 OUTDOOR COMMUNAL OPEN SPACES

Noise generated by residents using outdoor communal spaces during the night-time period (10pm – 7am) on the has the potential to be intrusive and offensive. To reduce the risk of intrusive and/or offensive noise emissions to surrounding noise-sensitive receivers, operational noise management techniques should be introduced to reduce the noise generated by patrons. Noise from the use of outdoor communal open spaces shall be mitigated with the following measures:

- Signage displayed reminding residents to be considerate and minimise noise while the space is in use (i.e. no shouting, restriction on any amplified music, and that the outdoor communal space is not to be used for parties), especially during noise sensitive hours of the day.

9.5 CONSTRUCTION NOISE AND VIBRATION

9.5.1 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.

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 demountable offices can be effective barriers);
- Constructing barriers that are part of the project design early in the project to introduce the mitigation of site noise; and
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

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.

Crane (diesel operated)

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

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; and
- Spotters or observers.

The above methods should be combined, where appropriate.

9.5.2 Noise & Vibration Monitoring Strategy

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; and
- Long-term monitoring.

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.

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.

Both methodologies 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.

10 CONCLUSION

This Noise and Vibration Impact Assessment has been prepared by E-LAB Consulting to support a concept State Significant Development Application (SSD-93222706) for the redevelopment of the site within the Waterloo Estate, known as 'Waterloo South'. This Noise and Vibration Impact Assessment specifically responds to the requirements of Item 9 of the SEARS (SSD-93222706) issued for the project by DPHI on 8th October 2025.

The assessment has considered the following key acoustic elements:

- Noise impacts from major roads surrounding the proposed development;
- Vibration impacts from nearby rail infrastructure on the proposed structures;
- Noise impacts from the operation of the development on surrounding noise sensitive receivers; and
- Noise and vibration impacts from construction activities associated with the development on surrounding noise sensitive receivers.

To assess each of the acoustic considerations for the proposed development, noise criteria has been established in Section 6 in accordance with the following documents:

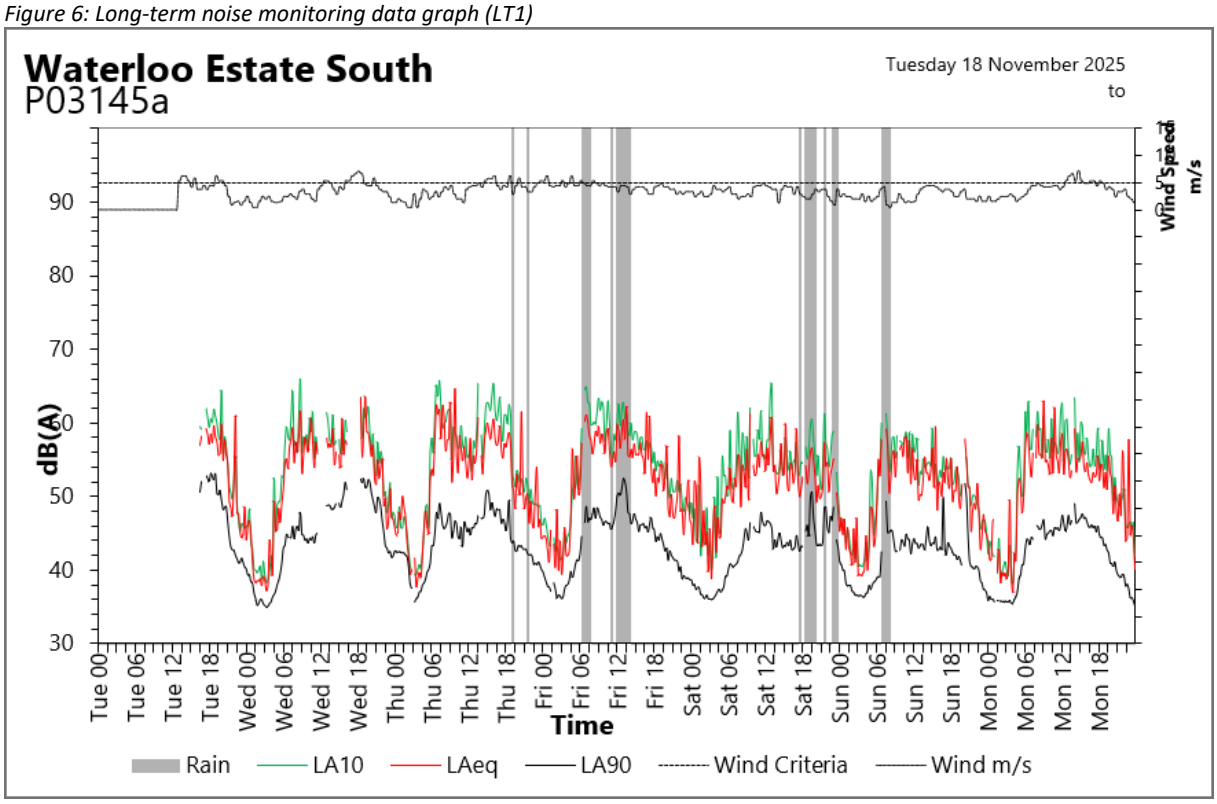
- NSW DPHI *Waterloo Estate (South) Design Guide* 2022;
- NSW DPHI State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021;
- NSW DPHI Development Near Rail Corridors and Busy Roads – Interim Guideline;
- NSW EPA Road Noise Policy (RNP), 2011;
- NSW EPA Noise Policy for Industry (NPI) 2017;
- NSW Office of Liquor and Gaming Liquor Act 2007;
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009;
- NSW EPA Assessing vibration: A Technical Guideline 2006;
- City of Sydney Council Development Control Plan (DCP) Part 3 (General Provisions) 2025;
- 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"; and
- German Standard DIN4150 – Part 3: "Structural vibration in buildings – Effects on structures".

Having given regard to the analysis conducted within this report, it is the finding of this noise and vibration impact assessment that the proposed redevelopment is capable of compliance with the relevant noise and vibration criteria controls for this type of development, with future detailed applications for the redevelopment to include a more detailed assessment of noise and vibrations where required.

It is recommended the concept SSDA be approved subject to the implementation of the mitigation measures outlined in this report.

Appendix A **Noise Monitoring Data**

Figure 6: Long-term noise monitoring data graph (LT1)



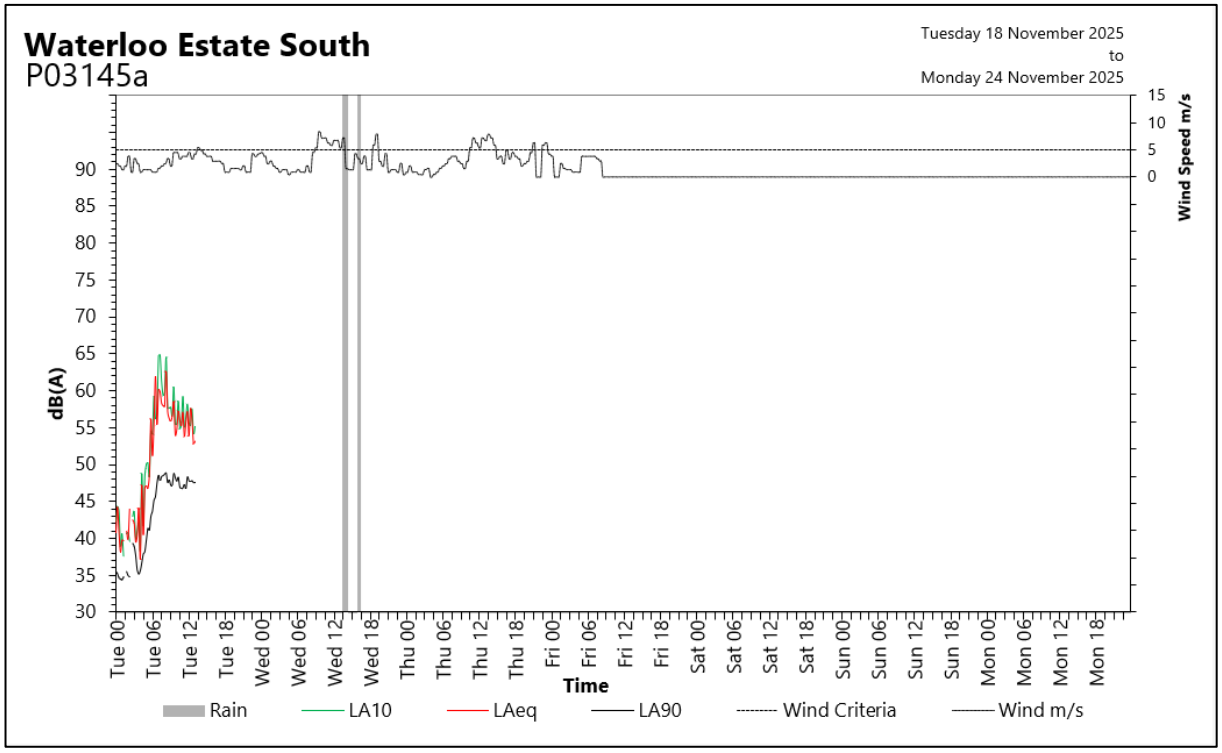
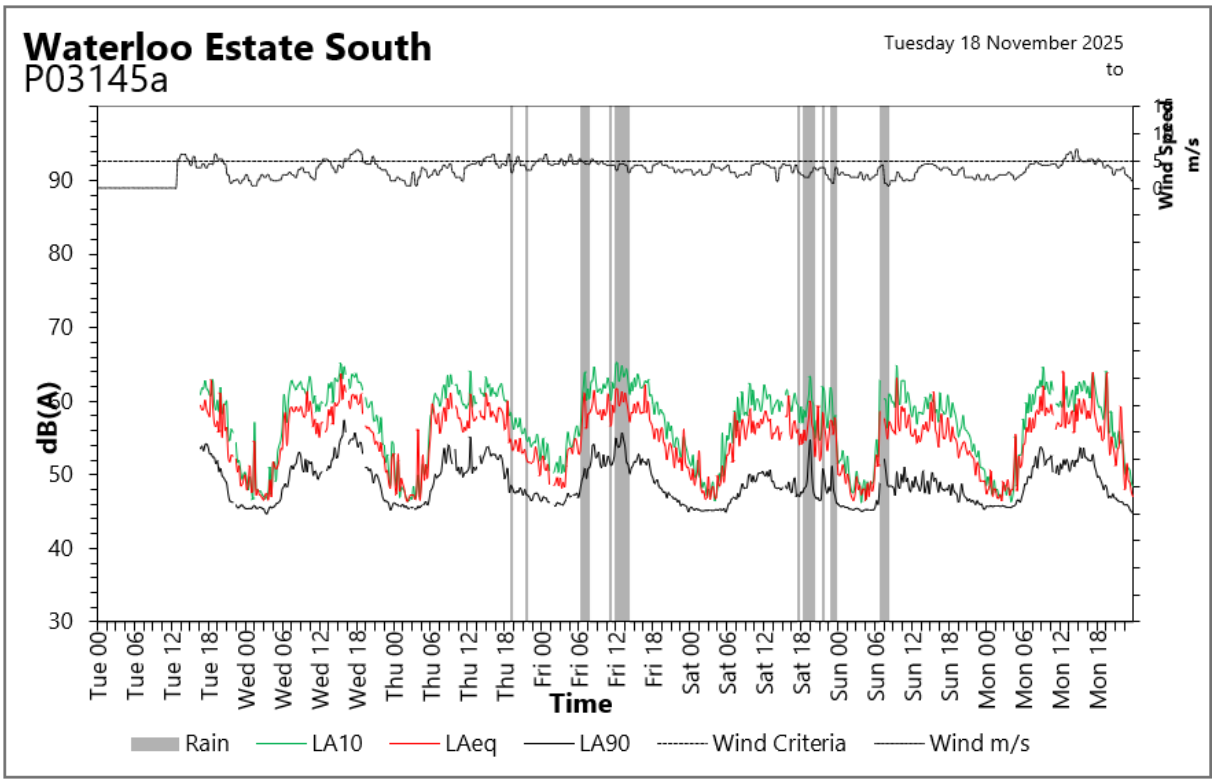


Figure 7: Long-term noise monitoring data graph (LT2)



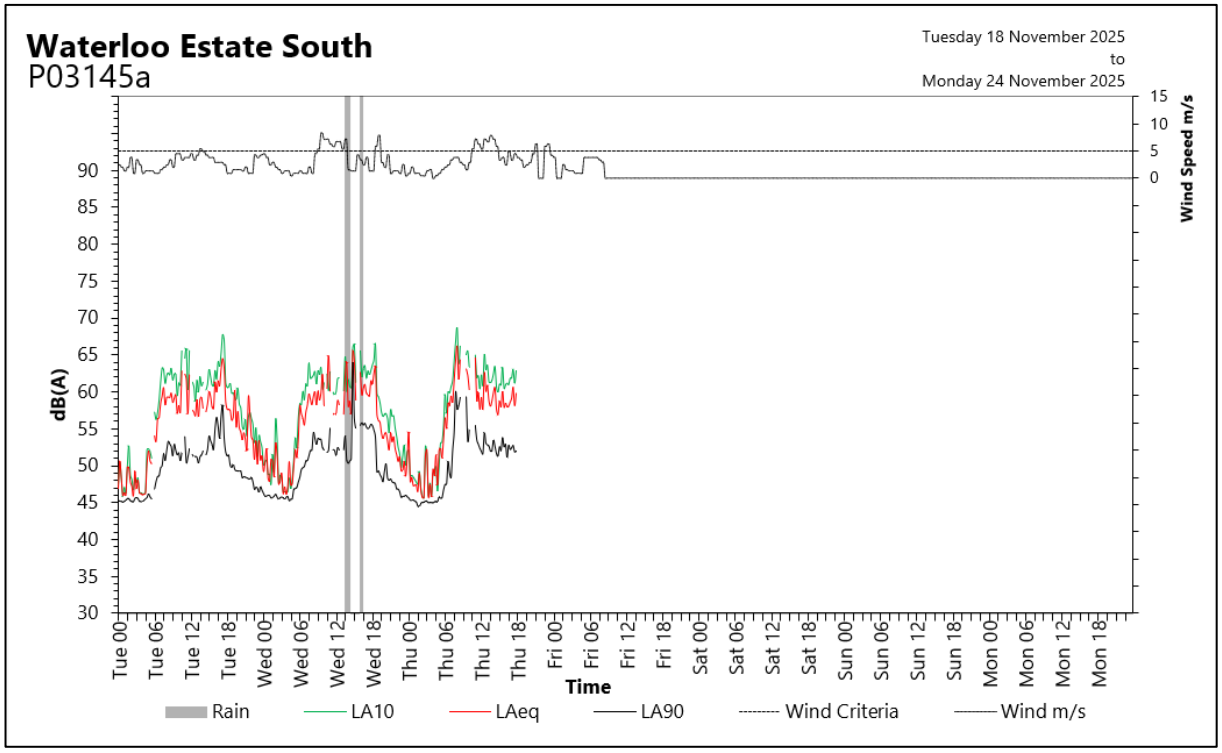
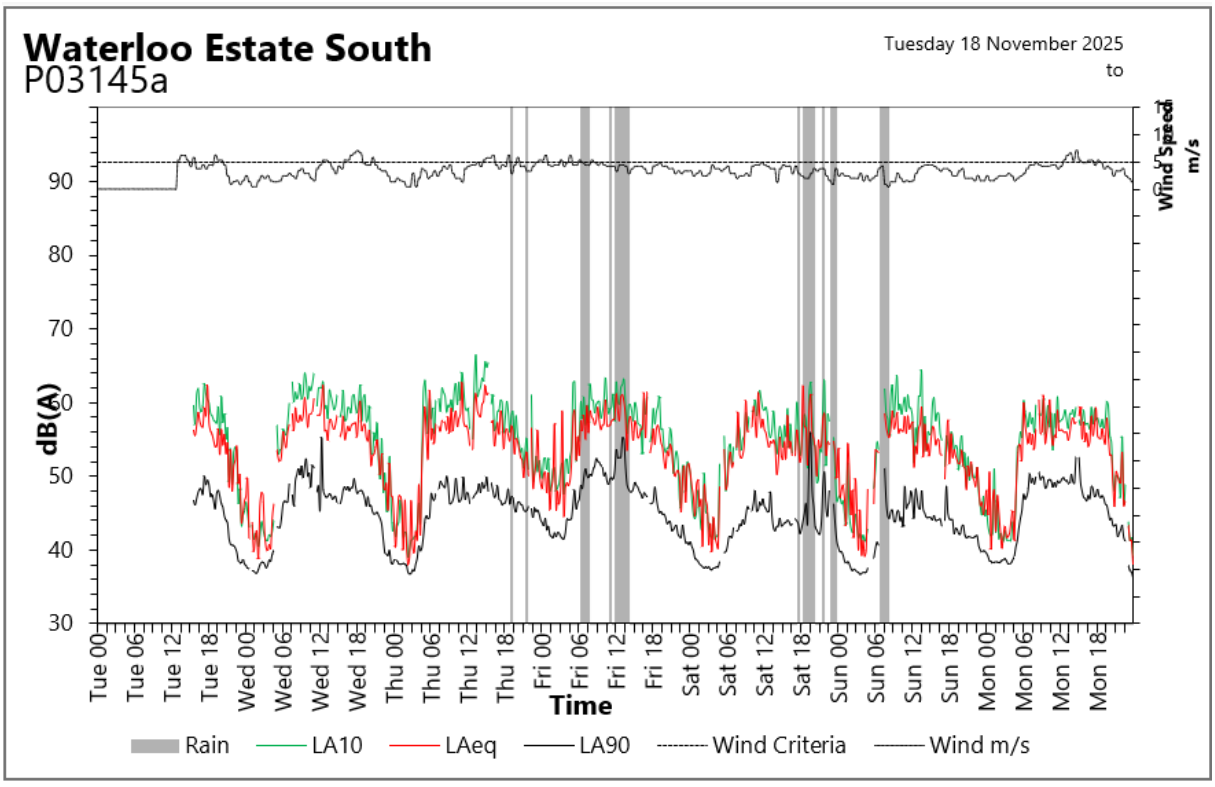


Figure 8: Long-term noise monitoring data graph (LT3)



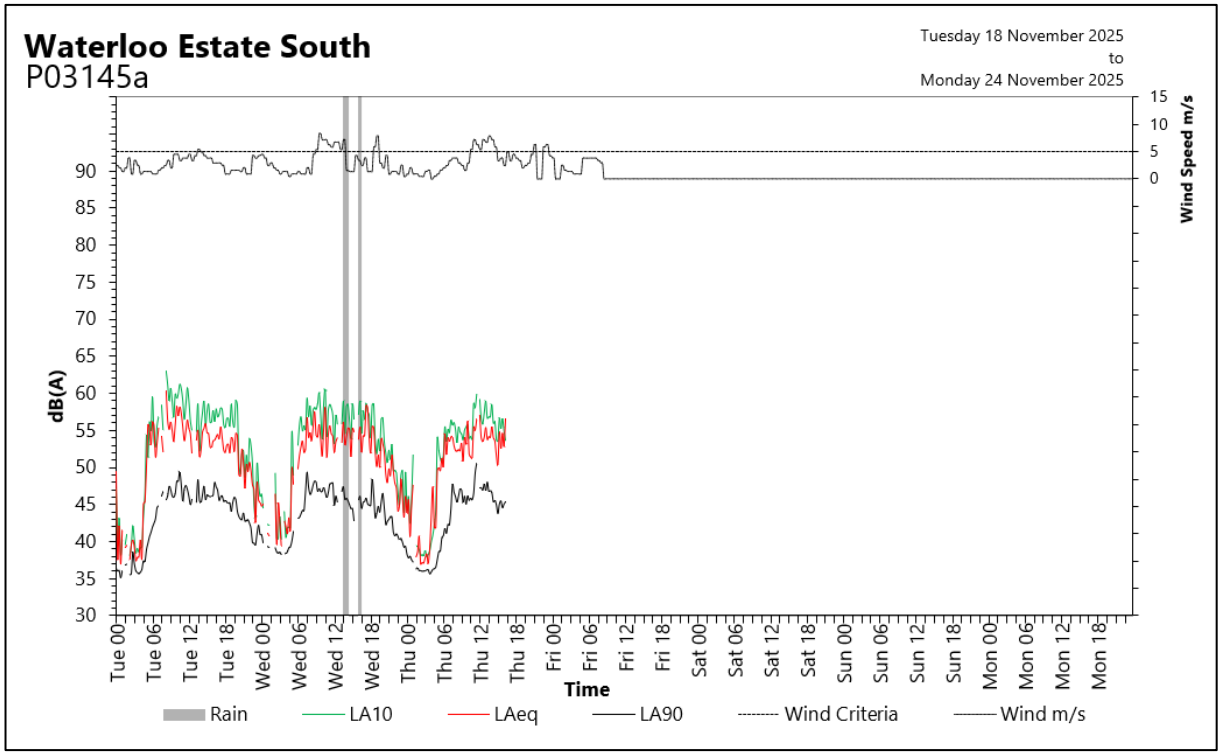


Figure 9: Long-term noise monitoring data graph (LT4)

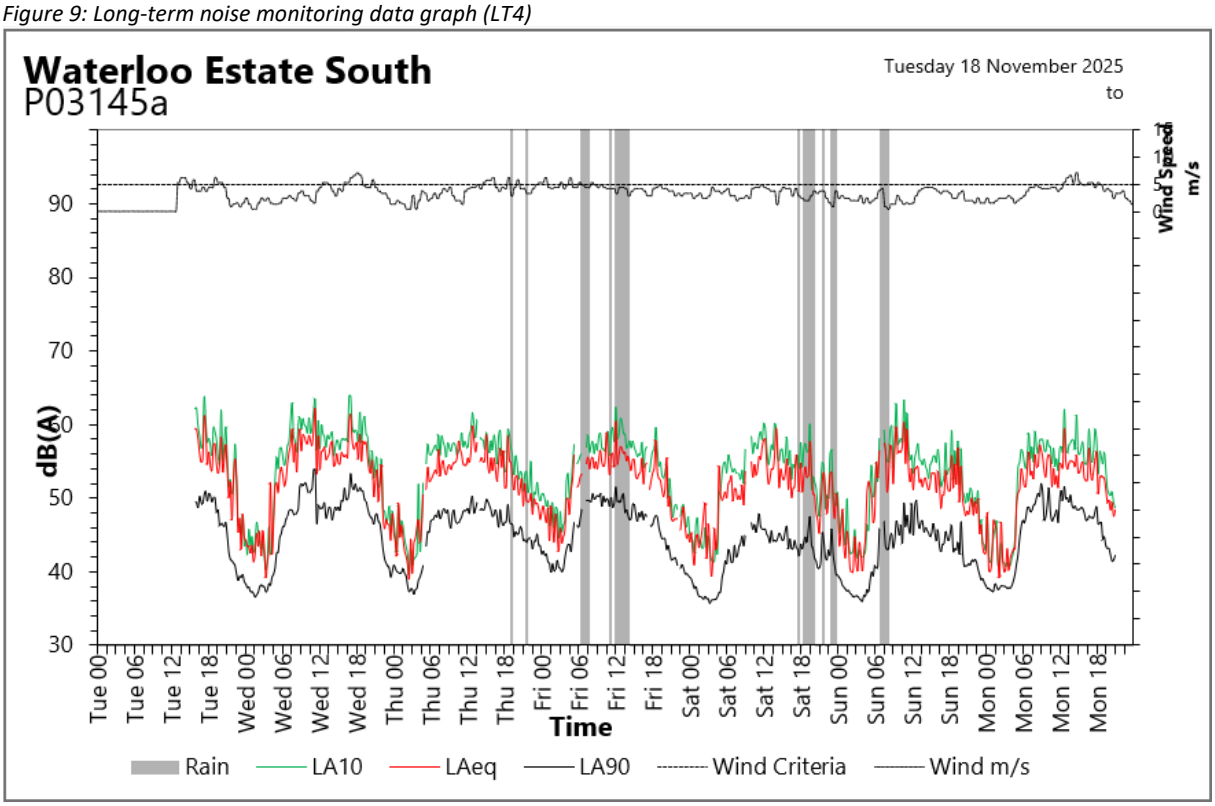
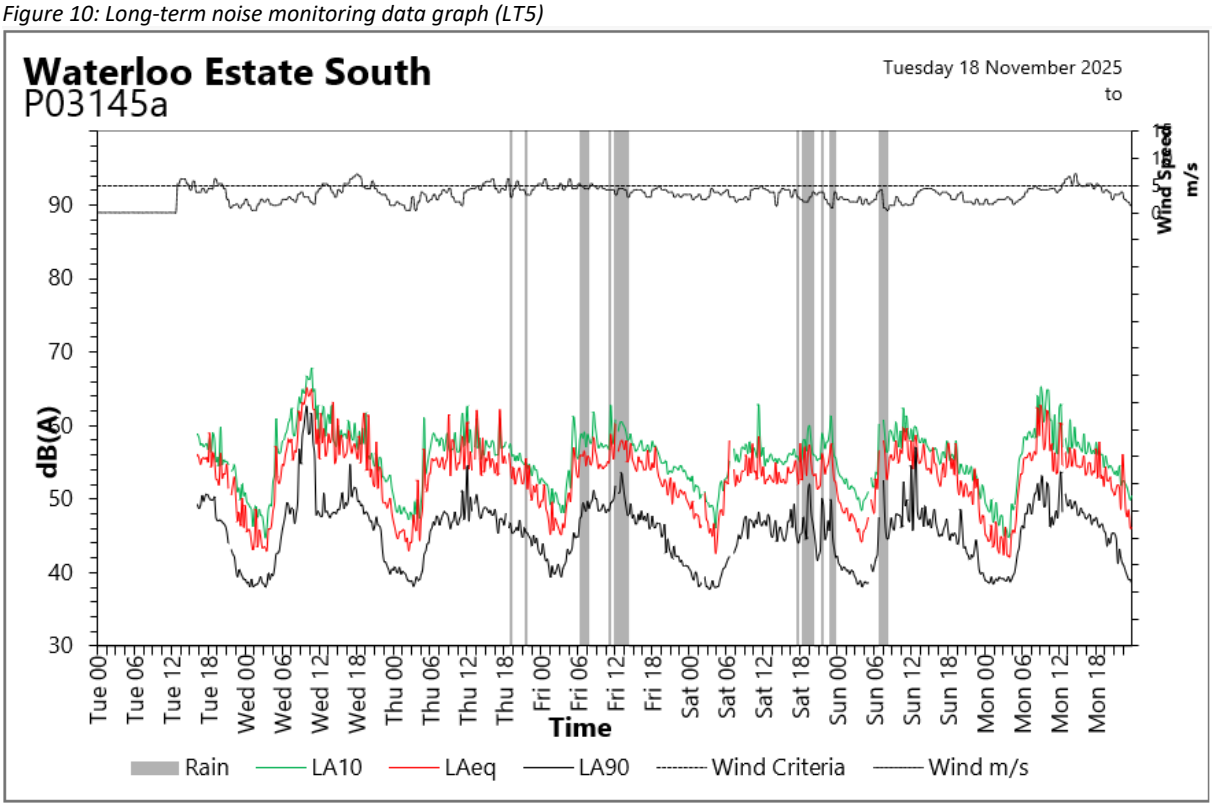


Figure 10: Long-term noise monitoring data graph (LT5)



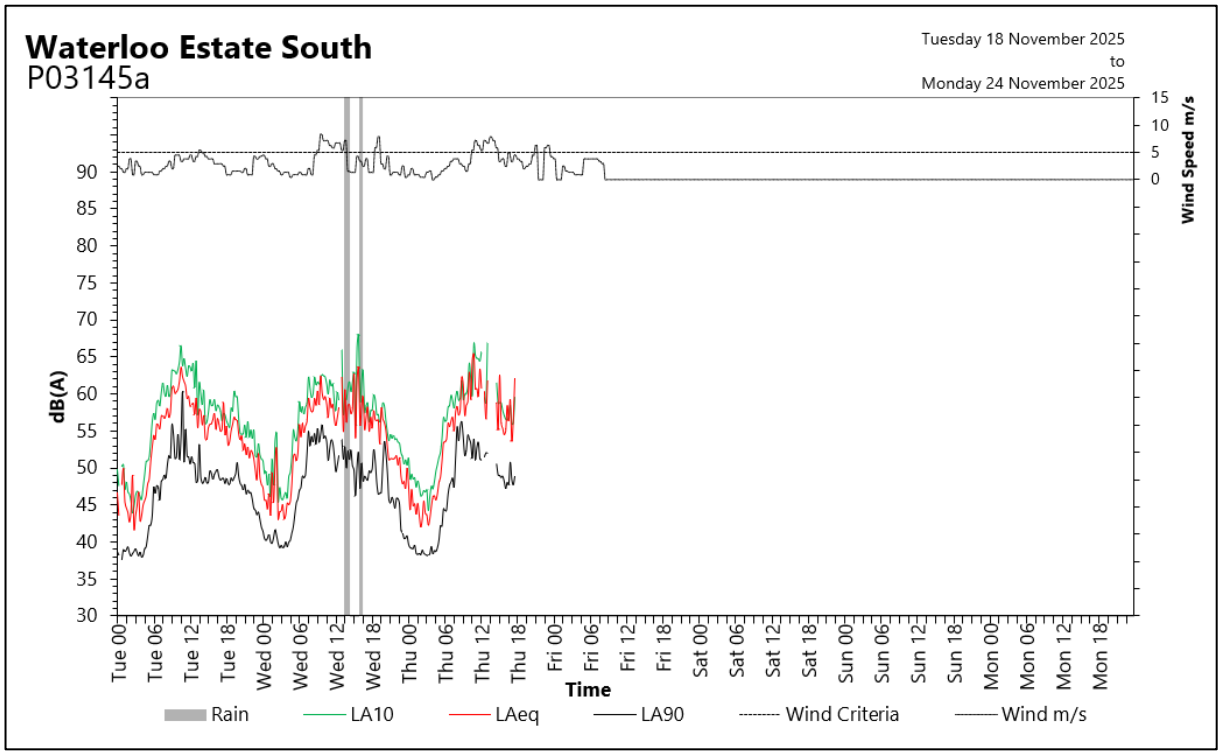


Figure 11: Long-term noise monitoring data graph (LT6)

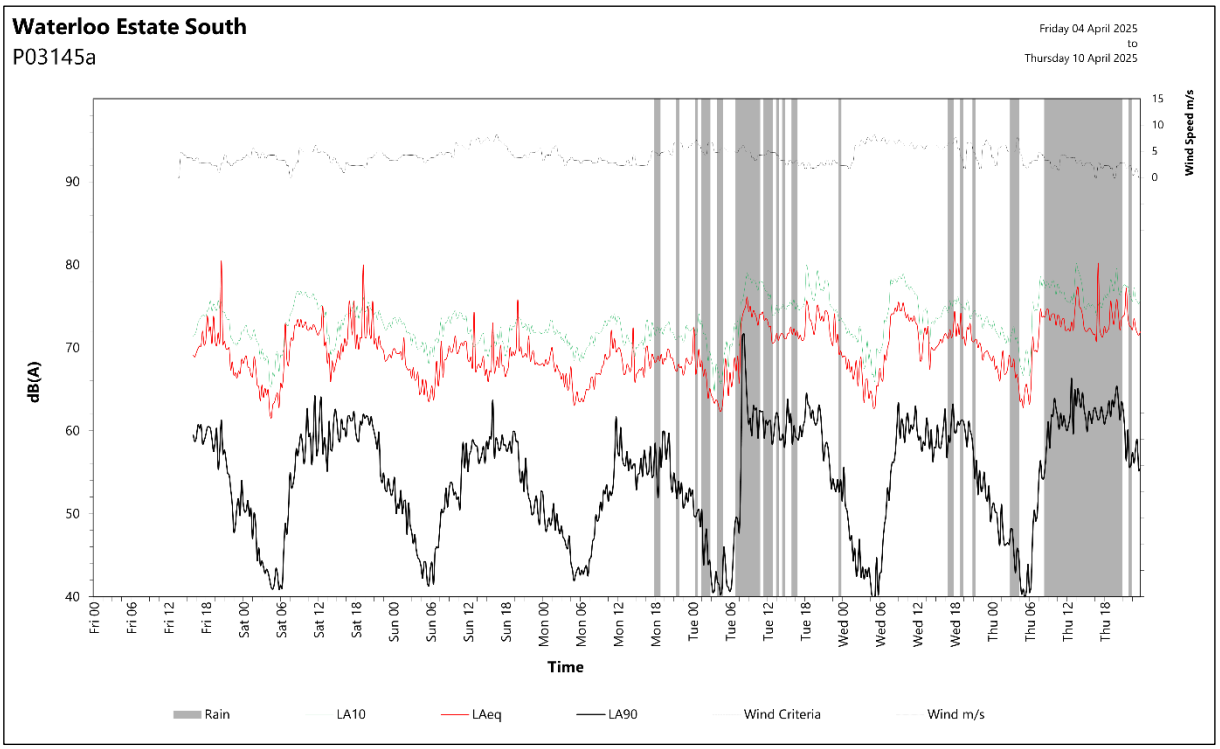
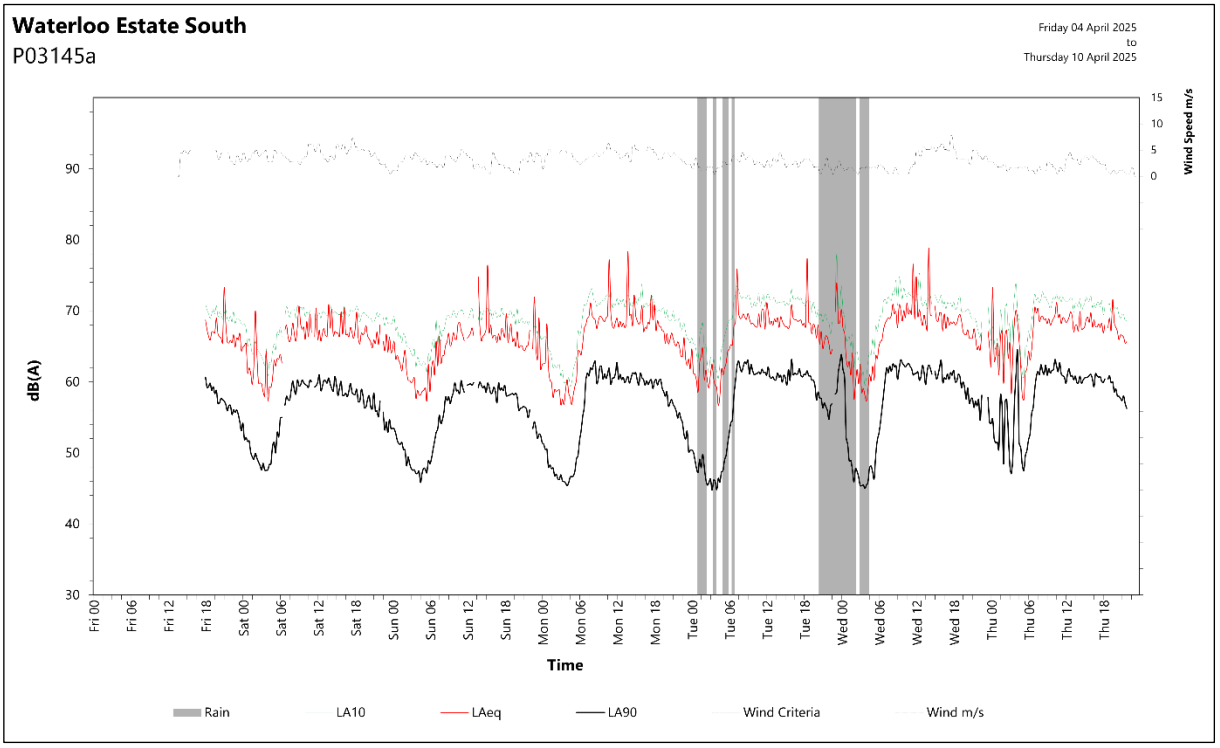
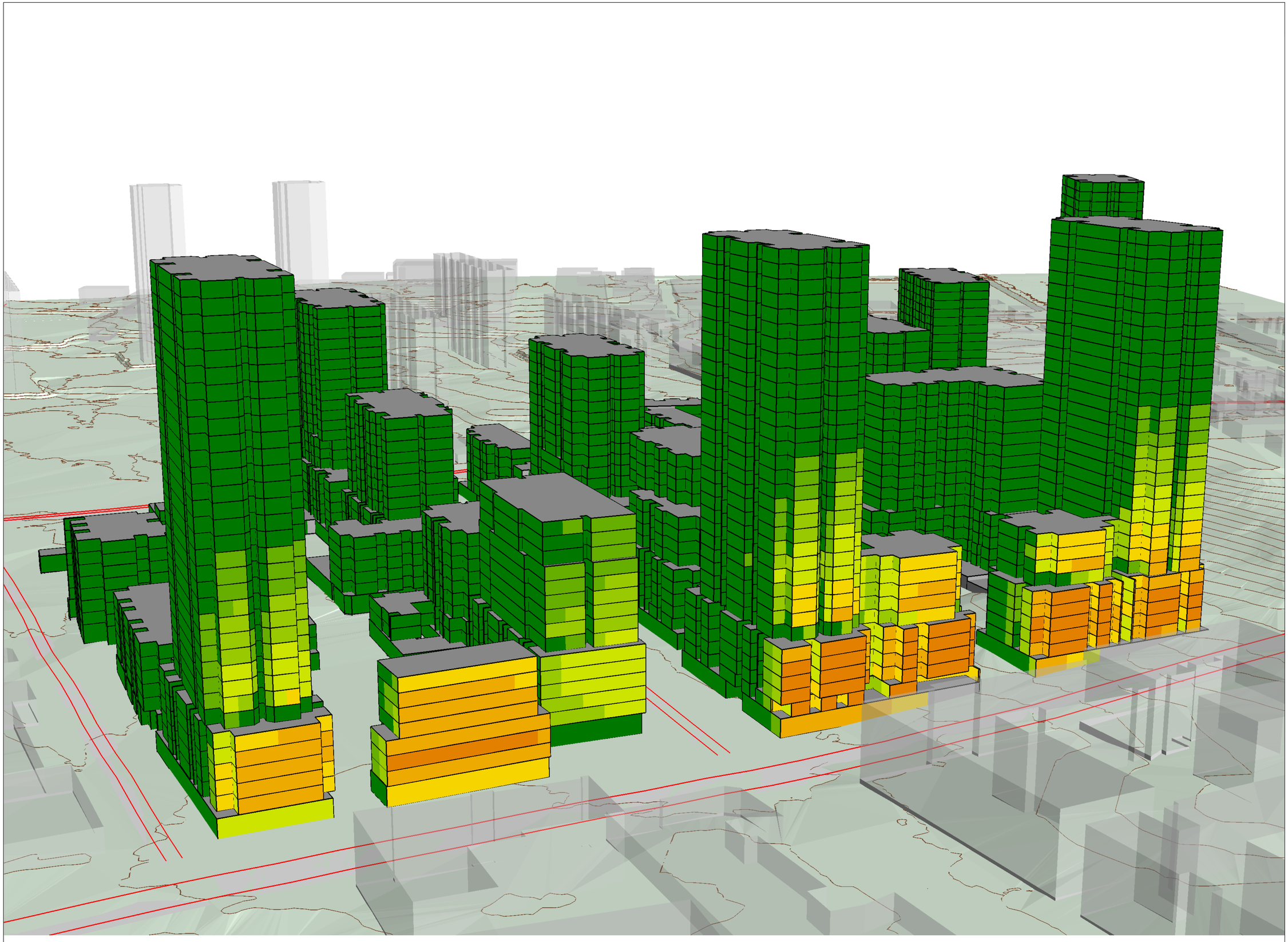


Figure 12: Long-term noise monitoring data graph (LT7)



Appendix B **Façade Noise Map**



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Daytime Facade Noise Level, $L_{Aeq,16hour}$ dB(A)

- ≤ 60
- 60-61
- 61-62
- 62-63
- 63-64
- 64-65
- 65-66
- 66-67
- 67-68
- ≥ 68

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

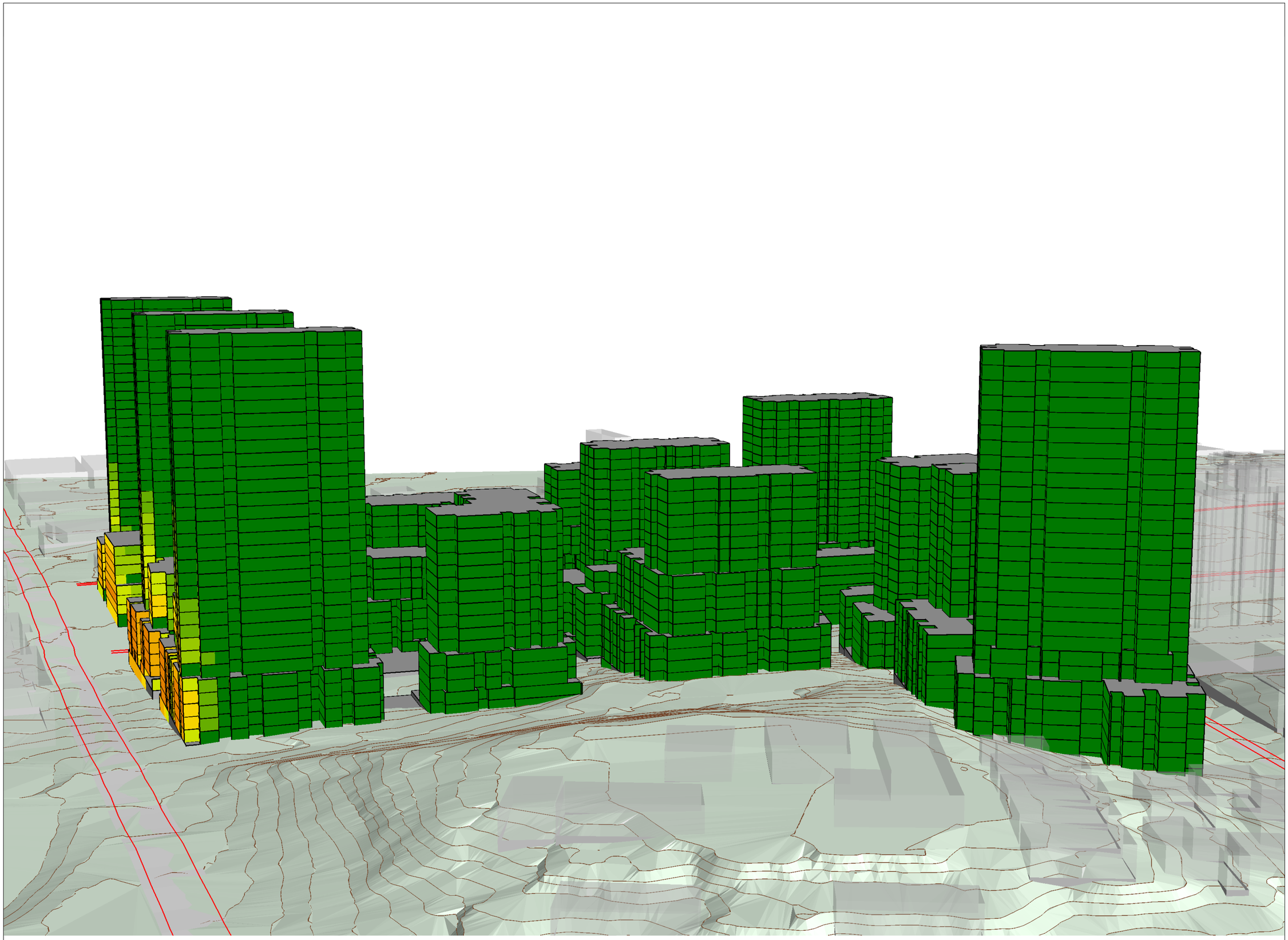
SCALE
NTS

STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - DAYTIME
VIEW 1

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER	REVISION
AC-DWG-100-01-01	002



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Daytime Facade Noise Level, $L_{Aeq,16hour}$ dB(A)

- ≤ 60
- 60-61
- 61-62
- 62-63
- 63-64
- 64-65
- 65-66
- 66-67
- 67-68
- ≥ 68

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

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STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - DAYTIME
VIEW 2

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REVISION
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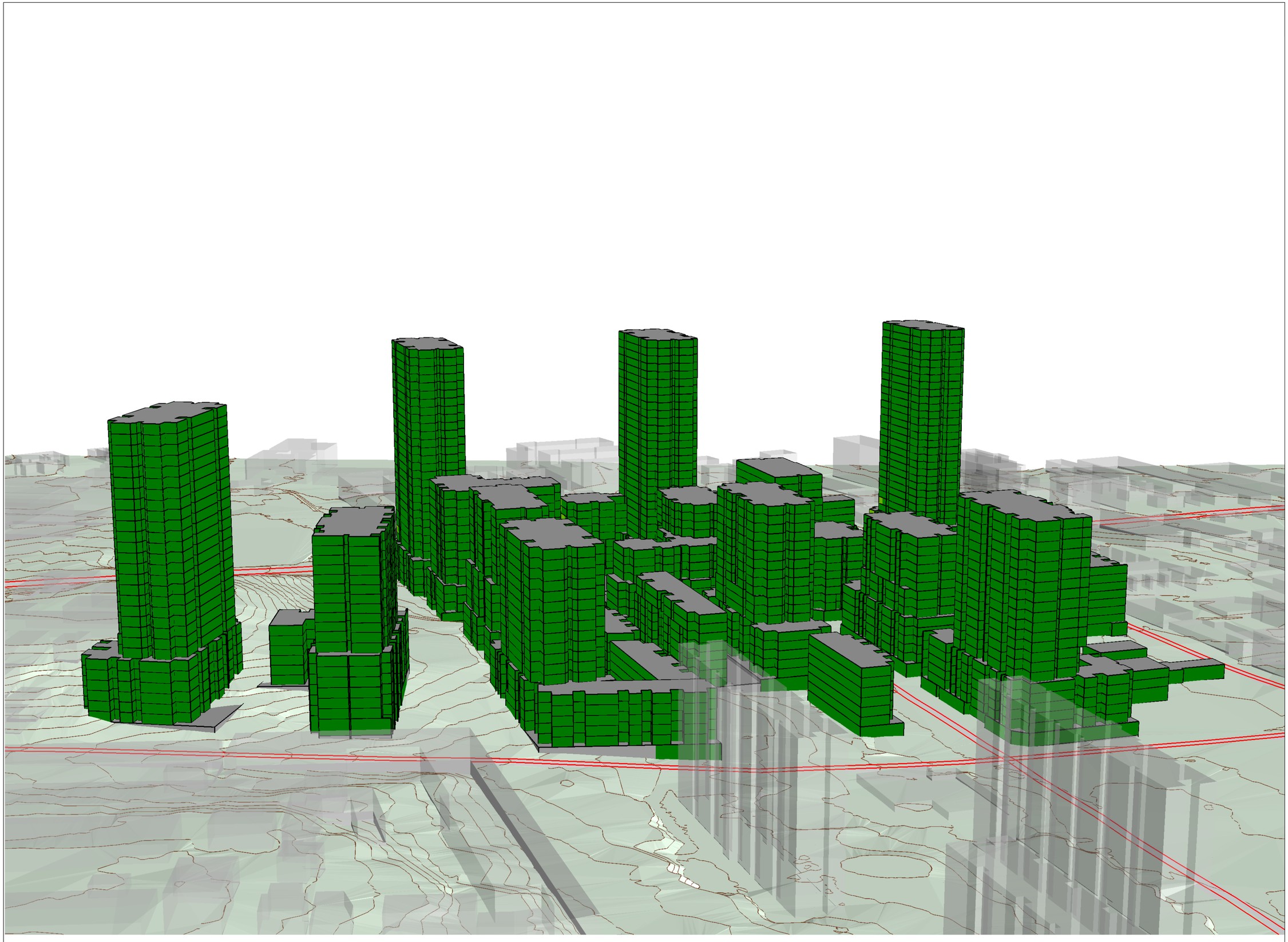

E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Daytime Facade Noise Level, $L_{Aeq,16hour}$ dB(A)

- ≤ 60
- 60-61
- 61-62
- 62-63
- 63-64
- 64-65
- 65-66
- 66-67
- 67-68
- ≥ 68

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

SCALE
NTS

STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - DAYTIME
VIEW 3

DISCIPLINE
ACOUSTICS AND VIBRATION

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REVISION
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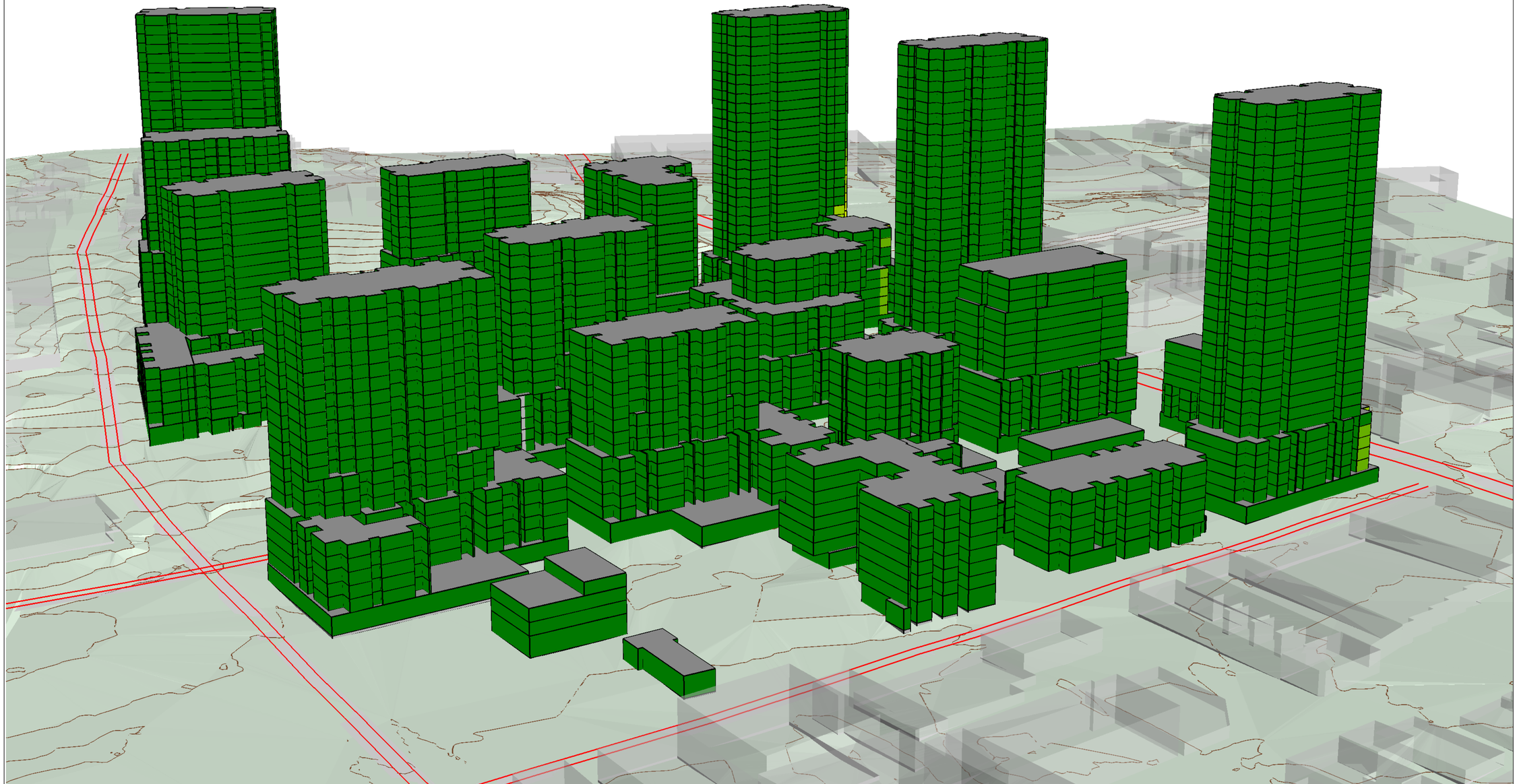

E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Daytime Facade Noise Level, $L_{eq,16hour}$ dB(A)

- ≤ 60
- 60-61
- 61-62
- 62-63
- 63-64
- 64-65
- 65-66
- 66-67
- 67-68
- ≥ 68

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

SCALE
NTS

STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - DAYTIME
VIEW 4

DISCIPLINE
ACOUSTICS AND VIBRATION

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REVISION
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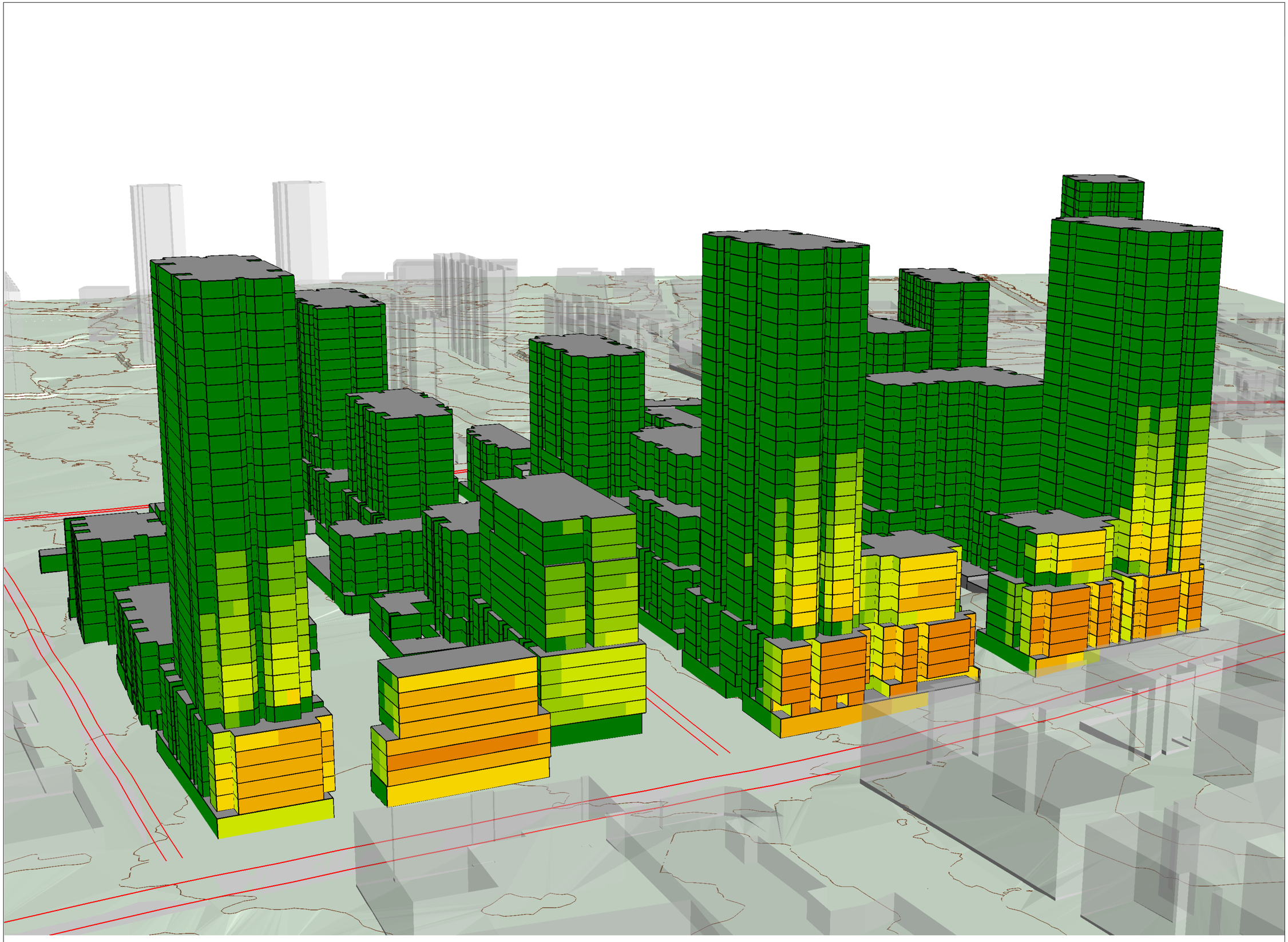


E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Night Time Facade Noise Level, $L_{Aeq,9hour}$ dB(A)

- ≤ 55
- 55-56
- 56-57
- 57-58
- 58-59
- 59-60
- 60-61
- 61-62
- 62-63
- ≥ 63

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

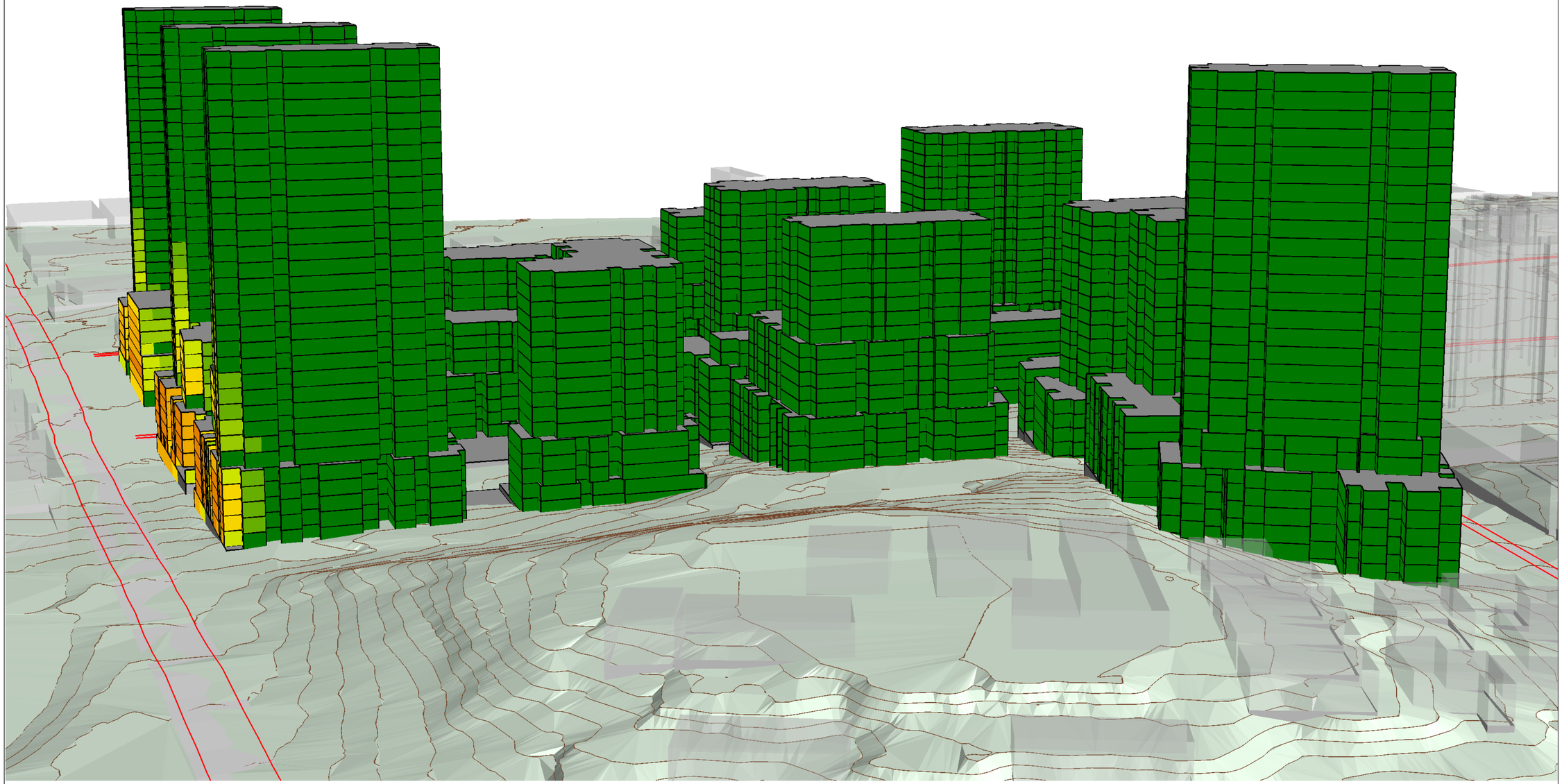
SCALE
NTS

STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - NIGHT TIME VIEW 1

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER	REVISION
AC-DWG-100-02-01	002



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Night Time Facade Noise Level, $L_{Aeq,9hour}$ dB(A)

- ≤ 55
- 55-56
- 56-57
- 57-58
- 58-59
- 59-60
- 60-61
- 61-62
- 62-63
- ≥ 63

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

SCALE
NTS

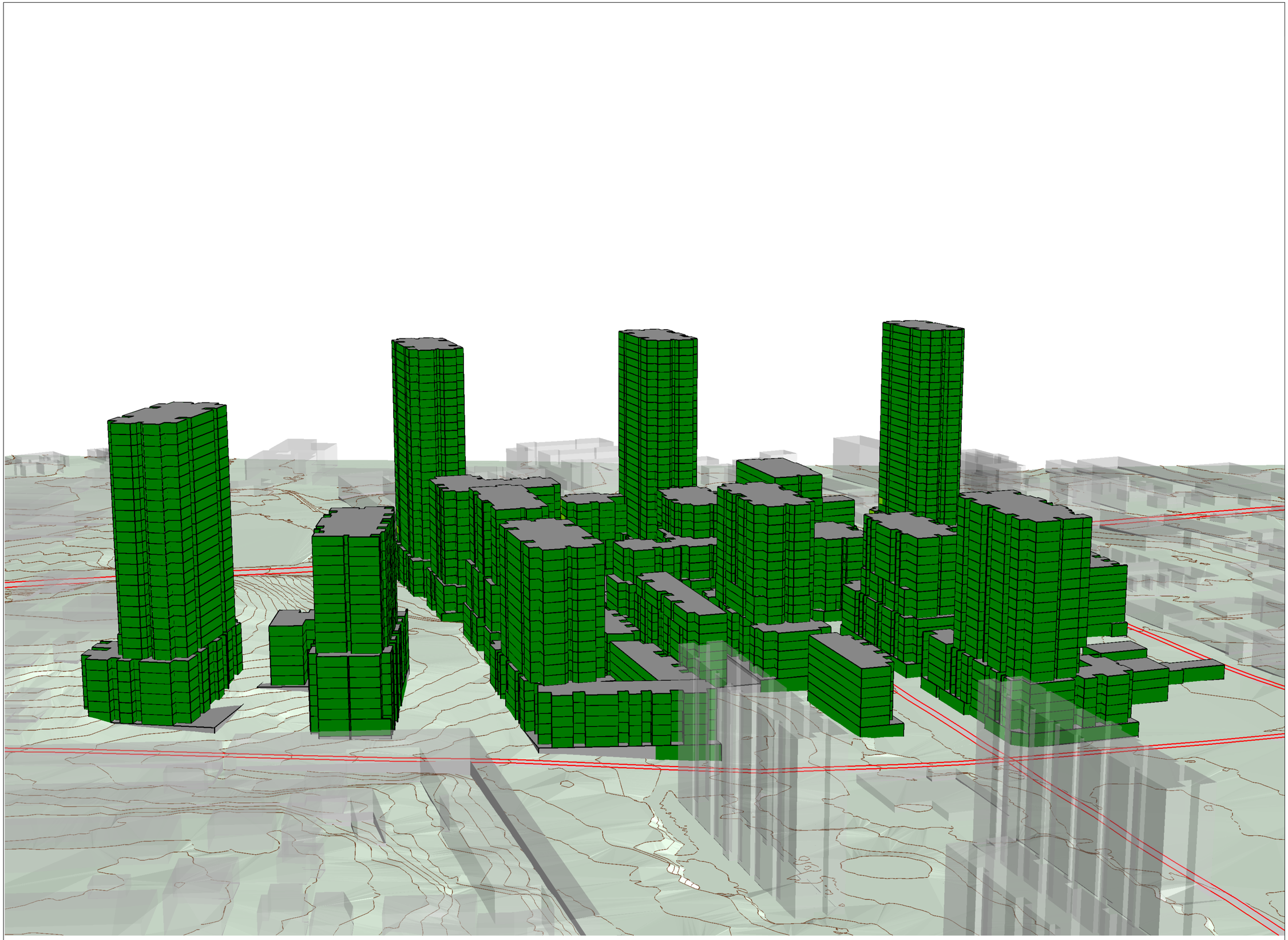
STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - NIGHT TIME
VIEW 2

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER
AC-DWG-100-02-02

REVISION
002



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Night Time Facade Noise Level, $L_{Aeq,9hour}$ dB(A)

- ≤ 55
- 55-56
- 56-57
- 57-58
- 58-59
- 59-60
- 60-61
- 61-62
- 62-63
- ≥ 63

NOTES

PROJECT
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PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

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STOCKLAND

SCALE
NTS

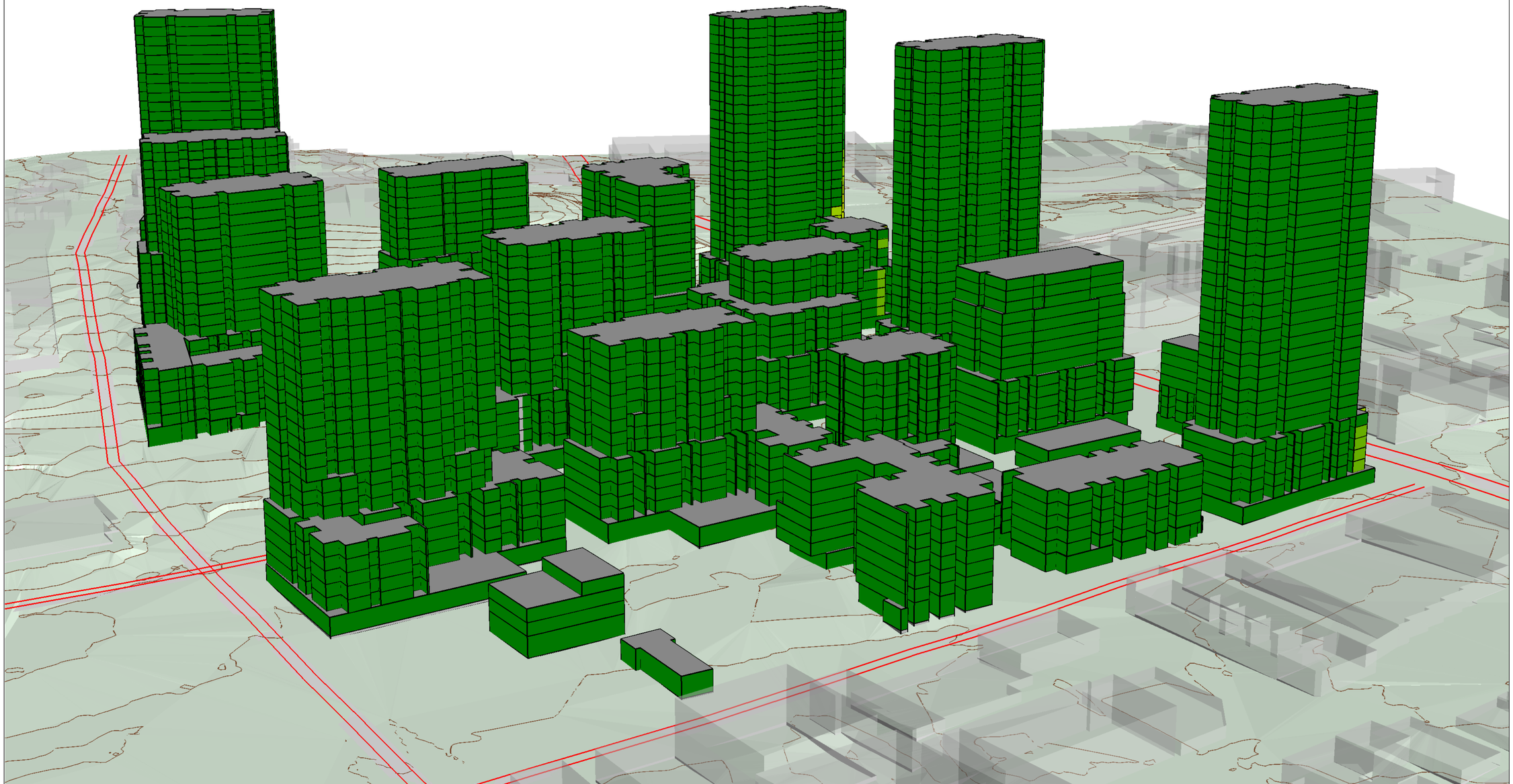
STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - NIGHT TIME VIEW 3

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER
AC-DWG-100-02-03

REVISION
002



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	19/01/2026	FOR INFORMATION
2	09/02/2026	FOR INFORMATION

LEGEND

Night Time Facade Noise Level, $L_{Aeq,9hour}$ dB(A)

- ≤ 55
- 55-56
- 56-57
- 57-58
- 58-59
- 59-60
- 60-61
- 61-62
- 62-63
- ≥ 63

NOTES

PROJECT
WATERLOO ESTATE SOUTH

PROJECT NO.
P03145A

ARCHITECT
SJB ARCHITECTS

CLIENT
STOCKLAND

SCALE
NTS

STATUS
FOR INFORMATION

DRAWING
FACADE NOISE LEVELS - NIGHT TIME
VIEW 4

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER
AC-DWG-100-02-04

REVISION
002

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