Eden Street, Arncliffe

Noise & Vibration Impact Assessment

State Significant Development Application

Prepared for: Arncliffe Eden Property Pty Ltd

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Date: 23 June 2021

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Revision

Revision	Date	Comment	Prepared By	Approved By
001	07/05/2021	Draft Issue	Shaun Khanna	Elle Hewett
002	17/05/2021	Draft issue	Shaun Khanna	Elle Hewett
003	21/05/2021	Draft issue – Updated Appendices	Shaun Khanna	Elle Hewett
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005	23/06/2021	Childcare assessment	Jonathan Salim	Elle Hewett
006	29/06/2021	Updated Appendices LAHC Comments	Jonathan Salim	Elle Hewett

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1. Executive Summary

This Noise and Vibration Impact Assessment has been prepared by Stantec (Australia) Pty Ltd to accompany the State Significant Development Application (SSDA), SSD-11429726 for a mixed-use development.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for SSD-11429726

This report concludes that the proposed development is suitable and warrants approval subject to the implementation of the following mitigation measures.

- Acoustically rated glazing and solid façade elements to mitigate noise in the residential and commercial spaces.
- Alternative means of ventilation to residential spaces that should not rely on opening their windows to be provided with ventilation where the external façade noise level is <60dB(A) or <55dB(A) for day and night-time periods respectively (Refer to Appendix C).
- Acoustic treatments to mitigate noise emissions from mechanical plant and equipment within the plantrooms, together with the generator room.
- 1.8m high acoustic barrier surrounding the play area of the proposed Childcare Centre.
- 2.4m high solid acoustic barrier surrounding the perimeter of the site during the construction of the proposed development.

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

2. Introduction

This Noise and Vibration Impact Assessment is submitted to the Department of Planning, Industry and Environment (DPIE) in support of a State Significant Development Application (SSDA-11429726) for the development of land identified at 26-42 Eden Street and 161-179 Princes Highway, Arncliffe (the site) for the purposes of a mixed-use precinct with open space, retail, and residential uses, comprising social and market housing as part of the NSW Land and Housing Corporation (LAHC)'s 'Communities Plus' program.

SSDA-11429726 seeks approval for the following development:

- Demolition of all existing buildings and structures on the site;
- Site preparation works, excavation and tree removal;
- The construction of a mixed-use development comprising:
    - 744 apartments across (4) buildings between 19-23 storeys in height, as follows:
        - 186 market housing apartments in Building A;
        - 202 market housing apartments in Building B;
        - 180 social housing apartments in Building C; and
        - 176 market housing apartments in Building D;
    - 3,113m2 retail gross floor area;
    - 240m2 for a future childcare centre;
    - 3,706m2 of communal open space;
    - 813 spaces of lower ground and basement car parking; and
- 4,870m2 of publicly accessible open space including a 4,000m2 park, an 870m2 public plaza (meeting space), and through site link connecting Eden Street and the Princes Highway.

This report assesses the likely impact of noise and vibration:

- on the development from the environment (road/rail traffic) and,
- on the environment from the development (operational noise from childcare centre, mechanical plants, and generated traffic noise associated with the development).

Noise levels are predicted and compared against specific noise and vibration limits for both construction and operational impacts. Where the relevant noise and vibration criteria are predicted to be exceeded, recommendations for noise control or noise management measures are proposed.

In accordance with *section 4.39 of the Environmental Planning & Assessment Act 1979 (EP&A Act), the Secretary's Environmental Assessment Requirements (SEARs) for SSDA-11429726 were issued on 18 December, 2020.* This report has been prepared to respond to the following SEARs:

SEAR's Requirements	Relevant section of report
11. Noise and Vibration The EIS must include a noise and vibration assessment in accordance with the relevant EPA guidelines, including Development Near Rail Corridors and Busy Roads – Interim Guideline. This assessment must detail construction and operational noise impacts on nearby sensitive receivers and outline the proposed management and mitigation measures that would be implemented.	5.2 Internal Noise Criteria 5.3 External Noise Emissions Criteria 5.4 Construction Noise Criteria 5.5 Construction Vibration Criteria 6 Noise and Vibration Assessment 6.7.3 Operational Noise Mitigation Measures 7 Construction noise and vibration assessment 7.4 Construction mitigation measures
22. Aviation The EIS must include a report prepared by a suitably qualified Aviation expert: • identifying whether the proposed development is located within any of the applicable Australian Noise Exposure Forecast (ANEF) contours • providing details of any flight paths that may be impacted by the proposed development	6.6 Aircraft Noise Assessment

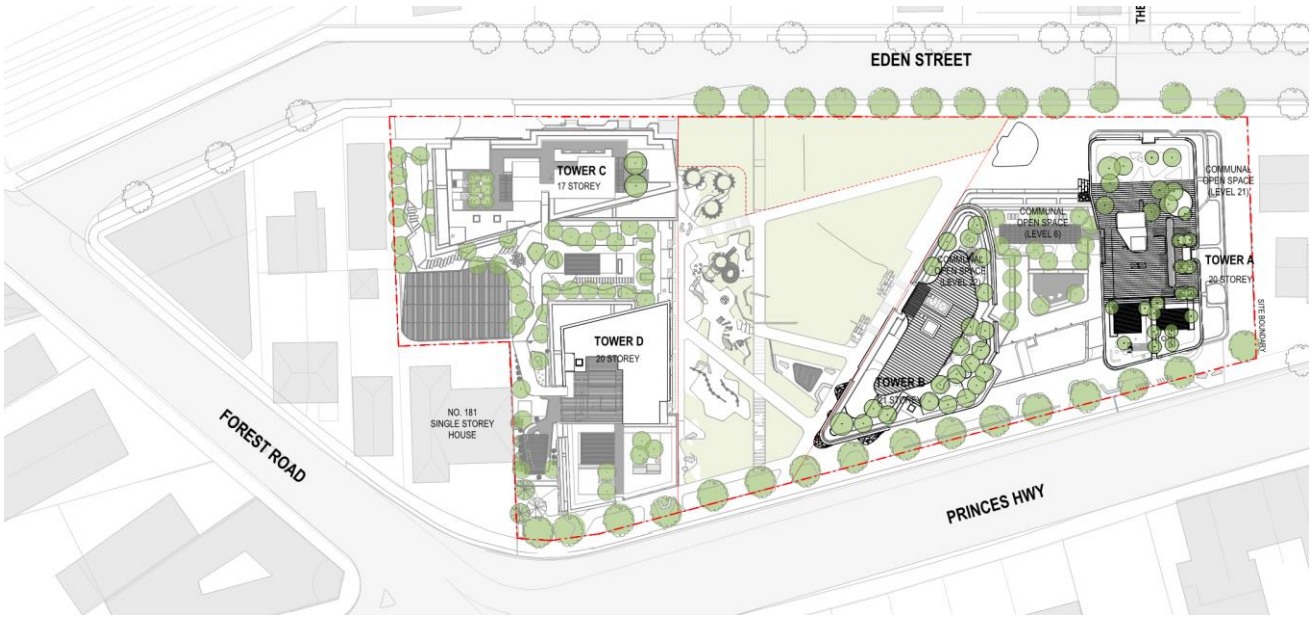
3. Project Description

The proposed mixed-use development is recognised on Lots stated below:

- Lots 1, 2, 3, 7, 8, 9, 10, 11 &12 as per DP23701
- Lots 1 & 2 as per DP1094906, and
- Lot 1 as per DP447649

The site area of 13,440m^2 includes four residential towers with 744 dwelling units; 3,706m^2 dedicated to communal open space, 3,113m^2 of retail space and 813 lower ground and basement parking spaces.

Figure 1: Master Plan



3.1 Site and Surrounding Context

The project shares its frontage with Eden street on the North western side and Princes Hwy on the South Eastern side, surrounded by residential receivers (R1, R2, R3, R4, and R5) on all sides. The Southern side of the development also directly adjacent to a commercial unit (C1) located at the corner of Eden Street and Forest Road. Similarly, there is also a commercial receiver (C2) located directly across the Princess Highway at the eastern side of the proposed development.

It is noted that there is a railway corridor approximately 26m away from the south-western side of the site boundaries behind by residential receivers across Eden Street (R1).

Figure 2 identifies the noise sensitive receivers currently established relative to the proposed development.

Figure 2: Aerial view the proposed mixed-use development and the site surroundings

4. Noise & Vibration Investigations

Noise and vibration measurements have been taken by Stantec around the proposed development site to identify the existing noise and vibration associated with the surrounding road and railway corridor. A glossary of acoustic terminology used throughout this report is included as Appendix A.

4.1 Noise Survey

Short-term (attended) and long-term (unattended) noise surveys were carried out between the 3rd and 12th of December 2020 on and around the proposed development site to characterise the noise generated by major nearby traffic noise sources (Forest Road and Princes Hwy), noise emissions from the adjacent railway corridor, and background and ambient noise at surrounding noise-sensitive receivers.

4.1.1 Instrumentation

The following equipment was used for the noise surveys:

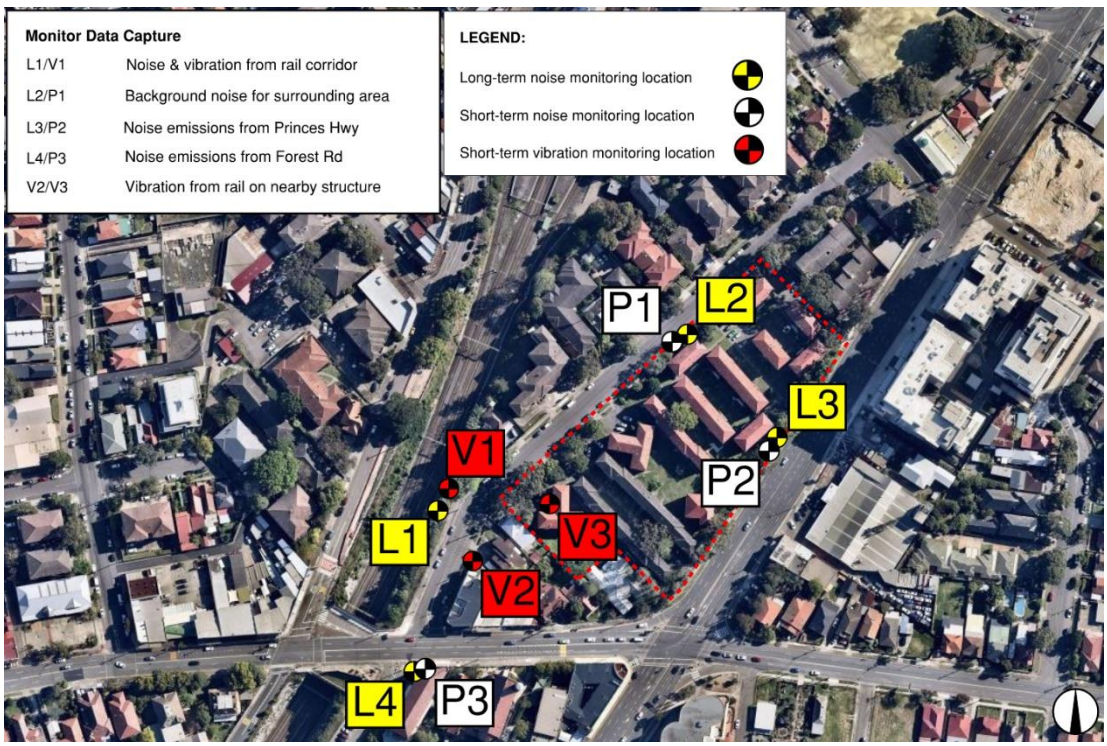
- Rion NL42-EX long-term noise monitor S/N 184110
- Rion NL42-EX long-term noise monitor S/N 521657
- Ngara EL-316 long-term noise monitor S/N 16-306-036
- Ngara EL-316 long-term noise monitor S/N 16-207-030
- Hand-held sound spectrum analyzer Casella CEL-63X, S/N 4257387
- Sound Calibrator B&K, S/N 2709826

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

4.1.2 Survey Locations

The site location, measurement positions and surrounding noise and vibration sensitive receivers are shown in Figure 3.

Figure 3: Overview of the measurement locations



4.1.3 Long-Term (Unattended) Noise Surveys

Background Noise

A noise monitor was placed at position L2, L3, and L4 as shown in Figure 3 to measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. All noise monitors were installed from the 3rd to the 12th of December 2020. The results of the unattended background and ambient noise survey is shown in Table 1 below (for the day, evening and night periods).

Table 1: Long-term noise survey summary – Background noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L2 – Eden Street	57	54	50	48	46	40
L3 – Princess Highway	72	71	68	60	59	47
L4 – Forest Road	74	74	73	59	56	48

Note:

1. The local ambient noise environment is dominated by noise from vehicular movement on Eden Street, the railway corridor together with pedestrian traffic throughout the majority of the day, evening and night periods.
2. The local ambient noise environment is dominated by noise from vehicular movement on Princess Highway and pedestrian traffic throughout the majority of the day, evening and night periods.
3. The local ambient noise environment is dominated by noise from vehicular movement on Forest Road and pedestrian traffic throughout the majority of the day, evening and night periods.

Note that any rain affected data during the period of logging has been excluded from the calculations. Refer to Figure 4 - Figure 6 for the graphical noise data for the total measurement periods.

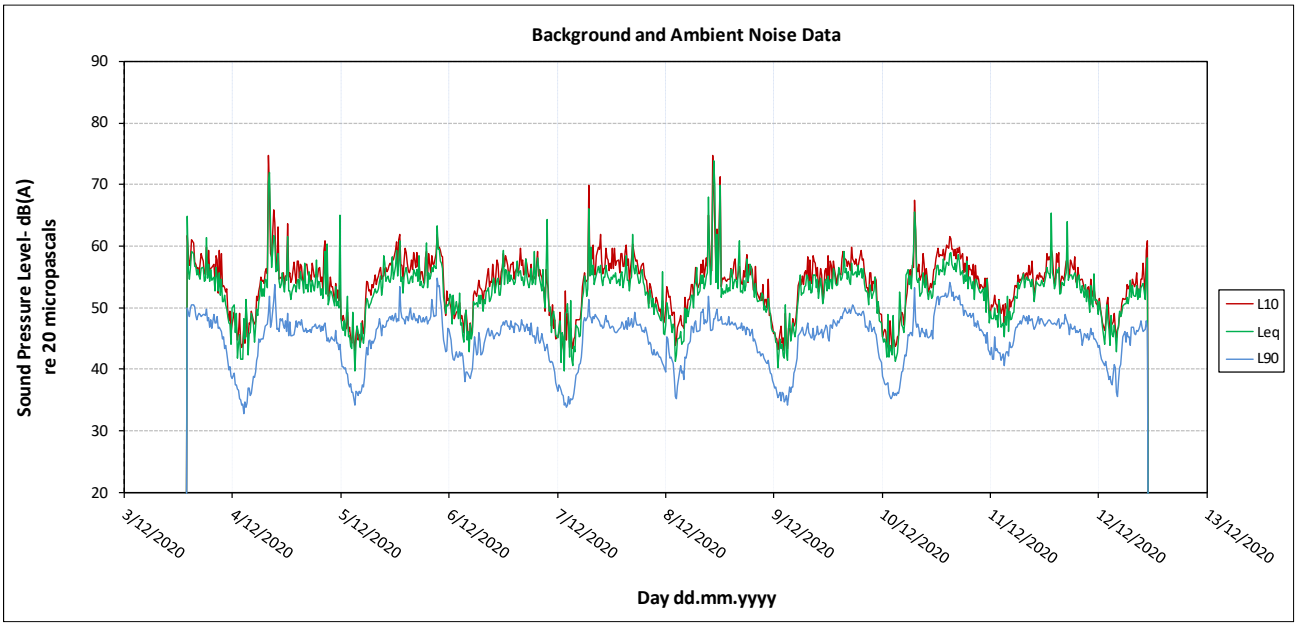


Figure 4: Long-term background noise monitoring data – L2

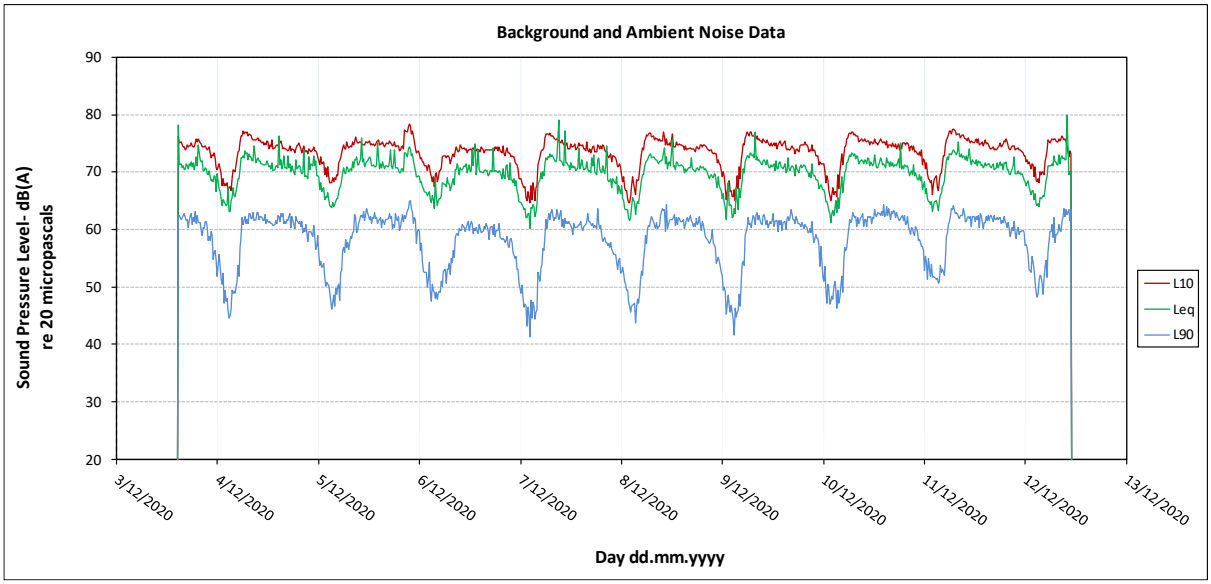


Figure 5: Long-term traffic noise monitoring data – L3

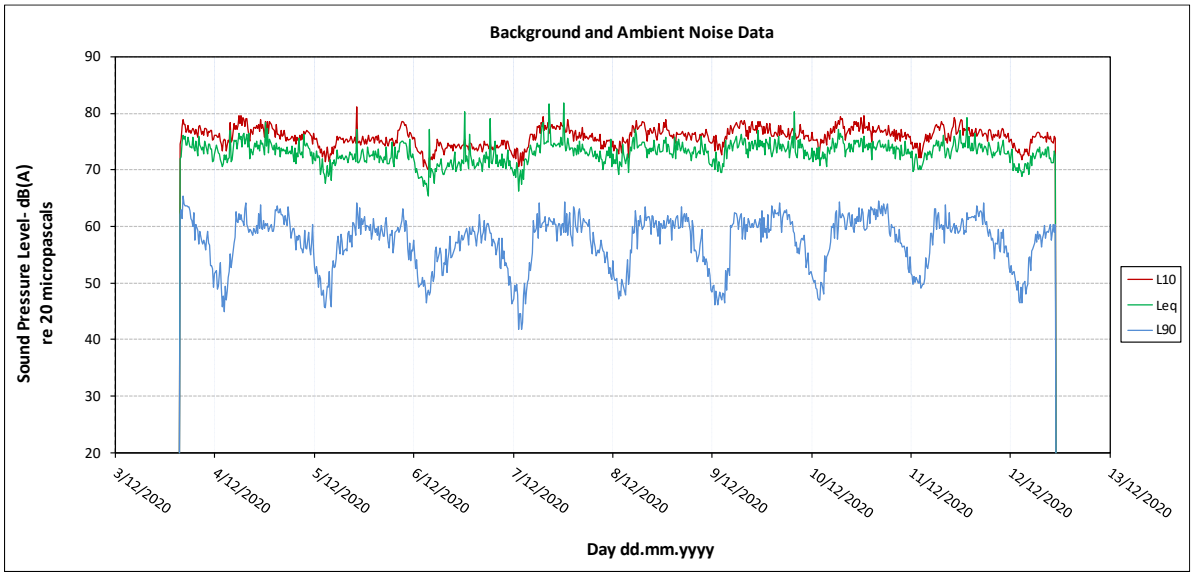


Figure 6: Long-term traffic noise monitoring data – L4

Traffic Noise

Noise monitors were placed at positions L2, L3 and L4 as shown in Figure 3 to measure the noise generated by vehicle movements during the 15-hour day and 9-hour periods established in the DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline. The results for the long-term traffic noise surveys are shown in Table 2 below (for the day and night periods).

Table 2: Long-term noise survey summary – Traffic noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)	
	Day (15hr)	Night (9hr)
L2 (Eden Street)	58	50
L3 (Princes Hwy)	72	68
L4 (Forest Road)	74	73

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

Note that any rain affected data during the period of logging has been excluded from the calculations. Refer to Figure 4 to Figure 6 for the noise data for the total period of measurement.

Rail Corridor Noise

Long-term noise measurements of the train activity within the railway corridor were conducted on site. The noise monitor L1 (see Figure 3 for survey locations) was installed from 3rd to 12th December 2020. The summary of noise survey is provided in Table 3 along with graphical representation (Figure 7) shown below:

Table 3: Arithmetic average LAeq period between 3rd to 12th December 2020

Location	Average Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)	
	Day (15hr)	Night (9hr)
L1	65	64

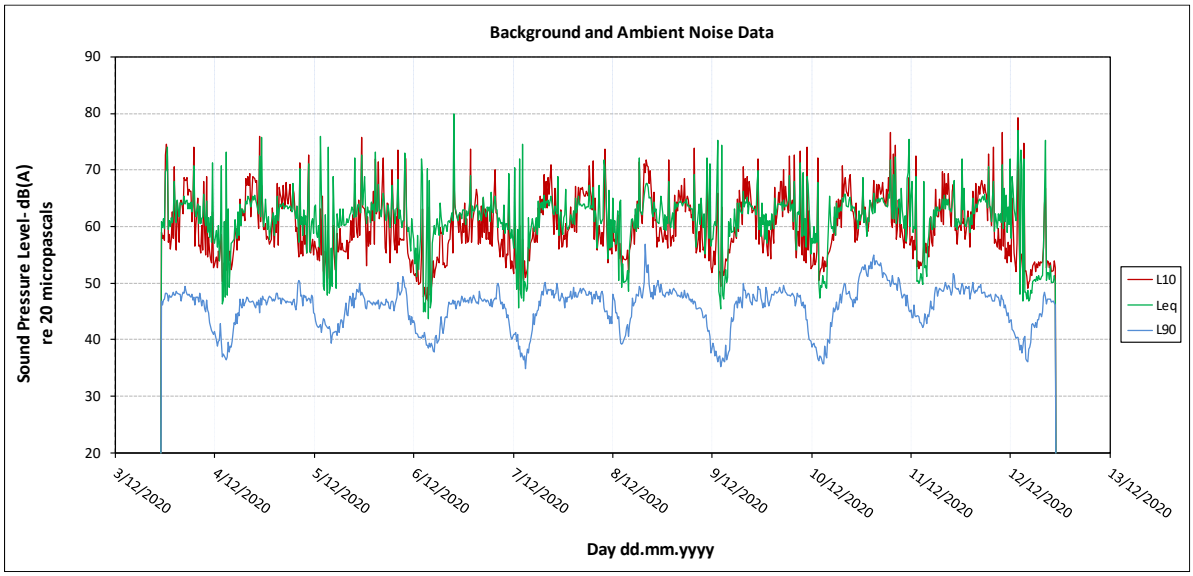


Figure 7: Long-term railway corridor noise monitoring data – L1

4.1.4 Short-Term (Attended) Noise Surveys

Short-term noise measurements were conducted in the vicinity of surrounding noise-sensitive receivers to characterize the background and ambient noise associated with these receivers. The results of the background noise measurements conducted at location P1 through P3 (see Figure 3 for location) are provided in Table 4.

Table 4: Short-term noise measurement summary – Background noise

Measurement Location	Measurement Time	L_{Aeq} dB(A)	L_{A10} dB(A)	L_{A90} dB(A)	Comments
P1 (Eden Street)	1:57pm 3/12/2020	57	59	51	Noise dominated by vehicular movement and pedestrians.
P2 (Princes Hwy)	2:43pm 3/12/2020	73	77	64	Noise from steady vehicle movements along Princes Hwy with general noise from pedestrian traffic
P3 (Forest Rd)	3:23pm 3/12/2020	73	76	63	Noise from steady vehicle movements along Forest Rd with general noise from pedestrian traffic

4.2 Vibration Survey

A short-term vibration survey was carried out around the site boundary using a triaxial accelerometer in accordance with the methodology provided in the guideline *"Assessing Vibration: A Technical Guideline 2006*" to obtain the vibration magnitudes and characteristics of train pass-bys within the railway corridor, and their impacts on existing structures.

The accelerometer was mounted at locations V1, V2, and V3 (refer to Figure 3) as they were representative locations in order to assess any adverse vibration impacts. A summary of the vibration measurements is shown below in Table 5

Table 5: Short-term vibration measurement summary

Measurement number	Duration (seconds)	$a_{rms,x}$ (m/s^2)	$a_{rms,y}$ (m/s^2)	$a_{rms,z}$ (m/s^2)
Location V1				
1	15	0.0302	0.0171	0.0271
2	21	0.0700	0.0422	0.0764
3	15	0.1377	0.0897	0.3495
4	21	0.1563	0.0917	0.1642
5	11	0.2221	0.1180	0.3573
6	18	0.1256	0.0646	0.149108
7	9	0.1839	0.1044	0.3528
8	13	0.0460	0.0284	0.0481
9	18	0.0905	0.0570	0.2259
10	13	0.1079	0.0584	0.1457
11	11	0.1409	0.0764	0.0732

Measurement number	Duration (seconds)	$a_{rms,x}$ (m/s^2)	$a_{rms,y}$ (m/s^2)	$a_{rms,z}$ (m/s^2)
12	11	0.0752	0.0377	0.0265
13	14	0.1237	0.0724	0.0946
14	12	0.0360	0.0210	0.0157
15	20	0.0513	0.0328	0.0579
16	17	0.1128	0.0697	0.0748
17	21	0.0363	0.0224	0.0623
18	23	0.0449	0.0262	0.0164
19	14	0.2030	0.1223	0.1395
20	6	0.0761	0.0532	0.0530
21	16	0.1959	0.0982	0.0992
Location V2				
22	15	0.0316	0.0050	0.0122
23	15	0.0513	0.0082	0.0282
24	33	0.0366	0.0090	0.0146
25	12	0.0382	0.0060	0.0167
26	29	0.0286	0.0076	0.0178
27*	43	0.0384	0.0138	0.0242
28	16	0.0295	0.0085	0.0178
29	14	0.0260	0.0099	0.0163
30	11	0.0395	0.0087	0.0278
Location V3				
31	13	0.0314	0.0131	0.0652
32	14	0.0310	0.0180	0.0425
33	16	0.0242	0.0151	0.0268

Note: *Test number 27 is a freight train pass by.

5. Noise and Vibration Criteria

5.1 Relevant Noise and Vibration Assessment Documents

This assessment has been prepared considering the following documents:

- Secretary's Environmental Assessment Requirements (SEARs)
- State Environmental Planning Policy (SEPP) (Infrastructure) 2007
- DPIE – Development near Rail Corridors and Busy Roads – Interim Guideline
- AS 2107:2016 "Acoustics – Recommended design sound levels and reverberation times for building interiors"
- NSW EPA Noise Policy for Industry (NPI) 2017
- NSW Road Noise Policy, 2011 (RNP 2011)
- NSW EPA Interim Construction Noise Guideline 2009
- The NSW EPA "Assessing Vibration: A Technical Guideline (2006)
- Rockdale Development Control Plan (DCP) 2011.
- British Standard BS5228: Part 1:1997 "Noise and Vibration Control on Construction and Open Sites."
- British Standard BS7358:1993 "Evaluation and Measurement for Vibration in Buildings" – Part 2: "Guide to Damage Levels from Groundborne Vibration"
- German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures"
- AS 2021:2015 "Acoustics – Aircraft noise intrusion – Building siting and Construction"

5.2 Internal Noise Levels Criteria

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

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

> *"If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> 1. *In any bedroom in the residential accommodation – 35 dB(A) at any time between 10.00 pm and 7.00 am,*
> 2. *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time."*

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

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

Table 6 provides a summary of the internal noise limits for both windows closed and open established in Clause 3.6 "What Noise and Vibration Criteria Should Be Applied" of the DoP Interim Guideline.

Table 6: Summary of DoP's Interim Guideline criteria spaces adjacent to rail corridors and busy roads

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria dB(A)	Windows/Doors Open Criteria – dB(A)
Bedroom	10:00pm – 7:00am	$L_{Aeq,9h(night)}$	35	45
Living area	At any time	$L_{Aeq,15h(day)}$	40	50

5.2.2 AS/NZS 2107:2016 – 'Acoustics- Recommended design sound levels and reverberation times for building interiors

Internal noise level design targets were obtained from AS/NZS 2107:2016 for the commercial and other spaces that do not fall under the remit of the DoP's Interim Guideline. These criteria will affect the design of air conditioning plant, other building services, and the performance of the facade. Table 7 presents the internal noise levels that are the basis of the acoustic design for each type of space.

Table 7: Recommended design internal noise level range (AS/NZS 2107:2016)

Type of occupancy / activity	Design sound level ($L_{Aeq,T}$) range, dB(A) $L_{Aeq,T}$, 8am – 5pm
Public Spaces (Community Centre)	40 to 50
Apartment Common Areas (Lobby)	45 to 50

5.2.3 Project Specific Internal Noise Limits

Table 8 below outlines the project specific internal noise level targets for the development.

Table 8: Project internal noise limits

Type of occupancy / activity	Metric	Design Noise Level dB(A)
Bedroom (windows closed)	$L_{Aeq,9h}$ (10pm – 7am)	≤ 35
Bedroom (windows open)	$L_{Aeq,9h}$ (10pm – 7am)	≤ 45
Living Areas	$L_{Aeq,15h}$ (At any time)	≤ 40
Living Areas	$L_{Aeq,15h}$ (At any time)	≤ 50
Public Spaces (Community Centre)	$L_{Aeq,9h}$ (8am – 5pm)	40 - 50
Apartment Common Areas (Lobby)	$L_{Aeq,9h}$ (8am – 5pm)	45 - 50

5.3 External Noise Emissions Criteria

5.3.1 Rockdale Development Control Plan 2011

The Rockdale DCP is applicable to this development. In accordance with Chapter 6.1 of the DCP regarding to Child care centres, the DCP states the following objectives in regards to noise emission associated with the child care centres:

> 19. *An Acoustic Report undertaken by a suitably qualified acoustic consultant is required for centres in/adjacent to residential zones. The report must demonstrate how the site planning and building design minimise noise impacts, and that noise levels (measured at any point on the boundary of the site between the centre and adjoining property over a 15-miniute period) will not exceed 5dBA above the background level. The report should include recommended noise attenuation measures.*

Table 9 presents the external noise emission criteria for the child care centres within the development.

Table 9: Noise emission criteria for child care centre

Period	Noise Descriptor – dB(A)	Noise Criteria – child care centres $L_{Aeq,15mins}$
R1 – Eden Street		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	53
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	51
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	45
R2 & R3 – Princess Highway		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	65
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	64
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	52
R4 & R5 – Forest Road		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	64
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	61
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	53

5.3.2 NSW EPA Noise Policy for Industry (2017)

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

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

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

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

5.3.3 Intrusiveness Criteria

The NSW EPA NPI states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

The intrusiveness criterion can be summarised as follows:

$L_{Aeq,\ 15minute} \leq$ RBL background noise level + 5 dB(A)

The intrusiveness criterion for the closest residential receivers is presented in Table 10 below. Note the values from L2 have been used in this assessment as they are the most relevant to define the background and ambient noise level of the residential receivers.

Table 10: EPA NPI Intrusiveness Criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – All residential receivers $L_{Aeq,15mins}$
R1 – Eden Street		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	53
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	51
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	45
R2 & R3 – Princess Highway		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	65
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	64
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	52
R4 & R5 – Forest Road		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	64
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	61
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	53

5.3.4 Amenity Criteria

The NSW NPI states the following:

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

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

Table 11: NSW NPI Table 2.2 amenity criteria for external noise levels

Reciever	Type of Receiver	Noise Amenity Area	Time of Day	L_{Aeq}, dB(A) **Recommended amenity noise level**	Project amenity noise level $L_{Aeq, 15min}$
R1 (Eden Street)	Residential	Urban[1]	Day	60	58
		Urban[1]	Evening	50	48
		Urban[1]	Night	45	43
R2 – R3 (Princess Highway)	Residential	Urban[1]	Day	60	60[3]
		Urban[1]	Evening	50	59[3]
		Urban[1]	Night	45	56[3]
R4 – R5 (Forest Road)	Residential	Urban[1]	Day	60	62[3]
		Urban[1]	Evening	50	62[3]
		Urban[1]	Night	45	61[3]
C1 – C3	Commercial Premises	All	When in use	65	65

Notes:

1. Project amenity noise level is Recommended Noise Level minus 5 dB(A) plus 3 dB(A) to convert from period level to a 15-minute level.
2. Urban area as defined in EPA NSW NPI Table 2.3
3. As per the conducted noise survey, the measured $L_{Aeq,period(traffic)}$ is at least 10dB higher than the recommended amenity noise level (ANL). Therefore, the receiver has been identified as being in an area of high traffic noise. As per section 2.4.1 of the NSW NPI, the high-traffic project amenity noise level has been calculated by $L_{Aeq,period(traffic)}$ – 15dB(A) plus 3 dB(A) to convert from period level to a 15-minute level.

5.3.5 Sleep Disturbance

The NPI establishes sleep disturbance criteria for residential receivers in close proximity to industrial noise sources during the night-time period, such as vehicle movements and car door slams on private roads. The criteria for protecting the amenity of surrounding residential receivers in regard to sleep disturbance are:

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

Table 12 summarises the sleep disturbance criteria for the proposed development.

Table 12: Sleep Disturbance Criteria

Period	Sleep Disturbance Criteria	
	L_{AFmax} – dB(A)	$L_{Aeq,15min}$ – dB(A)
Residential Receiver 1 (Eden Street)		
Night (10:00pm to 7:00am)	55	45
Residential Receiver 2-3 (Princess Highway)		
Night (10:00pm to 7:00am)	62	52
Residential Receiver 4-5 (Forest Road)		
Night (10:00pm to 7:00am)	63	53

5.3.6 'Modifying Factor' Adjustments

The NSW NPI also states:

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

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

Table C1 of Fact Sheet C of the NSW NPI (see Table 13 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 13: Table C1 from the NSW NPI – Modifying factor corrections

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

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

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

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

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

5.3.7 Project Noise Trigger Levels

The project noise trigger levels for industrial noise sources such as mechanical plant etc. are provided in Table 14. These noise levels have been derived from the Noise Policy for Industry 2017.

Table 14: Project noise trigger levels for industrial noise emissions

Receiver	Period	Descriptor	Project Noise Trigger Levels dB(A)
Residential Receivers R1 (Eden Street)	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	53
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	48
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	43
Residential Receivers R2 – R3 (Princess Highway)	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	60
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	59
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	52
Residential Receivers R4 – R5 (Forest Road)	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	62
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	61
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	53
Commercial Receivers C1 – C3 (All)	When in use	$L_{Aeq,15min}$	65

5.3.8 Traffic Generation Noise Criteria

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy. 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 15.

Table 15: NSW Road Noise Policy – Traffic noise assessment criteria

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

Note: 1. Since all access to and from the proposed development will go through Eden Street, the traffic noise generation criteria for local road will be used.

If the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above. If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2 dB above that of the corresponding 'no build option'.

5.4 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (ICNG July 2009) under the NSW Environment Protection Authority (EPA). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

5.4.1 Interim Construction Noise Guideline (ICNG)

In undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. Table 17 below (Section 4.1.3 of the ICNG) sets out the noise management levels for other land uses, including commercial premises. The external noise levels should be assessed at the most affected occupied point for commercial and industrial uses, and at the most affected point within 50 metres of the area boundary for parks. However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. The limits presented in Table 16 apply.

Table 16: NSW EPA ICNG Construction Noise Criteria (Table 2 Sec 4.1.1)

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured **$L_{Aeq,15min}$** is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur in, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB(A)	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2.

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

Table 17: Construction Noise Criteria for Land Uses

Land Use	Management Level, $L_{Aeq,15min}$ – applies when land use is being utilized
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 75 dB(A)

Based on the criteria in the tables above, the following noise management levels in Table 18 should be applied to the receivers outlined in Section 4.1.2. Construction during standard hours is assumed, with the exception of concrete pumping for particular elements which will be conducted out of hours.

Table 18 - Project Specific Construction Noise Management Levels

Land Use	Receiver	Management Level, $L_{Aeq,15min}$
Commercial	C1, C2	75 dB(A)
Residential	R1	58dB(A)
Residential	R2 – R3	75dB(A)
Residential	R4 – R5	75dB(A)
Rail Corridor & Assets	-	75 dB(A)

5.5 Construction Vibration Criteria

5.5.1 Human Comfort

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

Continuous & Impulsive Vibration

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

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 19. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 19: Preferred and maximum weighted RMS values for continuous and impulsive vibration (m/s^2)

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
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 place 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 place of worship	Day or night time	0.64	0.46	1.28	0.92

Intermittent Vibration

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

Table 20: Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

5.5.2 Cosmetic Damage

Table 21 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 21: Transient vibration guide values for cosmetic damage

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

5.5.3 Steady-state 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 Vibrations in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 22 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Table 22 - Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

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

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

5.5.4 Project Construction Vibration Limits

Table 23 indicates the vibration criteria for the nearest residential properties to the development.

Table 23: Construction human comfort vibration criteria summary

Receiver	Period	Human Comfort Vibration Objectives			Structural Damage Criteria
		Continuous mm/s2 (RMS)		Intermittent $m/s^{1.75}$ (VDV)	Peak Velocity (mm/s)
		z-axis	x- and y-axis		
C1 – C3	At any time	64 - 128	46 - 92	0.40 - 0.80	20
R1 – R5	Daytime	30 - 60	21 - 42	0.20 - 0.40	5
R1 – R5	Night time	10 - 20	7 - 14	0.20 - 0.40	5
Rail Corridor & Assets	At any time	-	-	-	20

6. Operational Noise and Vibration

6.1 Road Noise Impact Assessment

6.1.1 Noise Modelling and Assumptions

To provide acoustic amenity to occupants of the proposed development and comply with the project specific internal noise limits, the noise impacts of surrounding roads were assessed at the façade of the residential units and commercial spaces within the proposed development.

3D acoustic modelling for noise emissions from the surrounding roads was conducted using the software SoundPlan (Version 8.2). Noise emissions and impacts from vehicle movements on the surrounding busy roads (Princes Hwy, Forest Rd), were modelled in accordance with the CoRTN prediction techniques and calibrated to measurements and logger data from around the site.

This model is recognized by regulatory authorities around Australia and is endorsed by the NSW DPIE for use in projects of this scale. The acoustic modelling was undertaken considering specific meteorological characteristics such as wind speeds, prevailing wind directions and temperature.

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

6.1.2 Closed Windows Assessment

To achieve the project internal noise limits established in Section 5.2 the glazing components of the façade of the proposed development must meet the glazing performance presented in Table 24 below. The glazing requirements for the façade are indicated on the drawings provided in Appendix D.

Table 24: Recommended glazing performance to meet acoustic performance

Type	Typical system assembly	Required Acoustic Rating of Glazing Assembly (min. R_W)
1	Single glazed units (6.38mm laminated)	32
2	Single glazed units (10.38mm laminated)	35
3	Single glazed units (12.38mm laminated)	37
4	Double glazed units (6mm float /12mm air gap/ 12.38mm laminated) *	41
5	Double glazed units (10mm float /12mm air gap/ 12.5mm Hush) *	44
6	Winter garden (6mm float)	30

In addition to the required glazing systems outlined in Table 24 and indicated in Appendix D, the solid/non-glazed elements of the façade shall have an acoustic performance of no less than Rw 55 to ensure the resulting internal noise levels within each space in the proposed development do not exceed the project internal noise limits outlined in Section 5.2.

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

6.1.3 Open Windows Assessment for Natural Ventilation

An open windows assessment has been conducted to assess whether the habitable spaces can meet the internal noise level requirements of the *Development Near Rail Corridors and Busy Roads - Interim Guideline* with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the NCC). If there is an exceedance of the internal noise level criteria with the windows open, alternative means of ventilation is required in accordance with the requirements of the NCC to the noise-affected spaces (noise-affected defined in Section 6.1.2).

The results of the acoustic façade modelling indicate that the apartments shown in Appendix C will require an alternative means of ventilation to meet the aforementioned requirements.

Where the façade is highlighted in:

- **Red** – At this location, a bedroom or living room within a residential apartment space will require an alternative means of ventilation. The following options are available to be explored during design development:
    - Openable winter gardens which may provide up to an additional 8-10dB(A) of noise attenuation, where the winter garden soffit is treated with acoustic absorption.
    - Where higher noise attenuation is required a bespoke acoustic ventilator can be designed to be installed as a façade element.
    - A final option is to provide mechanical ventilation to draw in and exhaust fresh air.
- **Green** – At this location, spaces within a residential apartment will not require an alternative means of ventilation, and each space will be able to rely on opening their windows to achieve the ventilation requirements.

Mark-ups have been provided in Appendix C showing the habitable spaces within each apartment that will require alternative means of ventilation.

6.2 Rail Impact Assessment

6.2.1 Airborne Noise

Airborne noise emissions associated with the adjacent rail corridor was modelled in accordance with the Nord2000 Rail Traffic Noise Prediction Method (Nord2000) methodology and calibrated to noise levels and numbers of train pass-bys obtained by on-site noise monitoring conducted.

An assessment of the noise impact (based on the noise survey results) and subsequent façade/glazing performance design is provided within Section 1.1.1 and 6.1.2 of this report.

6.2.2 Ground-borne Noise / Regenerated Noise

The boundary of the development is >25m horizontally from the boundary of the rail corridor. Therefore, by definition the development does not require assessment in relation to the Infrastructure SEPP for rail corridors.

6.2.3 Human Comfort and Structural Damage

A vibration assessment has been conducted in accordance with the DP&E's Interim Guideline and referenced documents due to the proximity of the proposed development to the rail corridors. The vibration levels of train pass-bys have been measured at the nearest point on the façade of the proposed development for all three axes. The measured values were processed and assessed in accordance with the criteria to determine whether there will be any adverse effect on occupants of the development from human perception, or potential structural damage to the building. Refer to Table 25 for the highest measured Vibration Dose Value when compared with the vibration criteria for human comfort.

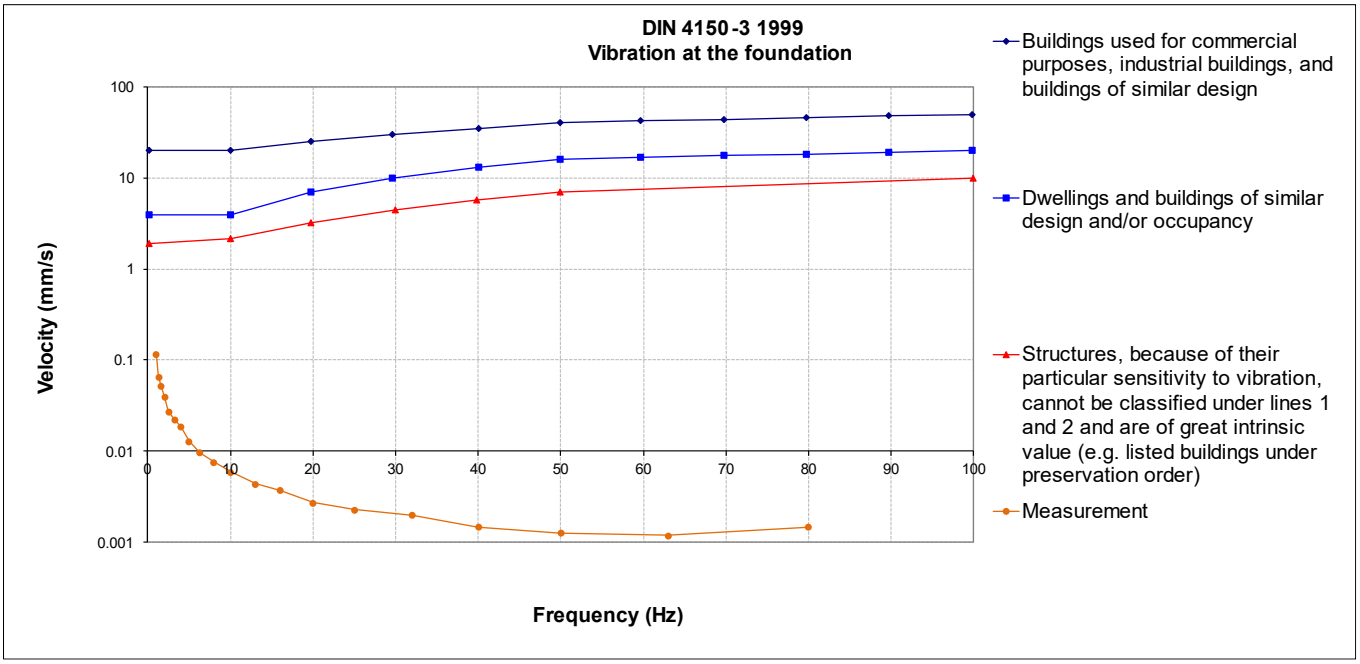
Table 25: Vibration Dose Values from train vibration

Period	eVDV ($m/s^{1.75}$)	Commercial Criteria	Residential Criteria	Complies (/×)
Location V1				
Day (7am – 10pm)	0.15	0.80	0.40	✓
Night (10pm – 7am)	0.12	0.80	0.26	✓
Location V2				
Day (7am – 10pm)	0.01	0.80	0.40	✓
Night (10pm – 7am)	0.009	0.80	0.26	✓
Location V3				
Day (7am – 10pm)	0.01	0.80	0.40	✓
Night (10pm – 7am)	0.008	0.80	0.26	✓

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

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

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



Based on the predicted vibration levels at the nearest structure of the proposed development, it is not expected that there will be any exceedance of the criteria established with regards to structural damage. Therefore, the vibration impact on the structure of the proposed development is predicted to comply with the requirements of the SEPP Infrastructure 2007 based on the structural design of the proposed development.

6.3 Mechanical Plant & Equipment Noise Emissions

6.3.1 Noise Emissions

This assessment has considered the noise emissions from the major mechanical plant associated with the development. These noise sources have been used to predict the worst-case scenario noise impact of the proposed use of the site to the nearby sensitive receivers. The assessment has been conducted to achieve noise levels as per the NSW NPI. Both have been assessed at the most affected external point at the surrounding residential and commercial receivers.

To assess the worst-case scenario, it was assumed that the mechanical services associated with the development are running at any time throughout the daytime. While exact equipment has not been selected for the project, the sound power levels provided in Table 26 have been assigned to each significant plant and equipment item, based on typical noise emissions data for plant and equipment of the sizes indicated.

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

Level 1

- Mechanical plantroom with retail exhaust and VRV outdoor units.

Level 2

- Supermarket mechanical plantroom

Level 19; 20; 21; 22

- mechanical plantroom

Table 26: Sound power levels of mechanical equipment and plant for typical size

Plant and Equipment	Sound Power Level re 10^{-12} W, dB – Octave Band Centre Frequency								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Carpark supply fan	96	98	98	98	91	89	8	81	104
Carpark exhaust fan	100	99	98	94	92	90	87	81	105
Kitchen Exhaust fan	76	92	91	79	76	70	65	70	87
VRV units	65	64	66	64	59	56	53	45	65
Stair Pressurisation Fan	93	89	92	89	88	89	82	75	95

6.3.2 Preliminary Noise Assessment

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

- Night-time criteria (10pm – 7am) is chosen as it is the most stringent criteria for the nearest sensitive receivers.
- The mechanical plant and equipment will be operating during all periods on any day.
- The load demanded of the mechanical plant and equipment will be reduced to approximately 60% during the evening period (6:00pm – 10:00pm) and 40% during the night-time period (10:00pm – 7:00am).

Table 27 provides a summary of the results of the noise impact assessment of the mechanical plant and equipment. The noise generated by the plant and equipment has been assessed with and without the noise mitigation measures outlined in Section 6.3.3

Table 27: Summary of results of mechanical noise impact assessment (with and without mitigation)

Receiver	Period	Predicted Noise Level LAeq,15min - dB(A) Without Mitigation	Predicted Noise Level LAeq,15min - dB(A) With Mitigation	PNTL LAeq,15min - dB(A)	Compliance (✓/×)
R1	Night	55	39	43	✓, with mitigation
R2 – R3	Night	64	55	58	✓, with mitigation
R4 – R5	Night	64	58	58	✓, with mitigation

Based on the results of the assessment of the noise generated by the mechanical plant and equipment, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 5.3 upon implementation of the mitigation measures outlined in Section 6.3.3

6.3.3 Mitigation Measures

Based on the preliminary noise assessment provided above, mitigation measures are expected to be required in order to meet the external noise emissions requirements for noise generated by the mechanical plant. It should be noted that the noise attenuation requirements will likely be refined once the mechanical plant and equipment selections and designs have been progressed further during the detailed design stage. The proposed mitigation measures include the following:

- Install acoustic screens to mechanical plantrooms where indicated. Acoustic barriers can be solid or can be an acoustic louvre that must have a transmission loss of no less than the values shown in .
- Install attenuators on carpark supply and exhaust fans

Further to the above, a detailed review of noise control for mechanical plant noise should be conducted prior to Construction Certificate to ensure compliance with the outlined criteria at the nearest sensitive receivers. These amelioration measures could include but not limited to the following:

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

The mitigation measures proposed at this stage of the development are conservative.

Table 28: Insertion loss required for Attenuators

Location	Required Insertion Loss (dB) – Octave Band Centre Frequency							
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Carpark Supply Fan (intake)	2	4	8	11	22	16	10	8
Carpark Exhaust Fan (Discharge)	10	20	39	50	50	50	45	30

Table 29: transmission loss required for types of acoustic barriers

Louvre	Required Transmission Loss (dB) – Octave Band Centre Frequency					
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Type 1	9	14	19	21	24	24
Type 2	8	7	11	21	24	16

Figure 9 - Acoustic barrier type designations - Level 1 Retail Plantroom (Building B)

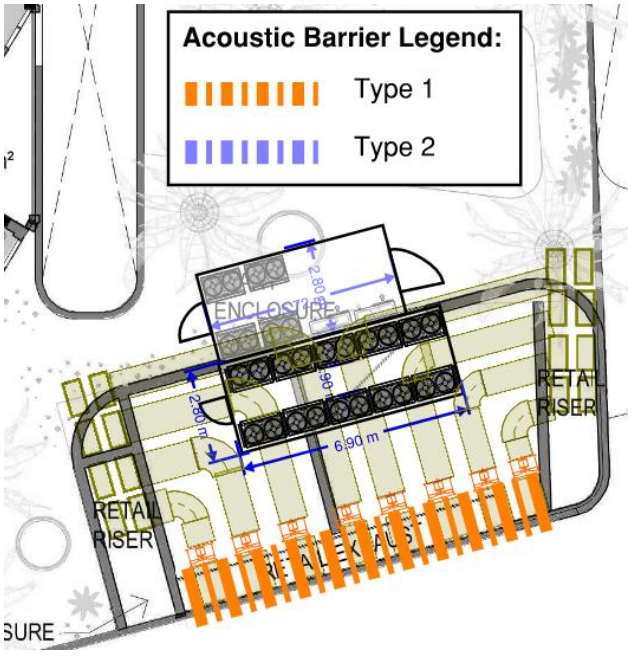


Figure 10 - Acoustic barrier type designations - Level 1 Coles Plantroom (Building C)

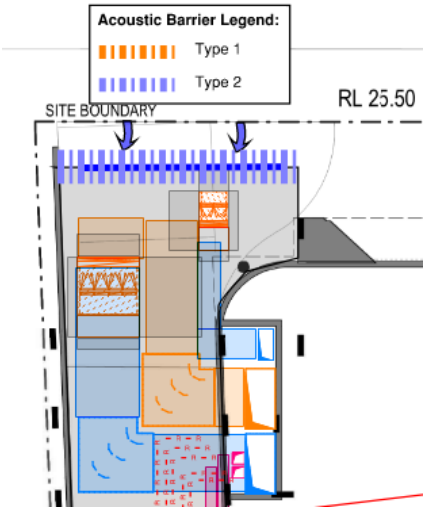


Figure 11 - Acoustic barrier type designations - Level 1 Coles Plantroom and Carpark Exhaust room (Building D)

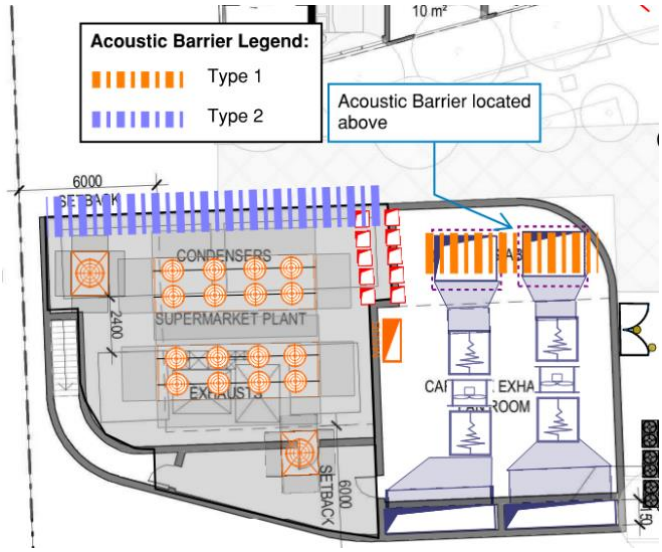
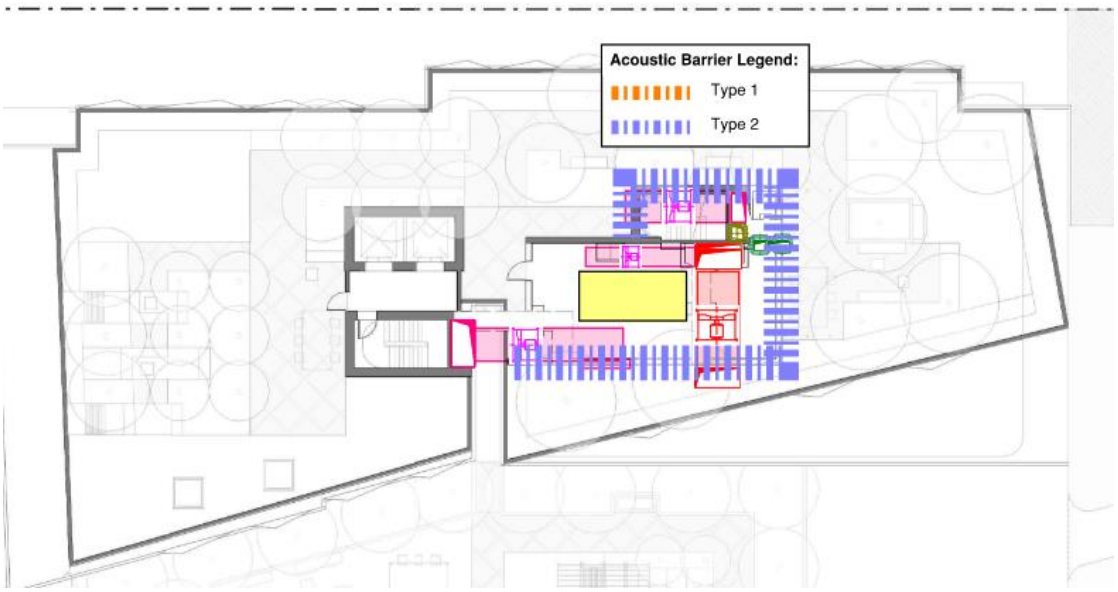


Figure 12 - Acoustic barrier type designations - Level 1 Coles Plantroom and Carpark Exhaust room (Building D)



6.4 Loading Dock & Waste Collection Noise Emissions

An assessment of the noise generated by activities within the Ground Level loading dock (such as garbage collections and deliveries) has been conducted to determine the impacts on the surrounding noise-sensitive receivers. Table 38 outlines the sound power level (SWL) and typical duration (minutes) associated with each of the standard loading dock activities.

Table 30: Typical sound power levels and duration of loading dock activities

Loading Dock Activity	Typical Duration of Activity	Sound Power Level ($L_{Aeq,\ 15min}$)
Garbage truck unloading bins	2 minutes	88
Medium rigid truck accelerating	15 seconds	57
Loading and unloading activities	10 minutes	88
Medium rigid truck idling on turntable	5 minutes	69

The noise generated by the activities during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 31. The following assumptions have been made for the assessment:

- Service vehicles are assumed to be either medium rigid trucks or garbage trucks.
- Two (2) service vehicle entering and exiting within a 15-minute period; and
- Loading and unloading activities will take place indoors
- Night-time criteria (10pm – 7am) is chosen as it is the most stringent criteria for the nearest sensitive receivers.

Table 31: Loading dock predicted noise levels at most affected receiver

Most Affected Receiver	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Project Noise Trigger Level $L_{Aeq,15min}$ - dB(A)	Compliance (✓/×)
Residential receiver 1	40	53	✓

Table 31 shows that the predicted noise levels of the loading dock activities at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 5.3.7.

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

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

6.5 Traffic Generation Noise Assessment

An acoustic review of the Parking and Traffic Impact Assessment prepared by Stanbury Traffic Planning (Ref. 20-171-5) has been conducted to establish existing and predicted development generated traffic. For the road traffic noise assessment, traffic numbers and generated vehicles from the car parking provision is based on the following assumptions:

- Passenger vehicle access is provided via separate ingress and egress driveways connecting with Eden Street within the south-western corner of the site.
- No passenger vehicular access is proposed between the site and Princes Highway.
- Eden Street accommodates two directional demands of up to 100 vehicles during the morning, afternoon and Saturday peak hours.
- Projected traffic generation for residential and retail aspects as shown in Table 32.

This data has been used to calculate the expected noise increase due to traffic associated with the development onto residences along Eden Street.

The relevant information regarding peak hour vehicle movements on the lane adjacent to the proposed development has been summarized in Table 32.

Table 32: Existing and predicted traffic flow volumes (peak hour)

Time	Existing Lane	
	Existing	Existing + Projected Traffic Generation
Eden Street (AM Peak 07:45-08:45)	313	313 + 141 residential + 148 retail = 602
Eden Street (PM Peak 17:00-18:00)	226	226 + 112 residential + 178 = 516

The values presented in Table 33 below compare the existing noise levels predicted by the assessment with the predicted noise levels expected from an increase in vehicle movements associated with the proposed development.

Table 33: Predicted increase in traffic noise levels (peak hour) versus NSW RNP criterion for local roads

Location	Existing Noise Levels		Predicted Noise Levels	Criteria	Complies?
	$L_{Aeq-1hour}$, dB(A)	Relative traffic noise increase dB(A)	$L_{Aeq-1hour}$, dB(A)	Local Road $L_{Aeq-1hour}$, dB(A)	
Eden Street (AM Peak)	63	2.8	65.8	55	✗
Eden Street (PM Peak)	63	3.6	66.6	55	✗

Table 33 shows that the existing traffic noise levels exceed the RNP criterion. Based on the predicted noise levels during the peak hours, the relative traffic noise increase is 2.8 dB(A) and 3.6 dB(A) for the morning and afternoon peak hours respectively. These relative increases in road traffic noise based on volume alone exceed the 2dB allowable increase stated in *Section 3.4.1 Process for applying the criteria – Step 4* of NSW RNP, by 0.8 dB(A) and 1.6 dB(A) respectively.

However, it should be noted that these projected traffic volume increases due to the development are for the morning and evening peak traffic hours only, when most residents will be active and less sensitive to noise. In addition, outside of these two hours the relative increase in traffic noise is expected to be negligible.

6.6 Aircraft Noise Assessment

The proposed site is located within proximity to Sydney Airport (approximately 1.5km away), the aircraft noise related to this airport has been considered as part of the noise assessment using the predicted Australian Noise Exposure Forecast (ANEF) map.

Figure 13 presents the location of the site in relation to Sydney Airport ANEF 2039. As can be seen from Figure 13, the proposed development is currently outside of ANEF 20 contour line. This indicates that the development site is within an acceptable area for a residential development. It should be noted that the actual location of the ANEF contours is difficult to define accurately, due to common deviation in flight paths. However, no issues are expected to arise from this due to the proximity to the airport.

Figure 13: Proposed development site in relation with Sydney Airport ANEF 2039

Table 34 shows the building acceptability criterion for various types of developments with respect to their proximity to the ANEF contours.

Table 34: Building Acceptability based on ANEF Zones (AS 2021:2015)

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF

6.7 Childcare Noise Assessment

The acoustic impacts from the proposed childcare centre will be assessed within a separate Development Application. Nevertheless, a preliminary operational noise assessment has been carried out to the nearest noise sensitive receivers. The nearest most affected receivers are:

- Residential receiver (R4) located at 181 Princess Highway, approximately 12m away from the boundary of the proposed child care centre
- Residential receiver (R5) located at 2 Wickham Street, approximately 40m away from the boundary of the proposed child care centre

Figure 14 presents the typical layout for the proposed childcare centre. The proposed location for the childcare centre is located at the upper ground level of Tower D Building.

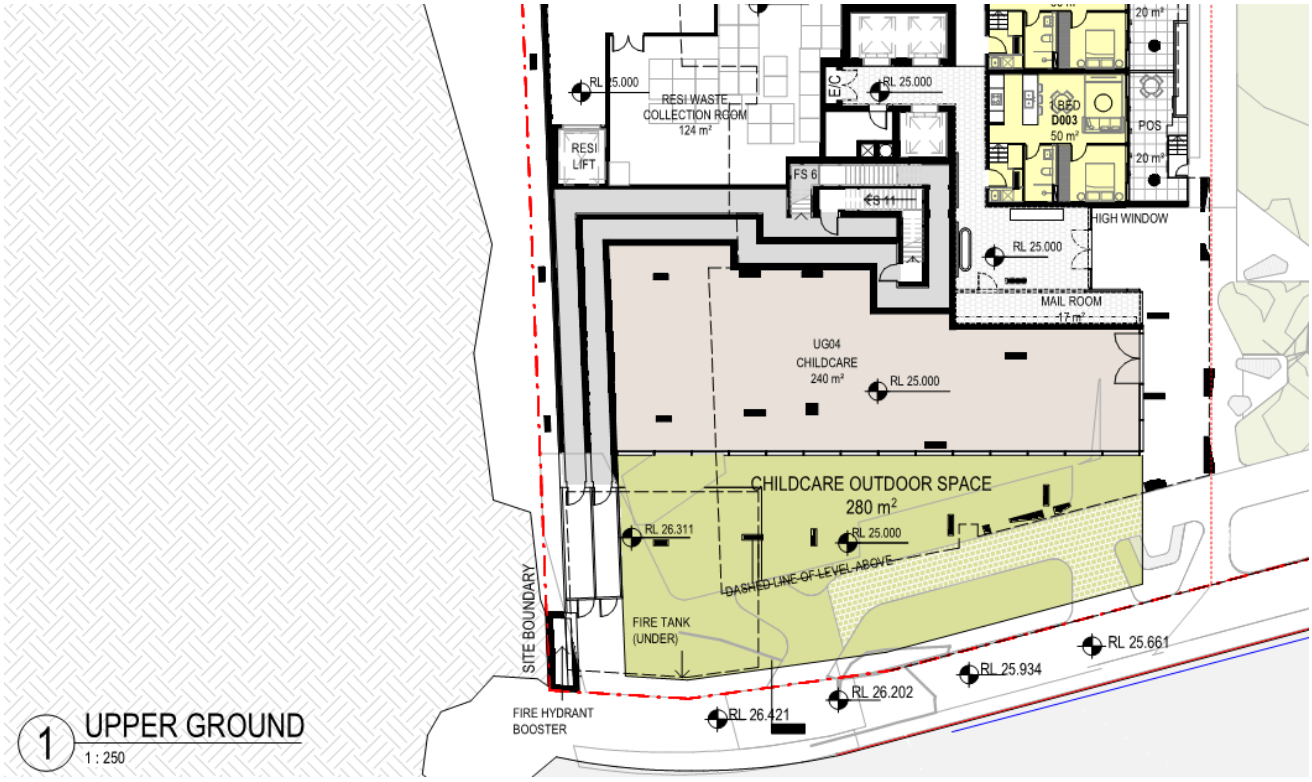


Figure 14: Proposed location of the childcare centre

6.7.1 Indoor Play Areas

The indoor play activities have been considered in the acoustic assessment of the development and have been deemed to meet the criteria set out above for the proposed number of children. The overall contribution of indoor play activities does not influence the overall noise emission at the boundary of the nearest sensitive receivers. Therefore, the noise emissions are driven by the outdoor play areas, and noise mitigation strategies adopted to meet the criteria.

6.7.2 Outdoor Play Areas

The sound power levels recommended in the Association of Australian Acoustical Consultants (AAAC) 'Guideline for Childcare Centre Acoustic Assessment' (September 2010) were used in the noise calculations for the outdoor play area. The sound power levels obtained from the guideline are adjusted to take into consideration the number of children in each age group and in the outdoor play areas to enable prediction of noise levels to receiver locations.

The AAAC guideline also adopts a background noise level plus 5dB at the boundary of the nearest sensitive receiver for outdoor play areas that in use for more than 2 hours a day which is in line with the Rockdale DCP 2011.

The assessment has been based on the following assumptions and requirements to meet the noise level predictions of this report:

- Sound power levels based on AAAC guidelines (worst case scenario)
- Maximum of 40 children in the outdoor play area at any one time
- The childcare operating hours is between Monday to Friday 7am-6pm
- Installation of all acoustic mitigation measures as detailed in section 6.7.3 of this report

Refer to Table 35 for the results of the noise assessment of children playing, assessed to the most affected surrounding residential and commercial receivers. The results presented in Table 35 are as per the assumptions presented above and the implementation of all acoustic mitigation measures.

Table 35: Predicted noise emissions from outdoor play area

Receiver	Sound source	Sound Pressure Level dB(A) with acoustic mitigation measures	Criteria at receiver boundary dB(A)	Meets the acoustic criteria? (✓/✗)
Most affected point on R4	Outdoor play area	**54**	65	✓
Most affected point on R5		**44**	65	✓

Based on the results of this assessment, should all acoustic mitigation measures been implemented, the proposed childcare is expected to comply with the noise emission criteria set out previously in Section 5.3.1 of this report.

6.7.3 Mitigation Measures

The following acoustic mitigation measures are proposed to achieve compliance with the relevant criteria:

- 1.8m high acoustic barrier around the play area as per Figure 15. The barrier is to be solid and free of any gaps that may limit the acoustic performance

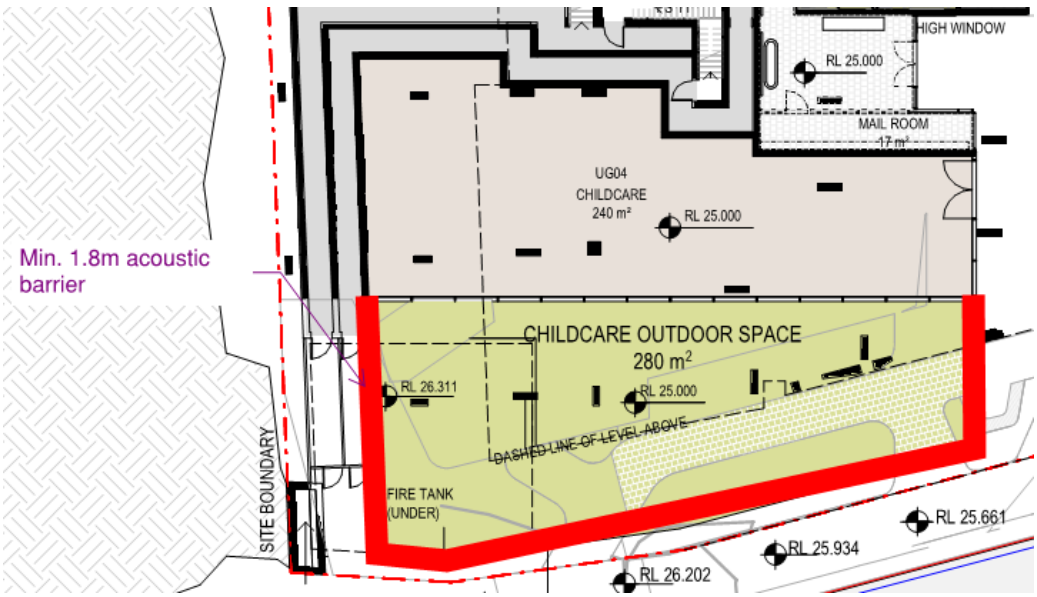


Figure 15: Proposed location of the acoustic barriers.

It is important to note that this is only a preliminary assessment. A detailed acoustic assessment is recommended as more information becomes available regarding to the operation of the childcare (e.g. hours of operations. the children age group, play area layouts, etc.).

7. Construction Noise & Vibration

7.1 Overview

Currently a detailed construction program is not yet full defined. This section provides general recommendations only and provides applicable criteria together with feasible and reasonable noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice provided within this assessment shall form the basis for the Contractor's detailed Construction Noise and Vibration Management Plan (CNVMP) which shall identify any noise criteria exceedances and relevant mitigation measures once construction methods and stages are known.

7.2 Proposed Construction Hours

The proposed construction hours are as follows:

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

7.3 Construction Noise Assessment

A preliminary construction noise assessment has been carried out based on typical plant and machinery expected throughout the construction stages. The preliminary noise assessment has been considered at the nearest existing residential receivers.

7.3.1 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 36. The equipment noise levels have been extracted from *AS 2436:2010* Guide to *Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

Table 36: Cumulative impact - Construction equipment noise levels

Stages	Equipment	Quantity	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
Early Works – Demolition & Dismantle	Jackhammer	1	113	20	3	106
	Electric hand tools	5	102	50	7.5	99
	Excavator 30 tonne	1	110	40	6	106
	Excavator breaker	1	115	40	6	111
	Bobcat	1	107	70	10.5	105
	Cherry picker	1	102	50	7.5	99
	Dump truck	2	108	40	6	104
Excavation, Retention and Foundation	Excavator 30 tonne	1	110	40	6	106
	Jackhammer	1	113	20	3	106
	Powered hand tool	4	102	50	7.5	99

Stages	Equipment	Quantity	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102
	Bored piling	1	110	16	2.4	102
	Generator	1	104	20	3	97
	Truck	2	108	40	6	104
Structural Works	Powered hand tool	4	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102
	Bored piling	1	110	16	2.4	102
	Generator	1	104	20	3	97
	Truck	2	108	40	6	104
Structural Works & Façade and Finishes	Powered hand tool	11	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102

7.3.2 Noise Modelling and Assumptions

To assess the noise impact from the site during the various construction stages, a noise model was prepared using commercial software SoundPLAN v8.2, which is a comprehensive software package for conducting three-dimensional complex noise propagation modelling. Using the software, a 3D model of the site and its surroundings was constructed including the nearby buildings, and the construction plant and equipment were positioned as noise sources. Within the model, the effects of the environment (built and natural) on propagation of sound were considered to reliably estimate the resulting noise effects on the surrounding noise sensitive receivers.

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

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

- The predicted noise levels represent the worst-case scenario for each receiver.
- Neutral weather conditions.

7.3.3 Predicted Noise Levels

The predicted noise levels have been presented in Table 37, Table 38, Table 39, and have been assessed against the construction noise criteria established in Section 5.4. The noise contour maps produced by the three-dimensional noise propagation modelling are provided in Appendix G.

Table 37: Predicted noise levels – Scenario 1: Early Works – Demolition & Dismantle

Receiver	Predicted Noise Level Range - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level Range – With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min\ dB}$	Noise Management Level Exceedance (dB) With Mitigation	Exceeds Highly Noise Affected Level? (> 75dBA)
North	61-72	57-72	75	-	No
South	65-75	64-75	75	-	No
East	63-69	59-64	75	-	No
West	66-71	62-66	58	4-8	No

Table 38: Predicted noise levels – Scenario 2: Excavation

Receiver	Predicted Noise Level Range - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level Range – With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB) With Mitigation	Exceeds Highly Noise Affected Level? (> 75dBA)
North	59-73	55-72	75	-	No
South	62-73	61-73	75	-	No
East	61-67	57-62	75	-	No
West	64-69	60-64	58	2-6	No

Table 39: Predicted noise levels – Scenario 3: Construction

Receiver	Predicted Noise Level Range - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level Range – With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
North	59-74	55-74	75	-	No
South	63-72	62-72	75	-	No
East	61-67	60-64	75	-	No
West	64-69	58-62	58	0-4	No

7.4 Project Specific Noise Recommendations

A solid acoustic barrier with minimum density of 12kg/m^2 (made from plywood or similar) 2.4 meters above Ground Level is recommended to be erected around the perimeter of the site. The acoustic barrier should be without any defects or gaps.

In addition, noise monitoring is recommended to be conducted at the most-affected noise-sensitive receivers in accordance with the monitoring program proposed in Section 1.

These recommendations are preliminary only and are to be re-assessed within a detailed CNVMP prior to Construction Certificate.

7.5 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.

7.5.1 Noise

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

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

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

7.5.2 Screening

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

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

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

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

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

Water pumps, fans and other plant equipment that operate on a 24-hour basis may not be an irritating source of noise during the day but may be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground provided this does not generate reverberant noise. In such cases, however, adequate ventilation should also be ensured. Long, temporary earth embankments can provide

quite an effective noise screen for mobile equipment moving, for example, on a haulage road. When the earthworks are complete, the earth mounds should be removed if possible, with smaller, quieter excavators. A noise barrier may be a more reliable method of noise control than the imposition of restrictions on throttle settings.

In many cases it may 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.

7.5.3 Crane (diesel operated)

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

7.5.4 Reversing and warning alarms

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

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

(a) Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal frequency ‘beep’) are less intrusive when heard in the neighborhood.

(b) Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.

(c) Non-audible warning systems (e.g. flashing lights, reversing cameras) may also be employed, providing safety considerations, are not compromised.

(d) 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.

(e) Spotters or observers.

The above methods should be combined, where appropriate.

Figure 16: Noise mitigation management flow chart

7.6 Noise & Vibration Monitoring Strategy

7.6.1 General Methodology

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

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

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

Noise and vibration monitoring can take two forms:

- Short term monitoring
- Long-term monitoring

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 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 through the DA conditions.

Both methods 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.

7.6.2 Noise & Vibration Monitoring Program

The following monitoring program is proposed for this project:

Table 40 - Proposed noise and vibration monitoring locations details

Sensitive Receiver Details	Proposed Monitoring Type and Phase
R1 – R5	Noise - All Phases
	Vibration - Civil & Basement Works

The monitoring program as shown above is to be carried out during the likely noisiest stages as agreed with the acoustic engineer and contractor.

8. Conclusion

A Noise and Vibration Impact Assessment (NVIA) for the proposed development located at 26 Eden St, Arncliffe has been prepared. This report forms part of the documentation package to be submitted to relevant authorities as part of the State Significant Development Application process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 5. This NVIA has specifically addressed the following acoustic items:

- Noise criteria for internal noise levels according to the DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline, provided in Section 5.2;
- Noise criteria for noise emissions from the development to noise-sensitive receivers in accordance with the NSW NPI Section 5.3;
- Traffic noise criteria for additional vehicle movements on public roads generated by the proposed development presented in Section 5.3.8;
- Operational vibration criteria for human comfort and structural damage, provided in Section 5.5;
- Construction noise criteria provided in Section 5.4; and
- Construction vibration criteria for human comfort and structural damage, provided in Section 5.5.
- Operational noise assessments including the following:
    - Road & rail impact assessment (Section 6.2 & 6.3)
    - Mechanical plant noise assessment (Section 6.3)
    - Loading dock & waste collection noise assessment (Section 6.4)
    - Traffic generation noise assessment (Section 6.5)
    - Aircraft noise assessment (Section 6.6)
    - Childcare noise assessment (Section 6.7)
    - Construction noise & vibration assessment (Section 7)

Having given regard to the analysis conducted within this report, it is the findings of this noise and NVIA that the proposed development is compliant with the relevant noise and vibration criteria controls for this type of development, except for a minor exceedance of the road noise criteria for development generated traffic.

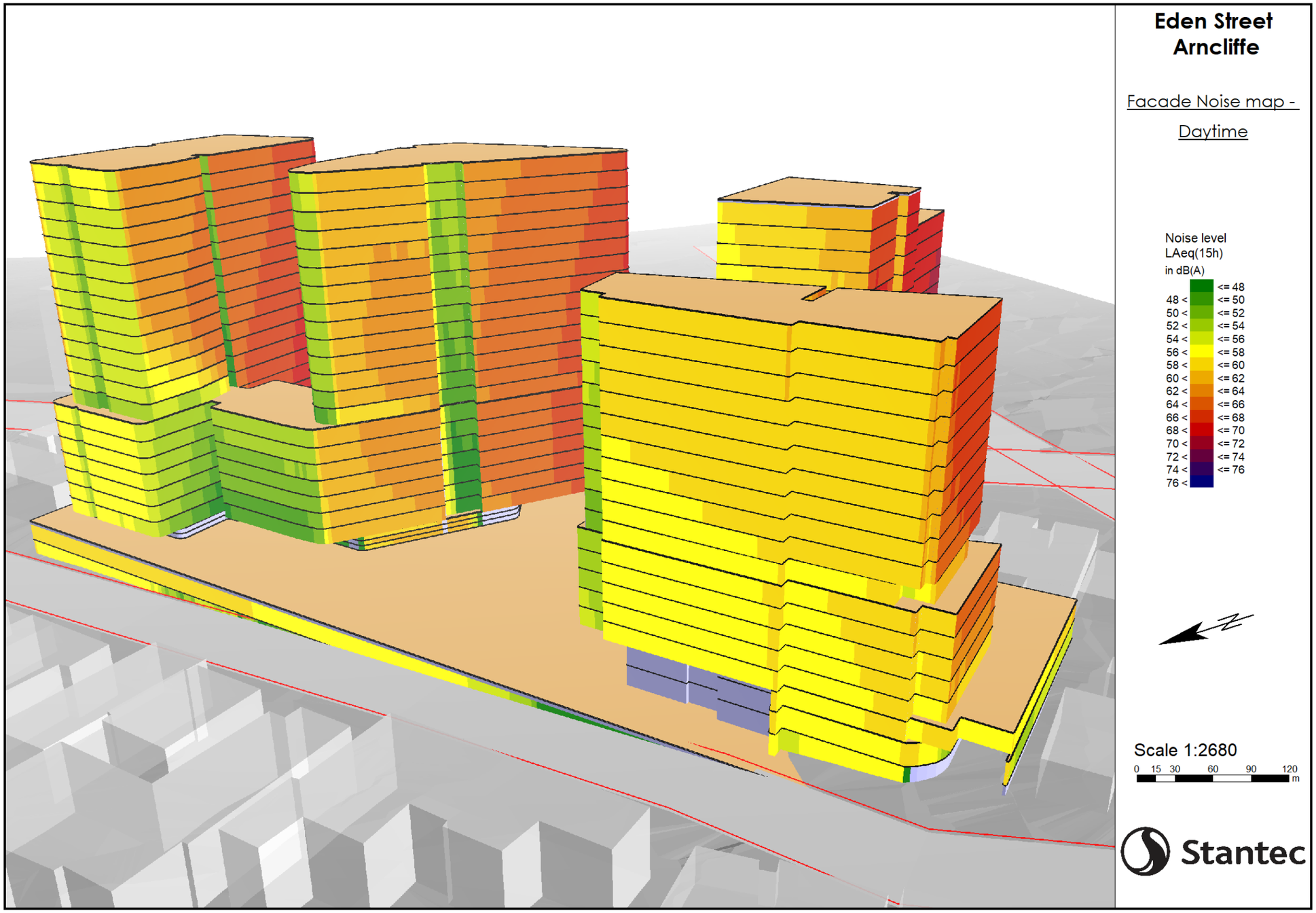
Based on the information presented in this report, the relevant objectives will be satisfied and therefore approval is recommended to be granted.

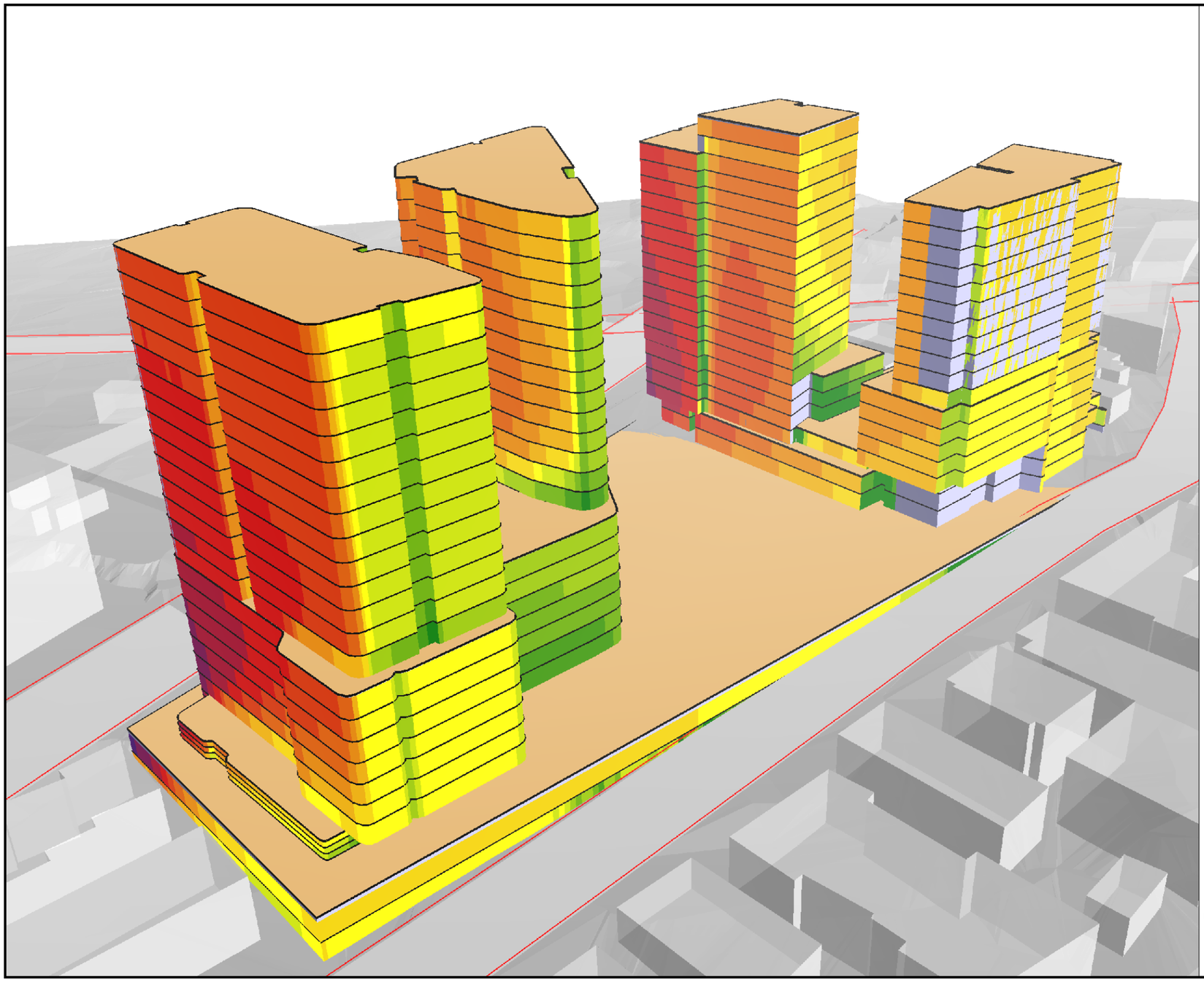
Appendix A - Glossary of Acoustic Terms

Term	Definition
Acceptable Noise Level:	The acceptable L_{Aeq} noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{A90} noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A-filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
L_{Amax}	The maximum A-weighted sound pressure level measured over a period.
L_{Amin}	The minimum A-weighted sound pressure level measured over a period.
L_{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
L_{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L_{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{A90} noise level expressed in units of dB(A).
L_{Aeq}	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.

$L_{Aeq,T}$	The constant A-weighted sound which has the same energy as the fluctuating sound of the measurement, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R_w:	The Sound Insulation Rating R_w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Appendix B – Façade Noise Maps





Eden Street Arncliffe

Facade Noise map - Daytime

Noise level
LAeq(15h)
in dB(A)

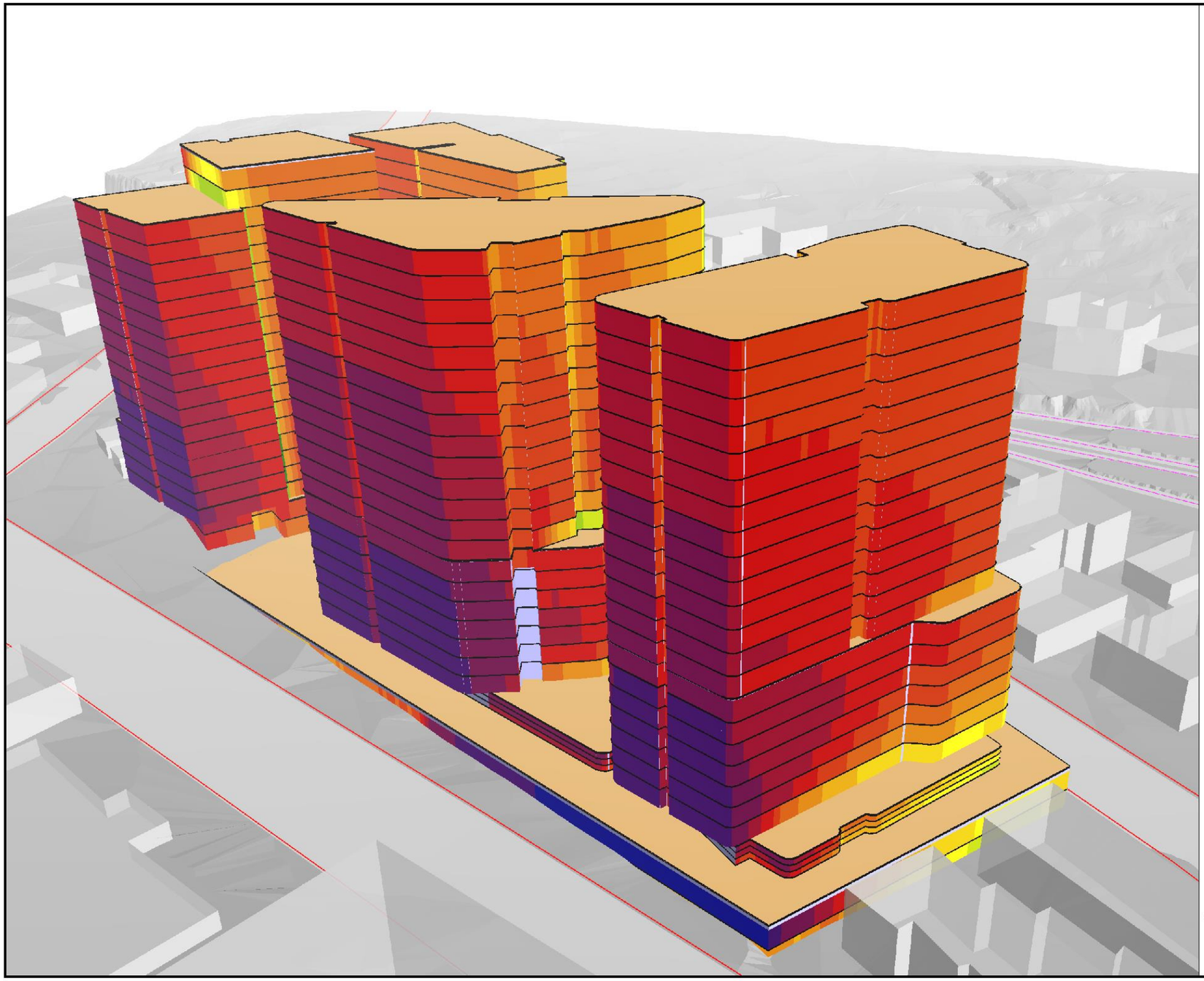
	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

N

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Daytime

Noise level
LAeq(15h)
in dB(A)

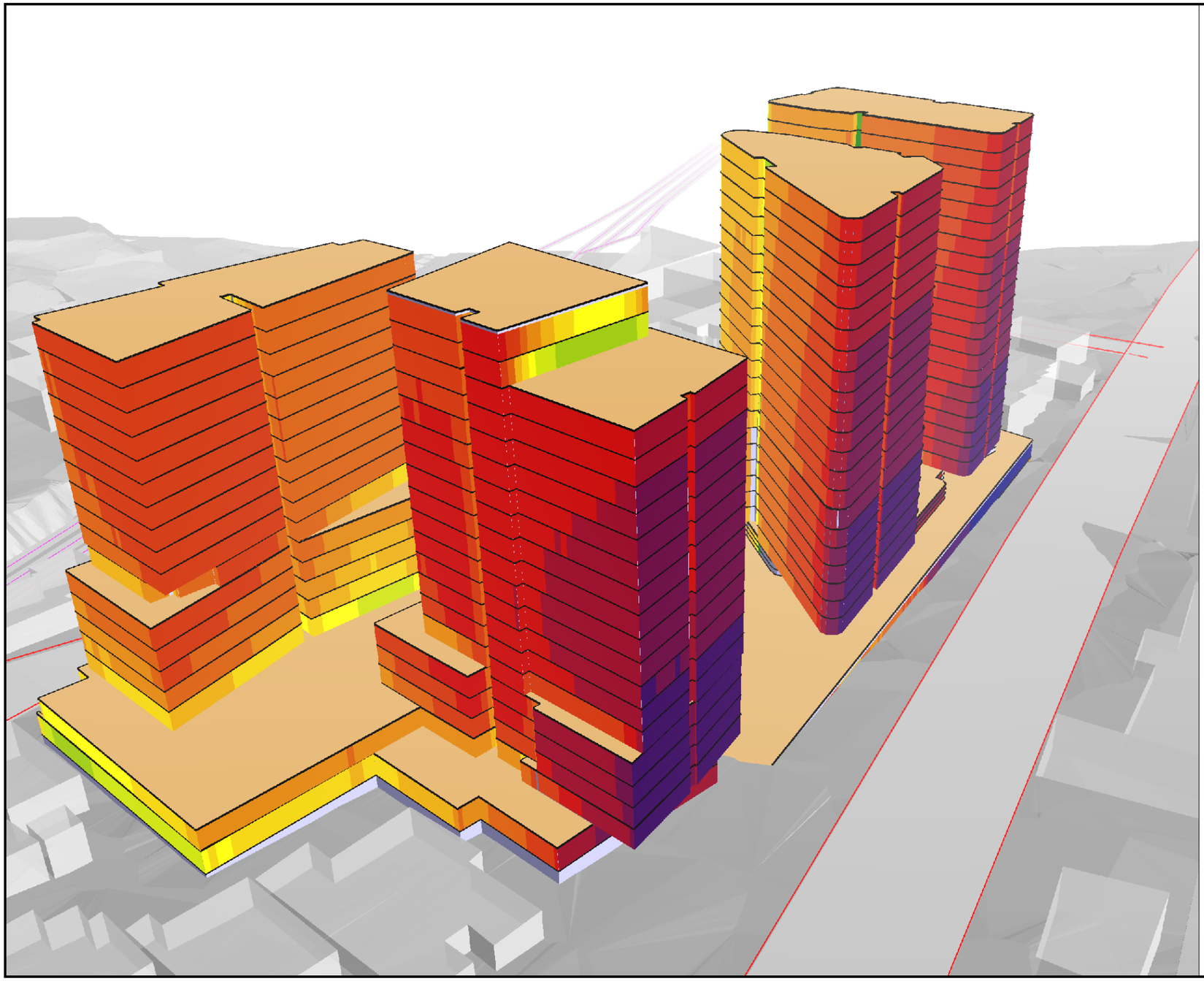
	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

N

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Daytime

Noise level
LAeq(15h)
in dB(A)

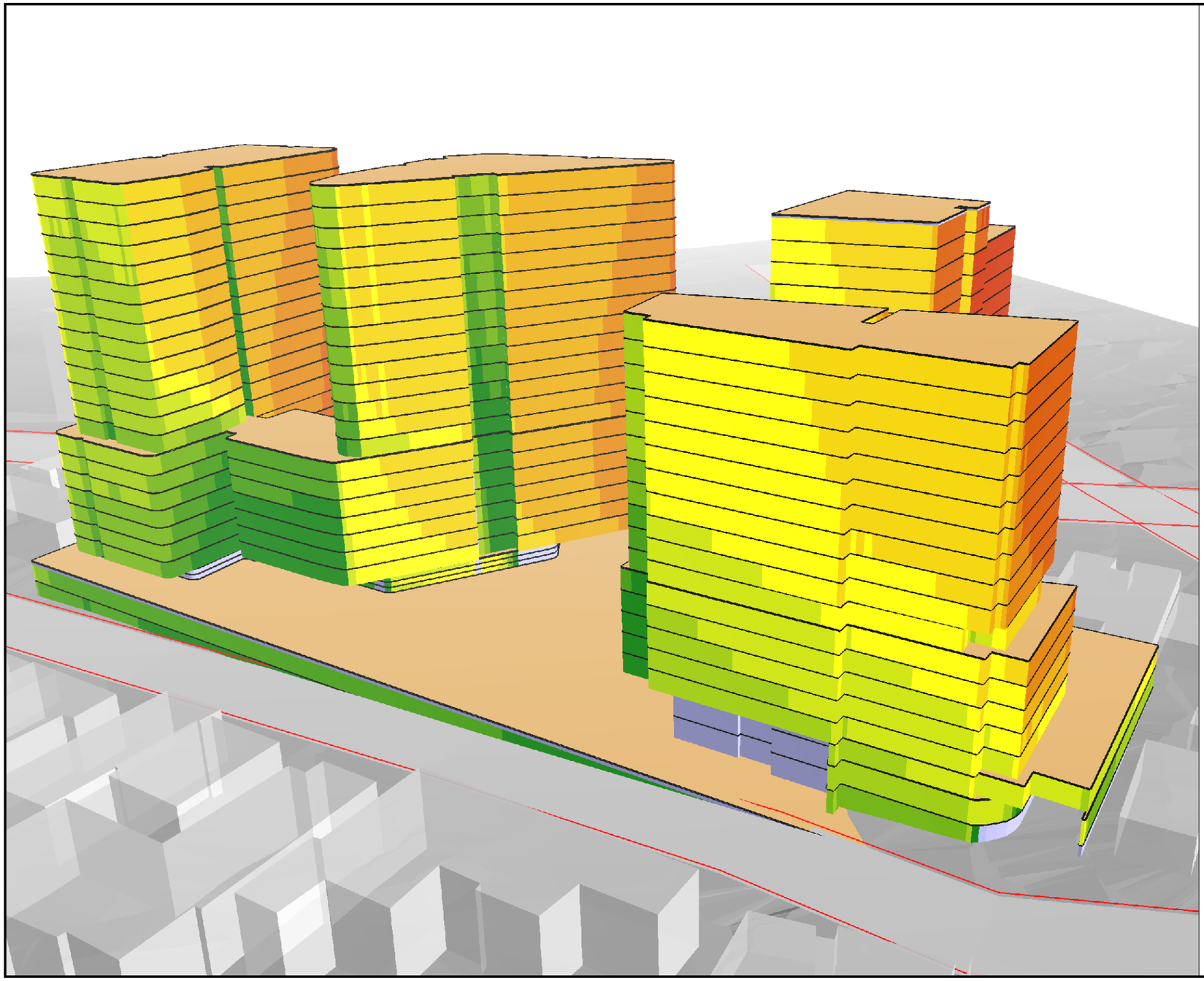
	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

N

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Night-time

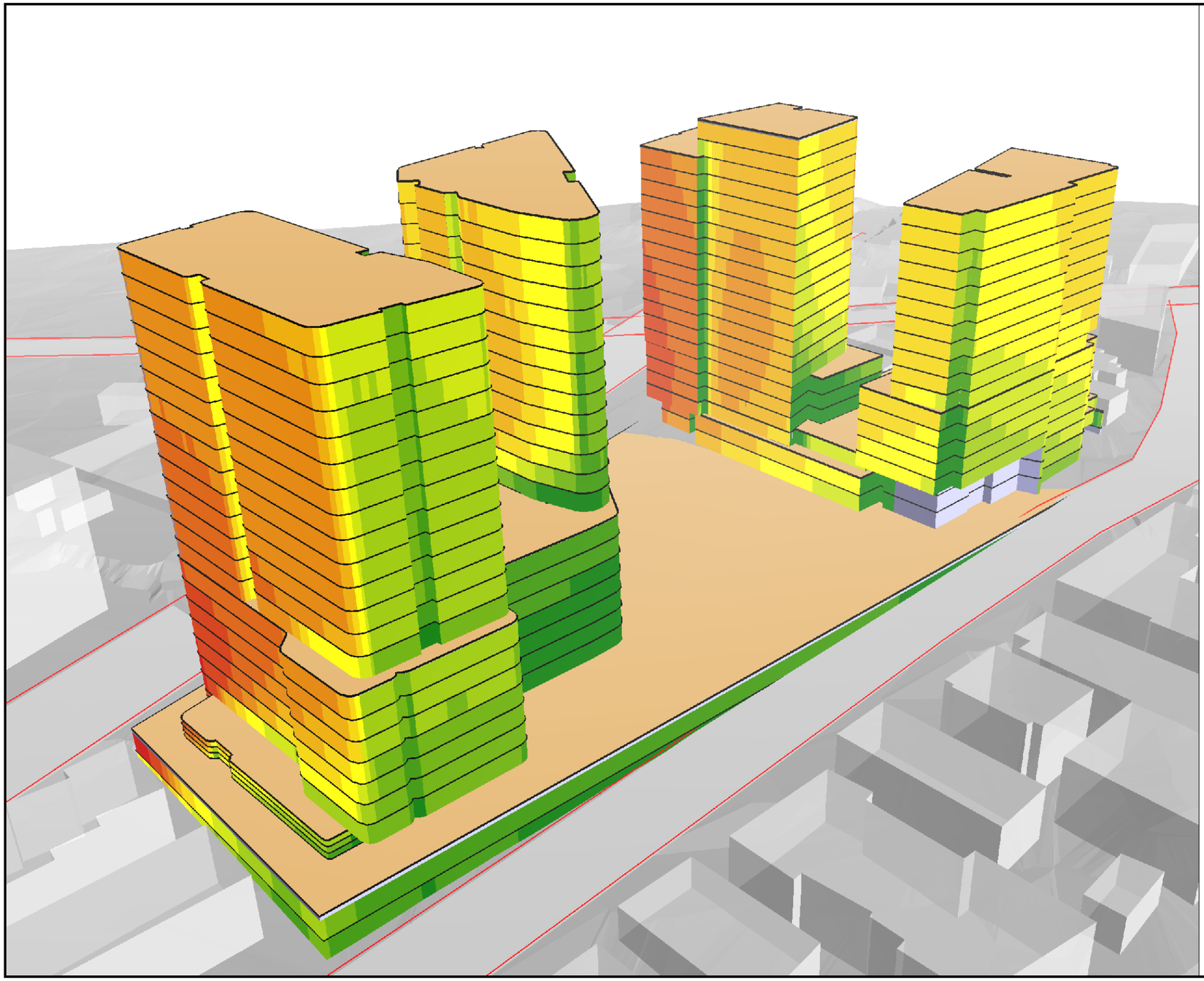
Noise level
LAeq(9h)
in dB(A)

	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Night-time

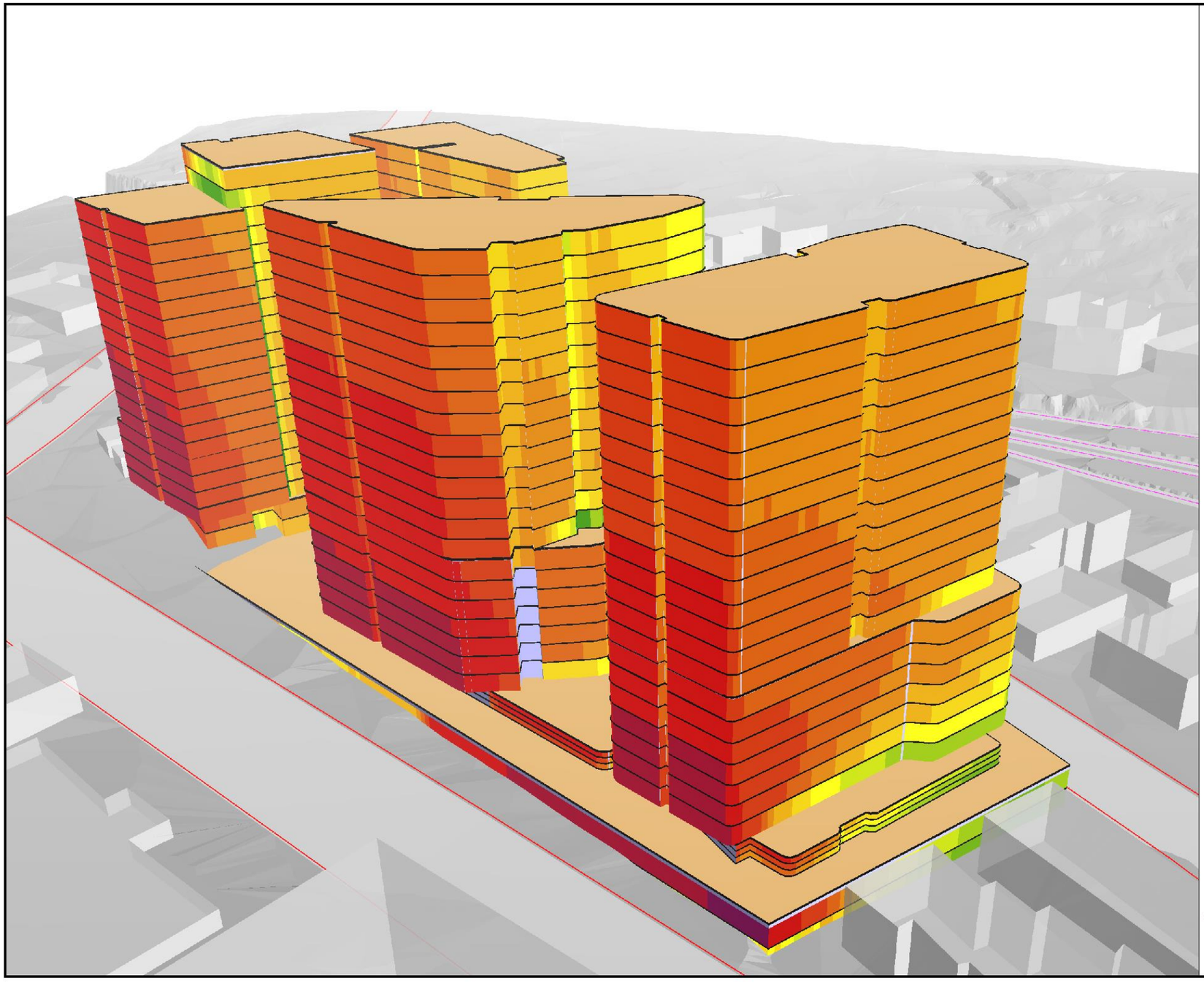
Noise level
LAeq(9h)
in dB(A)

	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Night-time

Noise level
LAeq(9h)
in dB(A)

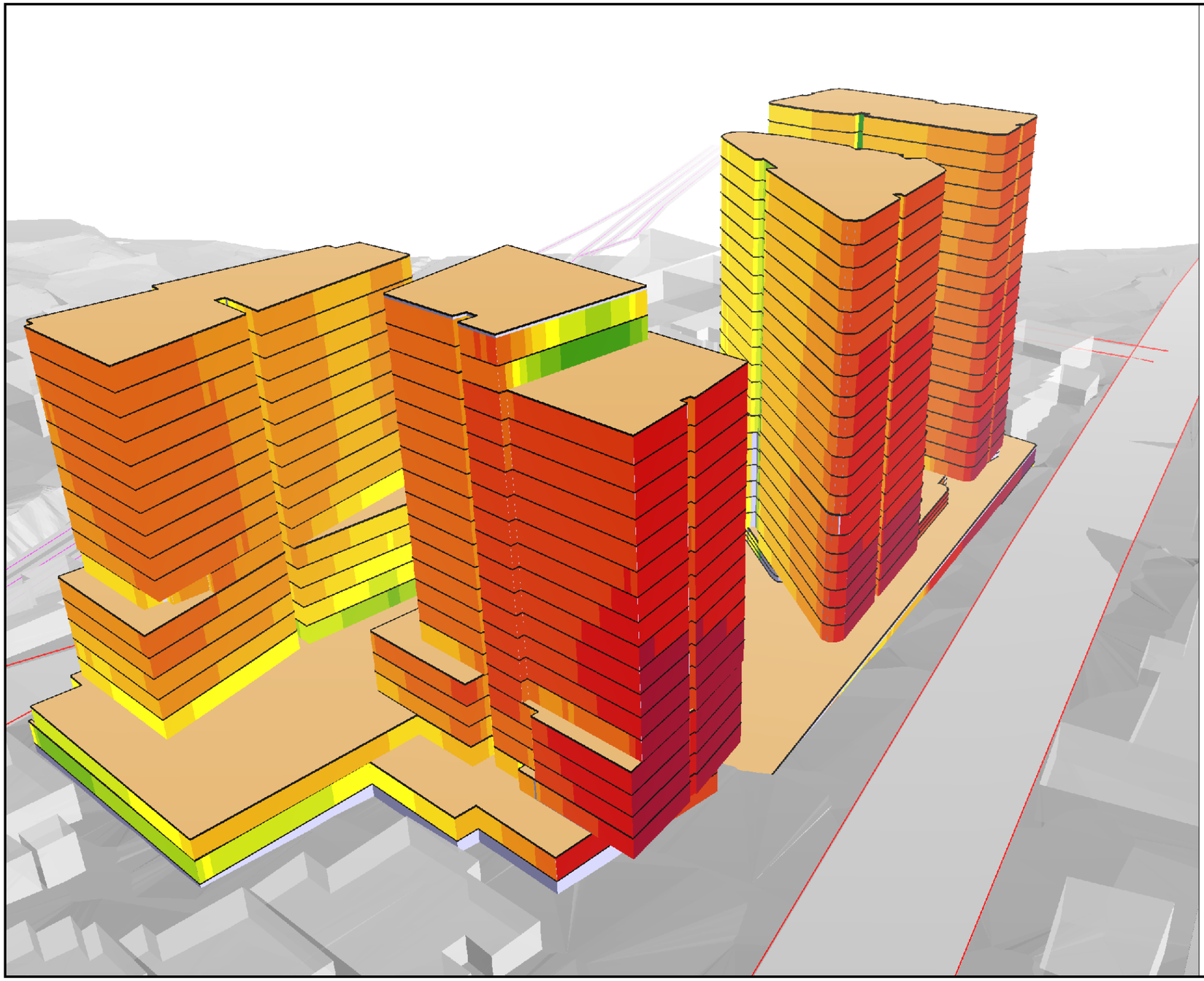
	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

N

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

Facade Noise map - Night-time

Noise level
LAeq(9h)
in dB(A)

	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	<= 70
70 <	<= 72
72 <	<= 74
74 <	<= 76
76 <	

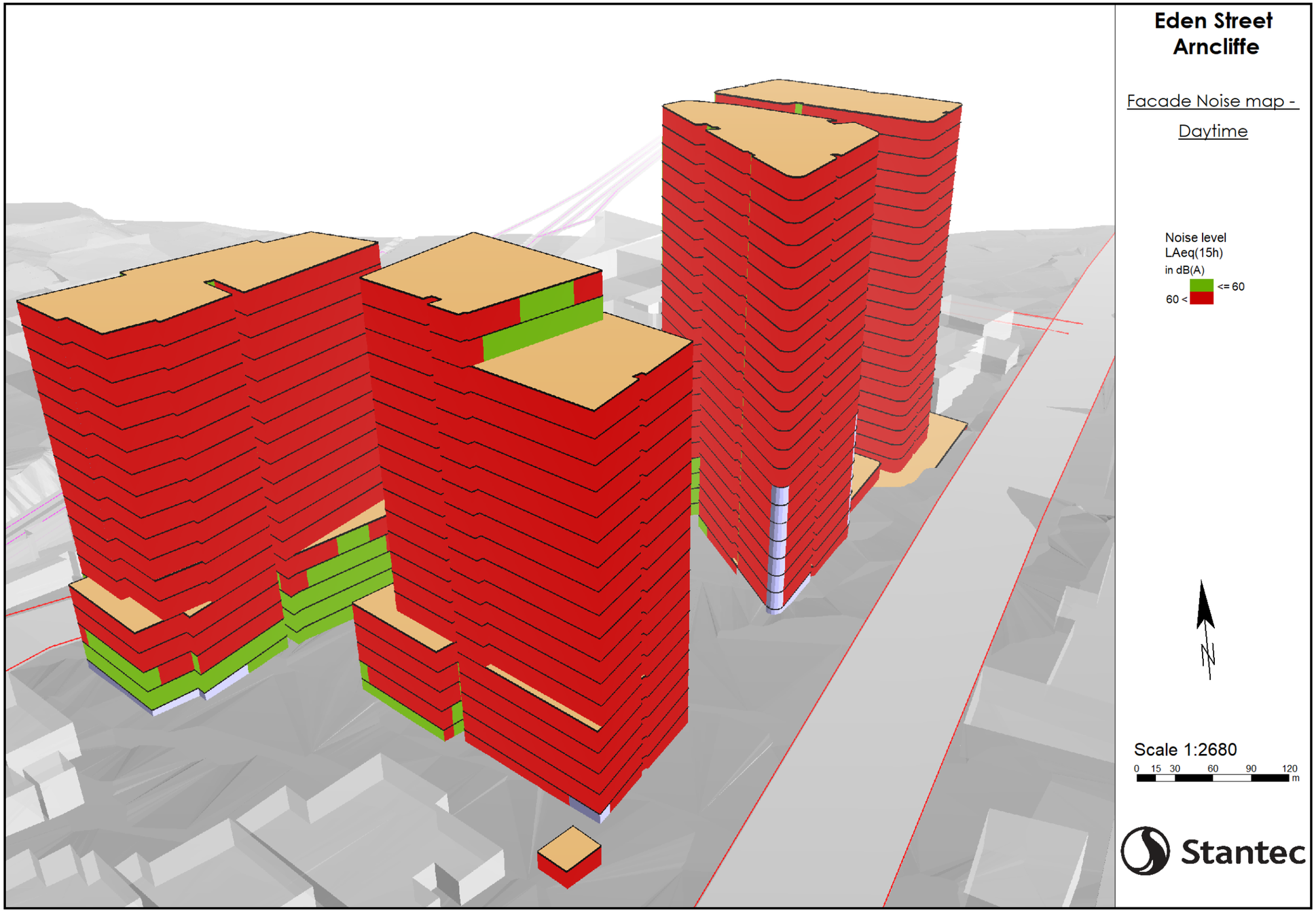
N

Scale 1:2680

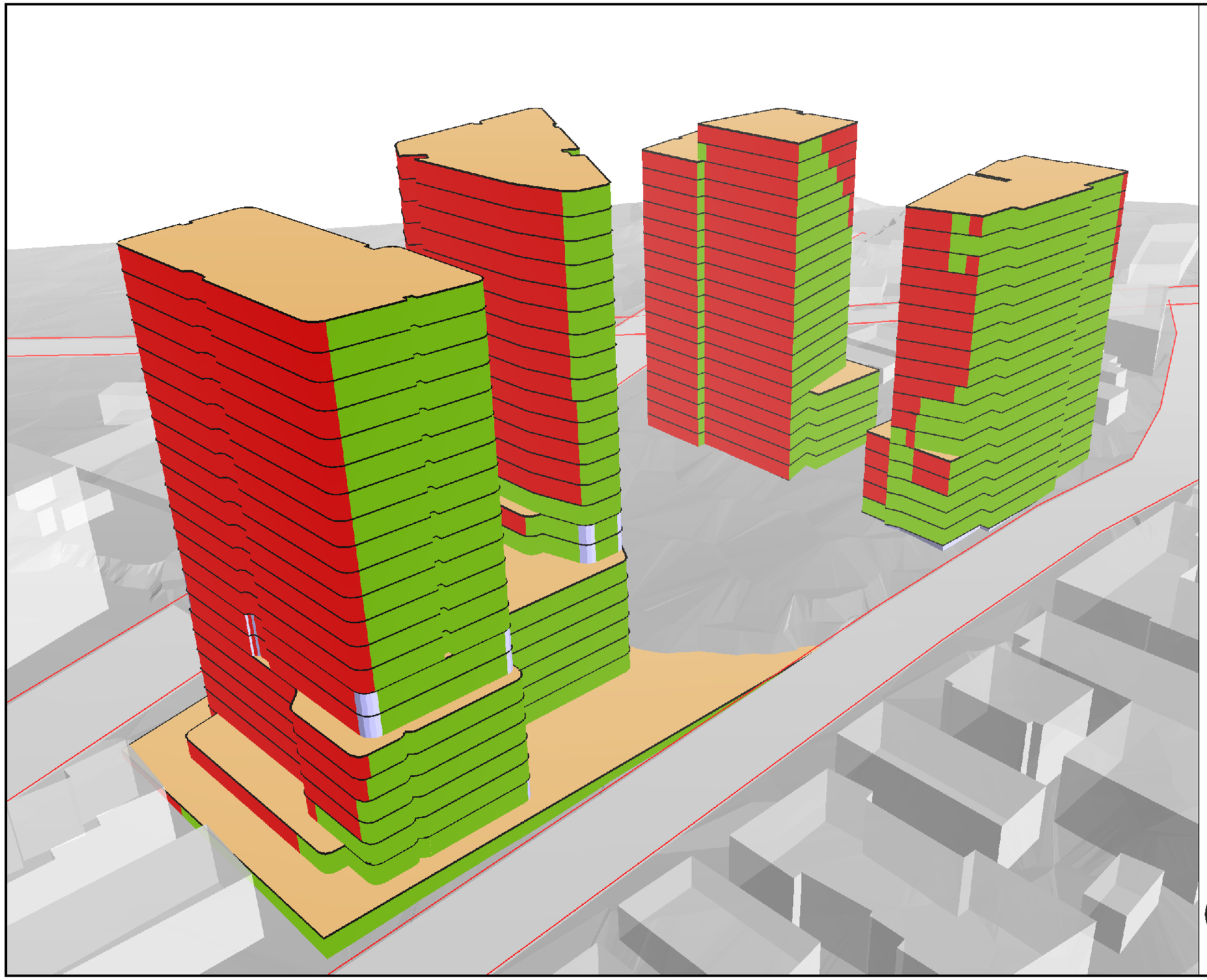
0 15 30 60 90 120 m

Stantec

Appendix C – Alternative Ventilation requirements




Eden Street
Arncliffe
Facade Noise map -
Daytime
Noise level
LAeq(15h)
in dB(A)
<= 60
60 <
Scale 1:2680
0 15 30 60 90 120
m
Stantec



Eden Street
Arncliffe

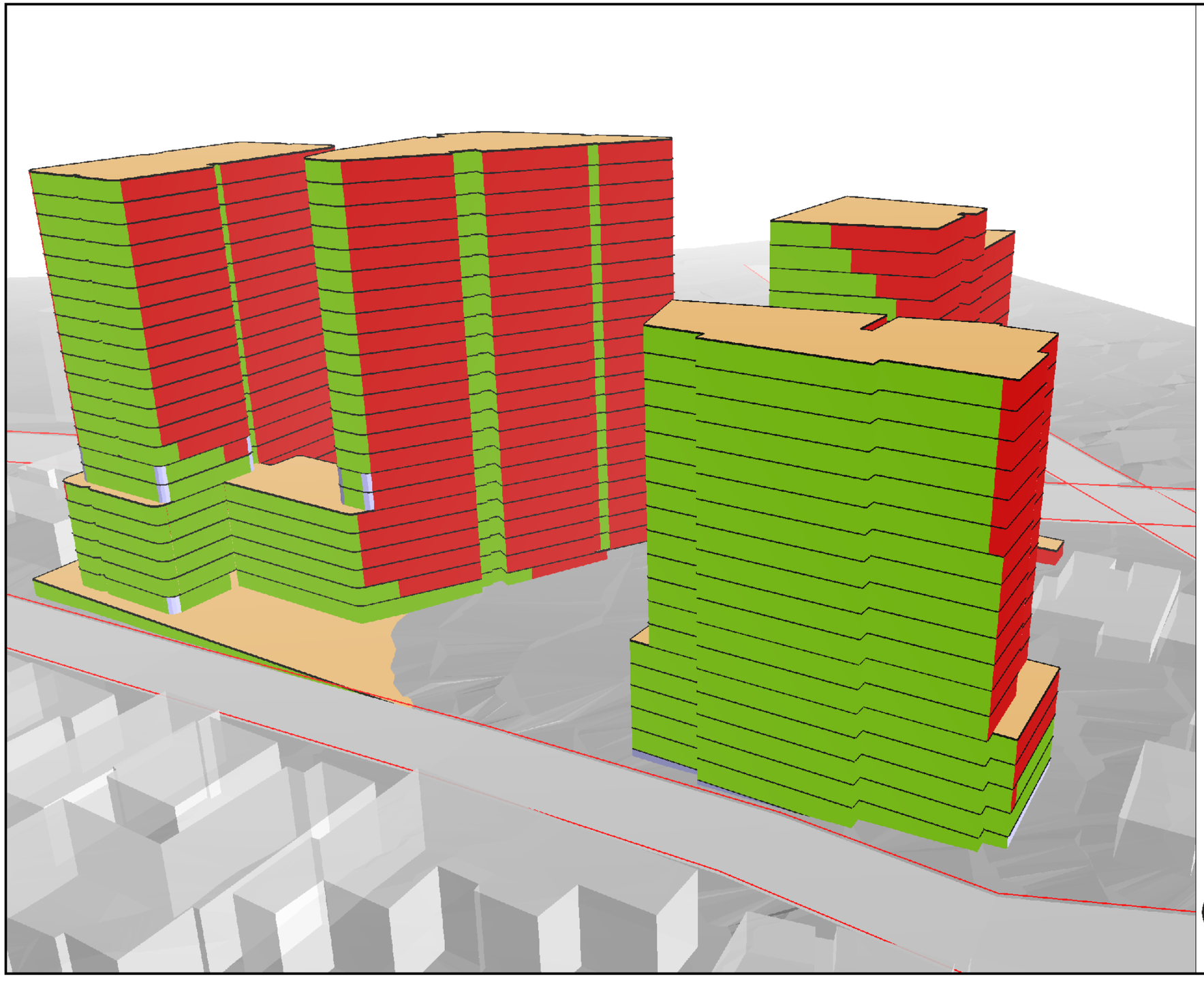
Facade Noise map -
Daytime

Noise level
LAeq(15h)
in dB(A)
<= 60
60 <

N

Scale 1:2680
0 15 30 60 90 120
m

Stantec



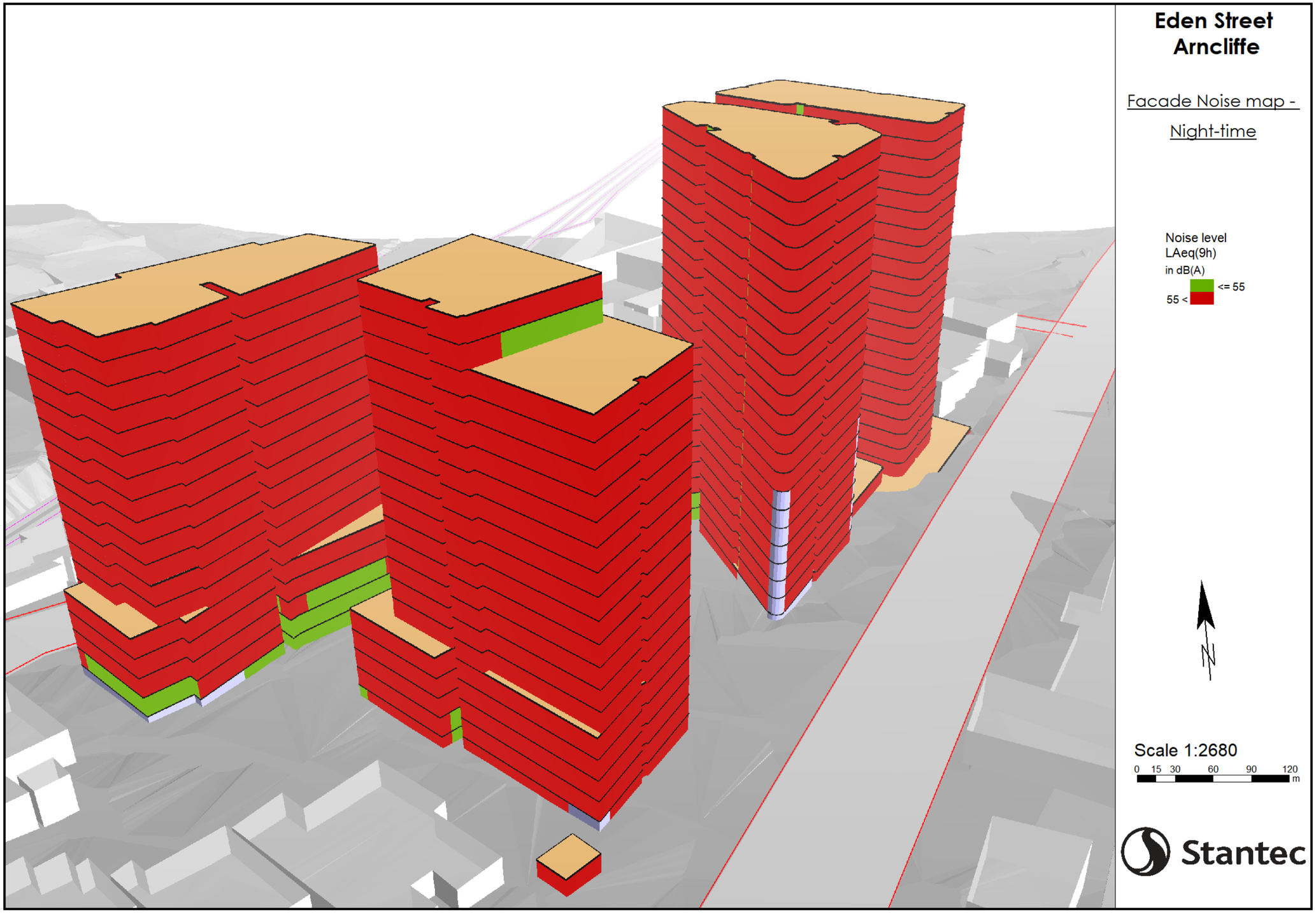
Eden Street Arncliffe

Facade Noise map - Daytime

Noise level
LAeq(15h)
in dB(A)
<= 60
60 <

Scale 1:2680
0 15 30 60 90 120 m

Stantec


Eden Street
Arncliffe
Facade Noise map -
Night-time
Noise level
LAeq(9h)
in dB(A)
<= 55
55 <
N
Scale 1:2680
0 15 30 60 90 120
m
Stantec

Eden Street Arncliffe

Facade Noise map - Night-time

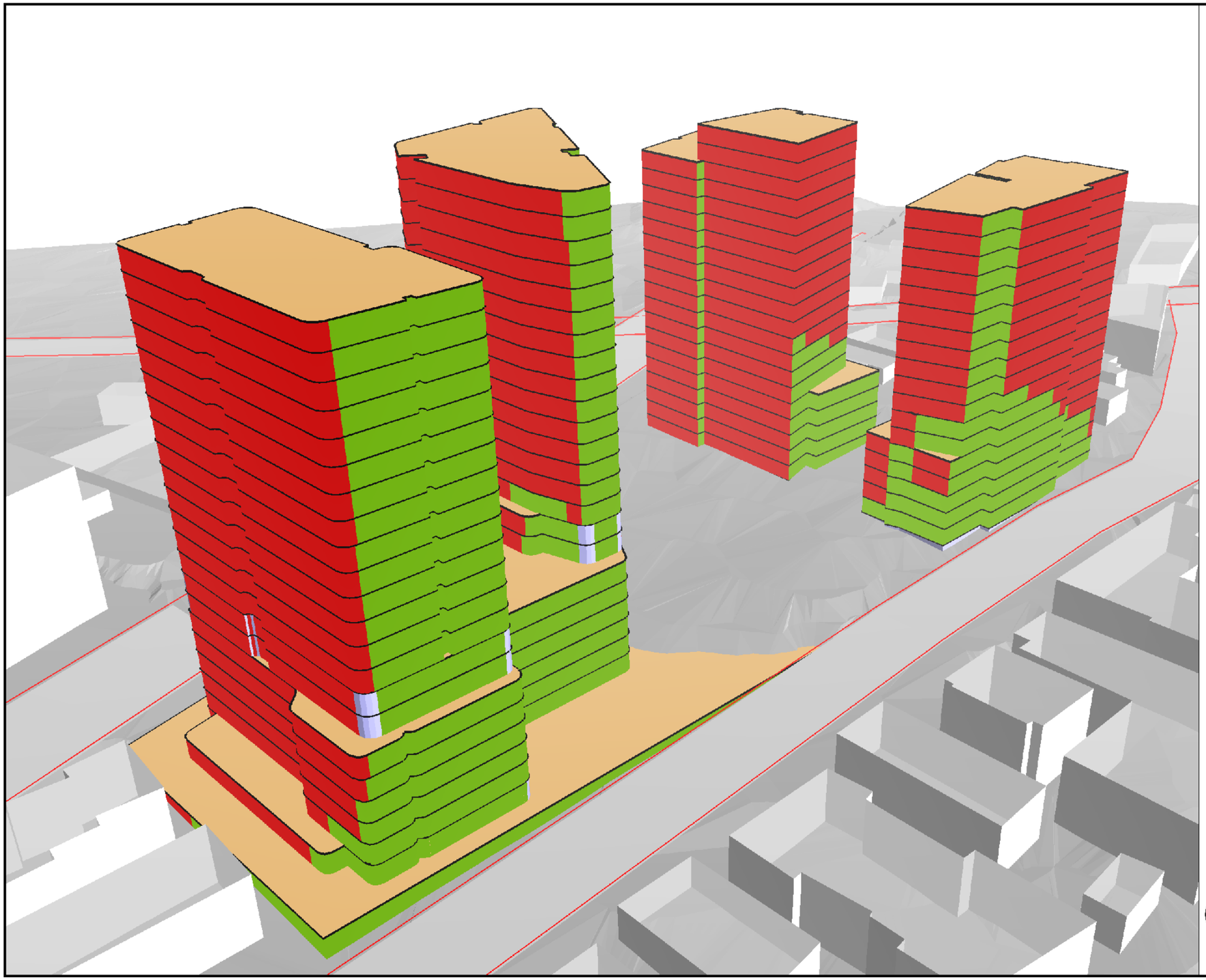
Noise level
LAeq(9h)
in dB(A)

<= 55
55 <

Scale 1:2680

0 15 30 60 90 120 m

Stantec



Eden Street Arncliffe

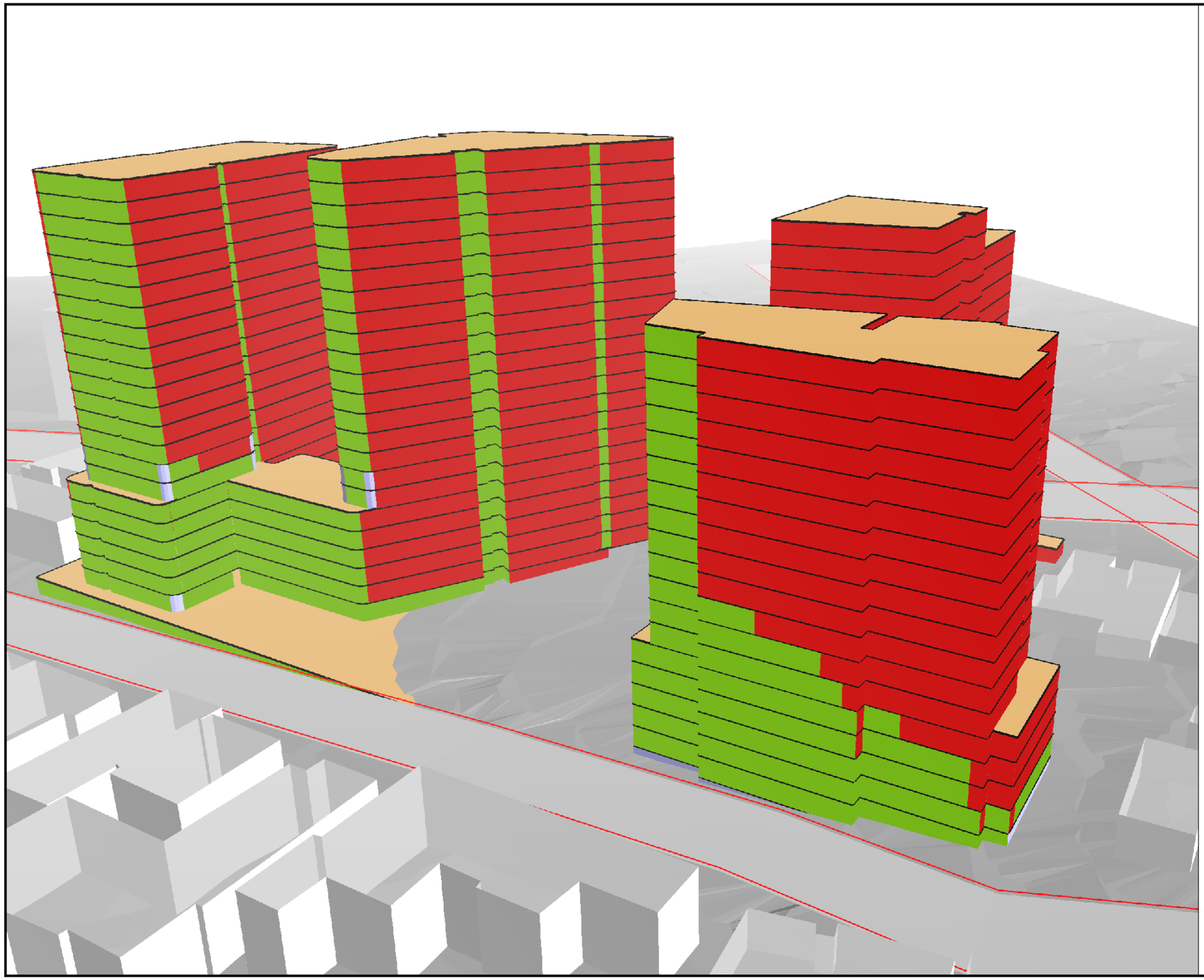
Facade Noise map - Night-time

Noise level
LAeq(9h)
in dB(A)
<= 55
55 <

N

Scale 1:2680
0 15 30 60 90 120
m

Stantec



Eden Street Arncliffe

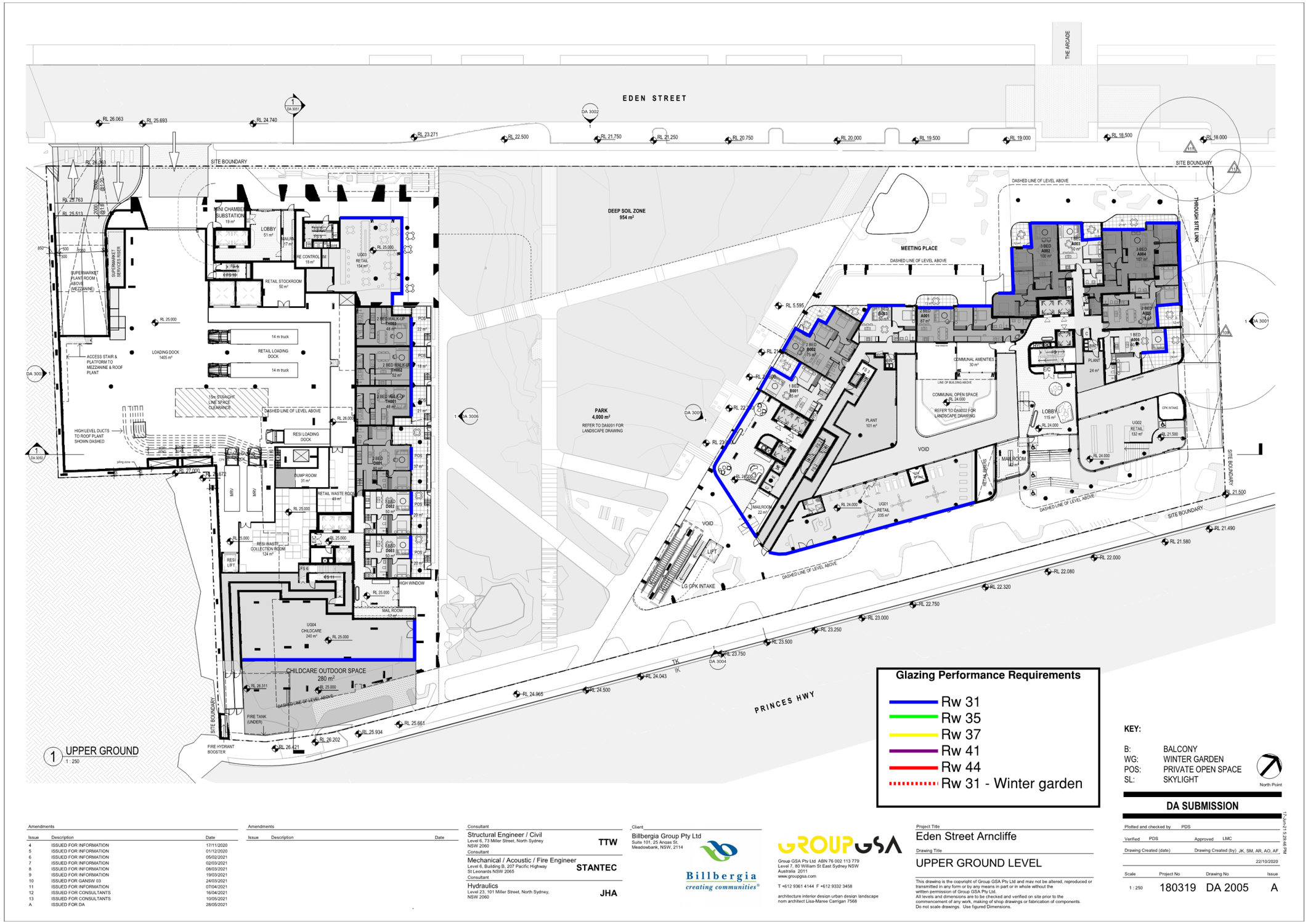
Facade Noise map - Night-time

Noise level
LAeq(9h)
in dB(A)
<= 55
55 <

Scale 1:2680
0 15 30 60 90 120
m

Stantec

Appendix D - Glazing Performance requirements



Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

Amendments

Issue	Description	Date
4	ISSUED FOR INFORMATION	17/11/2020
5	ISSUED FOR INFORMATION	01/12/2020
6	ISSUED FOR INFORMATION	05/02/2021
7	ISSUED FOR INFORMATION	02/03/2021
8	ISSUED FOR INFORMATION	08/03/2021
9	ISSUED FOR INFORMATION	19/03/2021
10	ISSUED FOR GANSW 03	24/03/2021
11	ISSUED FOR INFORMATION	07/04/2021
12	ISSUED FOR CONSULTANTS	16/04/2021
13	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant
Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant
Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client
Billbergia Group Pty Ltd
Suite 101, 25 Angas St, Meadowbank, NSW, 2114

Billbergia creating communities®

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Group GSA Pty Ltd ABN 76 002 113 779
Level 7, 80 William St East Sydney NSW Australia 2011
www.groupgsa.com

T +612 9361 4144 F +612 9332 3458

architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
UPPER GROUND LEVEL

Plotted and checked by PDS
Verified PDS Approved LMC
Drawing Created (date) Drawing Created (by) JK, SM, AR, AO, AF
22/10/2020

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2005	A

EDEN STREET

1 LEVEL 1
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

Plotted and checked by PDS

Verified PDS Approved LMC

Drawing Created (date) Drawing Created (by) JK, SM, AR, AO, AF,

22/10/2020

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2006	A

Amendments

Issue	Description	Date
2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	16/11/2020
5	ISSUED FOR INFORMATION	17/11/2020
6	ISSUED FOR INFORMATION	01/12/2020
7	ISSUED FOR INFORMATION	08/03/2021
8	ISSUED FOR GANSW 03	24/03/2021
9	ISSUED FOR INFORMATION	07/04/2021
10	ISSUED FOR CONSULTANTS	16/04/2021
11	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant
Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant
Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client
Billbergia Group Pty Ltd
Suite 101, 25 Angas St.
Meadowbank, NSW, 2114

Billbergia creating communities

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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 1

1 GA - LV 2
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

TYPICAL Level 2 - 5

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

Amendments

Issue	Description	Date
1	ISSUED FOR INFORMATION	08/03/2021
2	ISSUED FOR GANSW 03	24/03/2021
3	ISSUED FOR INFORMATION	07/04/2021
4	ISSUED FOR CONSULTANTS	16/04/2021
5	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant
Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant
Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client
Billbergia Group Pty Ltd
Suite 101, 25 Angas St.
Meadowbank, NSW, 2114

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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 2

Plotted and checked by PDS
Verified PDS Approved LMC
Drawing Created (date) Drawing Created (by) JK, SM, AR, AO, AF,
12/02/20

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2007	A

24-May-21 8:36:19 PM

EDEN STREET

1 LEVEL 6-7
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-May-21 8:32:32 PM

Amendments

Issue	Description	Date
-	ISSUED FOR CONSULTANTS	22/10/2020
1	ISSUED FOR PRE DA	29/10/2020
2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	01/12/2020
5	ISSUED FOR INFORMATION	08/03/2021
6	ISSUED FOR GANSW 03	24/03/2021
7	ISSUED FOR INFORMATION	07/04/2021
8	ISSUED FOR CONSULTANTS	16/04/2021
9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant

Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060
Consultant

Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065
Consultant

Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client

Billbergia Group Pty Ltd
Suite 101, 25 Angas St.
Meadowbank, NSW, 2114

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Australia 2011
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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 6

Plotted and checked by	PDS		
Verified	PDS	Approved	LMC
Drawing Created (date)		Drawing Created (by)	JK, SM, AR, AO, AF,
			22/10/2020

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2011	A

EDEN STREET

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

PRINCES HWY

DASHED LINE OF LEVEL ABOVE

REFER TO DA9203 FOR LANDSCAPE DRAWING

LEVEL 7
COMMUNAL OPEN SPACE
RL 46.900

RL 47.700

RL 46.900

DA 3001

DA 3002

DA 3003

DA 3004

DA 3005

DA 3006

1 GA - LV 7
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-May-21 8:58:47 PM

Amendments

Issue	Description	Date
-	ISSUED FOR INFORMATION	08/03/2021
1	ISSUED FOR GANSW 03	24/03/2021
2	ISSUED FOR INFORMATION	07/04/2021
3	ISSUED FOR CONSULTANTS	16/04/2021
4	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant

Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060
Consultant

Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065
Consultant

Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client

Billbergia Group Pty Ltd
Suite 101, 25 Angas St.
Meadowbank, NSW, 2114

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Australia 2011
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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 7

Plotted and checked by	PDS		
Verified	PDS	Approved	LMC
Drawing Created (date)		Drawing Created (by)	JK, SM, AR, AO, AF,
			12/08/20

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2012	A

EDEN STREET

1 LEVEL 8-14
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-Nov-21 8:33:17 PM

Amendments

Issue	Description	Date
1	ISSUED FOR PRE DA	29/10/2020
2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	17/11/2020
5	ISSUED FOR INFORMATION	01/12/2020
6	ISSUED FOR INFORMATION	08/03/2021
7	ISSUED FOR GANSW 03	24/03/2021
8	ISSUED FOR INFORMATION	07/04/2021
9	ISSUED FOR CONSULTANTS	16/04/2021
10	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant
Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant
Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client
Billbergia Group Pty Ltd
Suite 101, 25 Angas St
Meadowbank, NSW, 2114

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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 8-12

Plotted and checked by	PDS
Verified	PDS
Approved	LMC
Drawing Created (date)	22/10/2020
Drawing Created (by)	JK, SM, AR, AO, AF,

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2013	A

EDEN STREET

1 GA - LV 13-15
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-May-21 8:33:34 PM

Plotted and checked by PDS

Verified PDS Approved LMC

Drawing Created (date) Drawing Created (by) JK, SM, AR, AO, AF,

03/08/21

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2018	A

Amendments

Issue	Description	Date
-	ISSUED FOR INFORMATION	08/03/2021
1	ISSUED FOR GANSW 03	24/03/2021
2	ISSUED FOR INFORMATION	07/04/2021
3	ISSUED FOR CONSULTANTS	16/04/2021
4	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant
Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant
Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client
Billbergia Group Pty Ltd
Suite 101, 25 Angas St, Meadowbank, NSW, 2114

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Group GSA Pty Ltd ABN 76 002 113 779
Level 7, 80 William St East Sydney NSW Australia 2011
www.groupgsa.com

T +612 9361 4144 F +612 9332 3458

architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 13-15

EDEN STREET

SITE BOUNDARY

SITE BOUNDARY

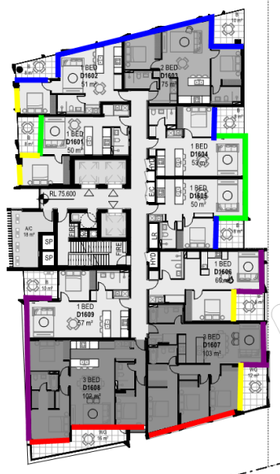
SITE BOUNDARY

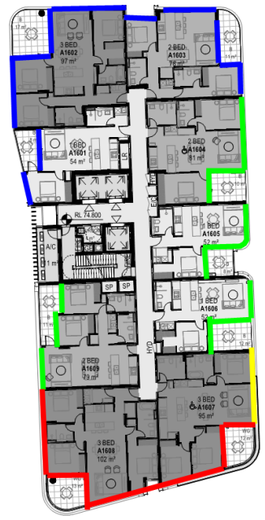
SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

PRINCES HWY





1 GA - LV 16-17
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

Amendments

Issue	Description	Date
-	ISSUED FOR CONSULTANTS	22/10/2020
1	ISSUED FOR PRE DA	29/10/2020
2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	01/12/2020
5	ISSUED FOR INFORMATION	08/03/2021
6	ISSUED FOR GANSW 03	24/03/2021
7	ISSUED FOR INFORMATION	07/04/2021
8	ISSUED FOR CONSULTANTS	16/04/2021
9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant

Structural Engineer / Civil — TTW
Level 6, 73 Miller Street, North Sydney NSW 2060

Consultant

Mechanical / Acoustic / Fire Engineer — STANTEC
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065

Consultant

Hydraulics — JHA
Level 23, 101 Miller Street, North Sydney, NSW 2060

Client

Billbergia Group Pty Ltd
Suite 101, 25 Angas St.
Meadowbank, NSW, 2114

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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 16-17

Plotted and checked by	PDS
Verified	PDS
Approved	LMC
Drawing Created (date)	22/10/2020
Drawing Created (by)	JK, SM, AR, AO, AF,

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2021	A

24-Aug-21 8:30:11 PM

EDEN STREET

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

PRINCES HWY

DA 3001

DA 3002

DA 3003

DA 3004

DA 3005

DA 3006

DA 3050

1 GA - LV 18
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-July-21 8:30:28 PM

Plotted and checked by PDS

Verified PDS Approved LMC

Drawing Created (date) Drawing Created (by) JK, SM, AR, AO, AF,

22/10/2020

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2023	A

Amendments

Issue	Description	Date
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2	ISSUED FOR INFORMATION	05/11/2020
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8	ISSUED FOR CONSULTANTS	16/04/2021
9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant

Structural Engineer / Civil
Level 6, 73 Miller Street, North Sydney
NSW 2060
TTW

Consultant

Mechanical / Acoustic / Fire Engineer
Level 6, Building B, 207 Pacific Highway
St Leonards NSW 2065
STANTEC

Consultant

Hydraulics
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NSW 2060
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architecture interior design urban design landscape
nom architect Lisa-Maree Carrigan 7568

Project Title

Eden Street Arncliffe

Drawing Title

Level 18

EDEN STREET

1 LEVEL 19
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24th July 2020 8:13:10 PM

Plotted and checked by PDS

Verified PDS Approved LMC

Drawing Created (date) 22/10/2020 Drawing Created (by) JK, SM, AR, AO, AF,

Scale	Project No	Drawing No	Issue
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Amendments

Issue	Description	Date
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3	ISSUED FOR INFORMATION	12/11/2020
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5	ISSUED FOR INFORMATION	08/03/2021
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7	ISSUED FOR INFORMATION	07/04/2021
8	ISSUED FOR CONSULTANTS	16/04/2021
9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil
Level 6, 73 Miller Street, North Sydney NSW 2060
TTW

Consultant
Mechanical / Acoustic / Fire Engineer
Level 6, Building B, 207 Pacific Highway St Leonards NSW 2065
STANTEC

Consultant
Hydraulics
Level 23, 101 Miller Street, North Sydney, NSW 2060
JHA

Client
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Meadowbank, NSW, 2114

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nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 19

EDEN STREET

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

SITE BOUNDARY

PRINCES HWY

TOW 86.700

TOW 86.700

TOW 86.700

TOW 86.700

TOW 86.700

TOW 86.700

TOW 86.700

TOW 86.700

RL 89.650
LIFT OVERRUN

RL 88.200

TOWER C - ROOF
COMMUNAL OPEN SPACE
LEVEL 18
RL 84.900

SL

SL

TOW 86.000

TOW 86.000

TOW 86.000

TOW 86.000

TOW 86.000

TOW 86.000

TOWER D - ROOF
COMMUNAL OPEN SPACE
LEVEL 19
RL 85.000

FAN

SL

RL 87.200

DA 3002 1

DA 3003 1

DA 3005 1

DA 3004 1

DA 3001 1

1 DA 3002

1 DA 3001

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

1 LEVEL 20
1 : 250

Amendments

Issue	Description	Date
-	ISSUED FOR CONSULTANTS	22/10/2020
1	ISSUED FOR PRE DA	29/10/2020
2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	01/12/2020
5	ISSUED FOR INFORMATION	08/03/2021
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7	ISSUED FOR INFORMATION	07/04/2021
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9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant

Structural Engineer / Civil
Level 6, 73 Miller Street, North Sydney
NSW 2060
Consultant
TTW

Mechanical / Acoustic / Fire Engineer
Level 6, Building B, 207 Pacific Highway
St Leonards NSW 2065
Consultant
STANTEC

Hydraulics
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NSW 2060
JHA

Client

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nom architect Lisa-Maree Carrigan 7568

Project Title

Eden Street Arncliffe

Drawing Title

Level 20

Plotted and checked by	PDS
Verified	PDS
Approved	LMC
Drawing Created (date)	22/10/2020
Drawing Created (by)	JK, SM, AR, AO, AF,

Scale	Project No	Drawing No	Issue
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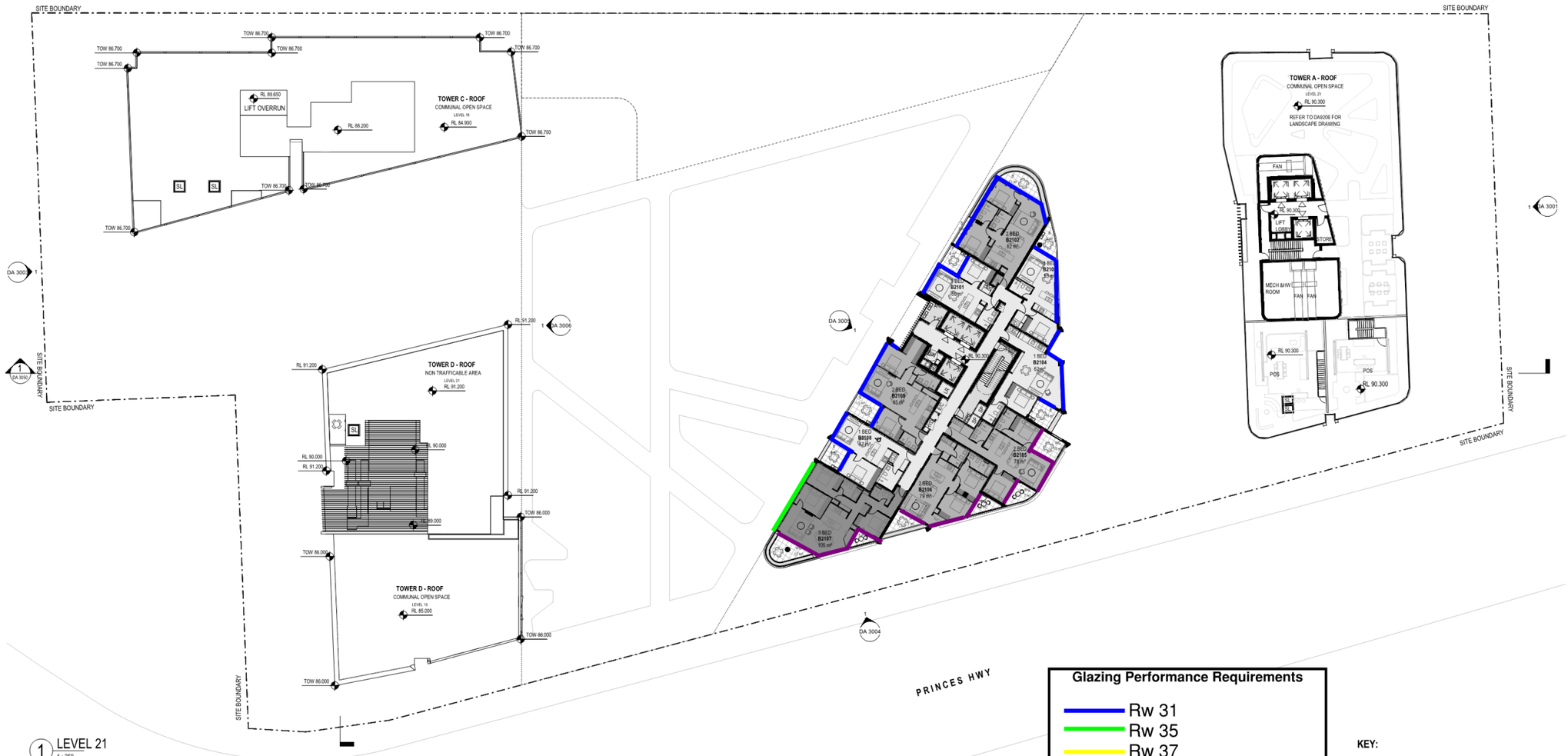
EDEN STREET



1 LEVEL 21
1 : 250

Glazing Performance Requirements

- Rw 31
- Rw 35
- Rw 37
- Rw 41
- Rw 44
- Rw 31 - Winter garden

KEY:

B:	BALCONY
WG:	WINTER GARDEN
POS:	PRIVATE OPEN SPACE
SL:	SKYLIGHT

North Point

DA SUBMISSION

24-May-21 8:32:27 PM

Amendments

Issue	Description	Date
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2	ISSUED FOR INFORMATION	05/11/2020
3	ISSUED FOR INFORMATION	12/11/2020
4	ISSUED FOR INFORMATION	01/12/2020
5	ISSUED FOR INFORMATION	08/03/2021
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7	ISSUED FOR INFORMATION	07/04/2021
8	ISSUED FOR CONSULTANTS	16/04/2021
9	ISSUED FOR CONSULTANTS	10/05/2021
A	ISSUED FOR DA	28/05/2021

Amendments

Issue	Description	Date

Consultant
Structural Engineer / Civil
Level 6, 73 Miller Street, North Sydney NSW 2060
TTW

Consultant
Mechanical / Acoustic / Fire Engineer
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nom architect Lisa-Maree Carrigan 7568

Project Title
Eden Street Arncliffe

Drawing Title
Level 21

Plotted and checked by	PDS		
Verified	PDS	Approved	LMC
Drawing Created (date)		Drawing Created (by)	JK, SM, AR, AO, AF,
			22/10/2020

Scale	Project No	Drawing No	Issue
1 : 250	180319	DA 2026	A

Figure 17: Demolition Phase with mitigation

Figure 18: Demolition Phase with mitigation

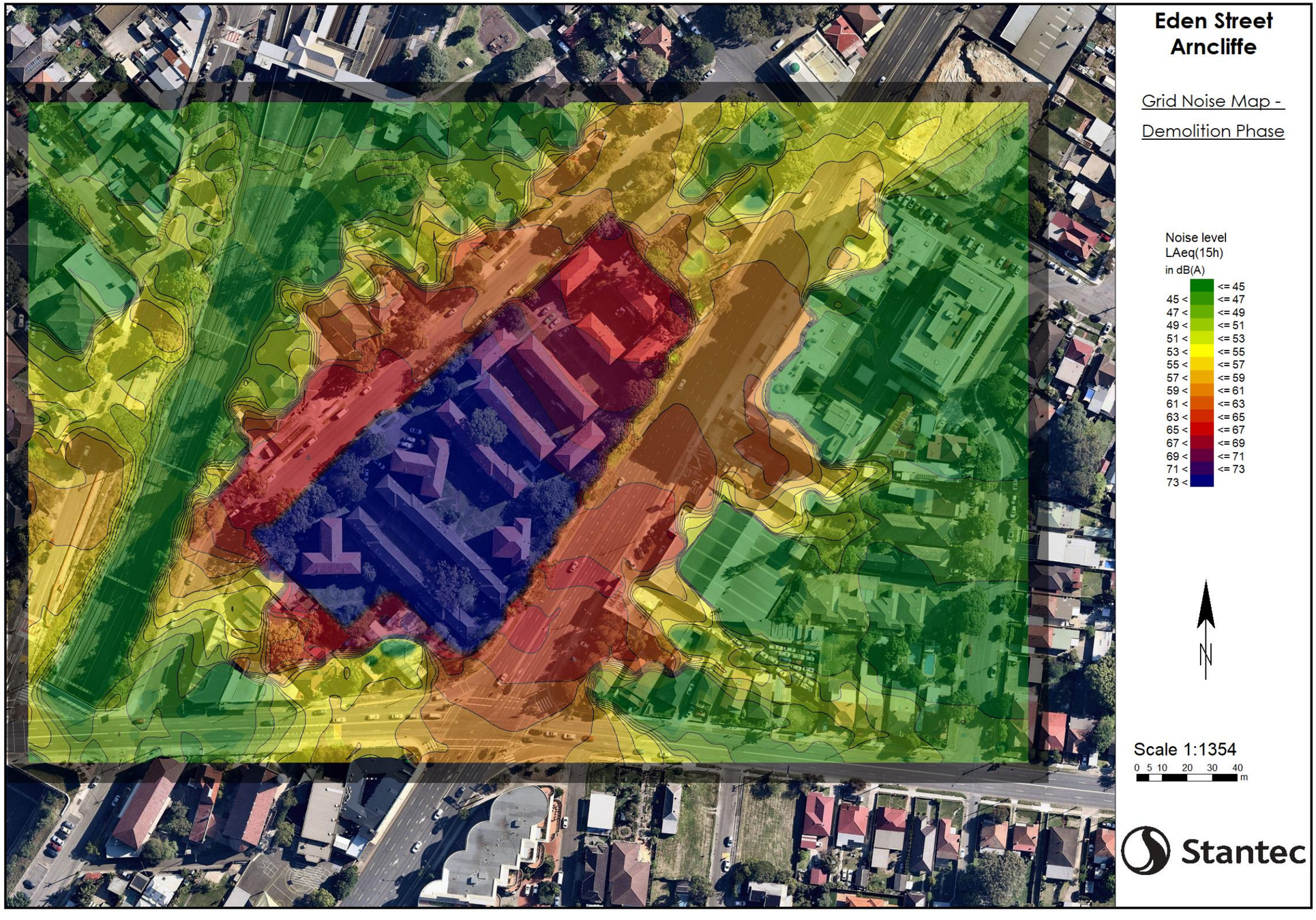


Figure 19: Excavation Phase with mitigation

Figure 20: Excavation Phase with mitigation

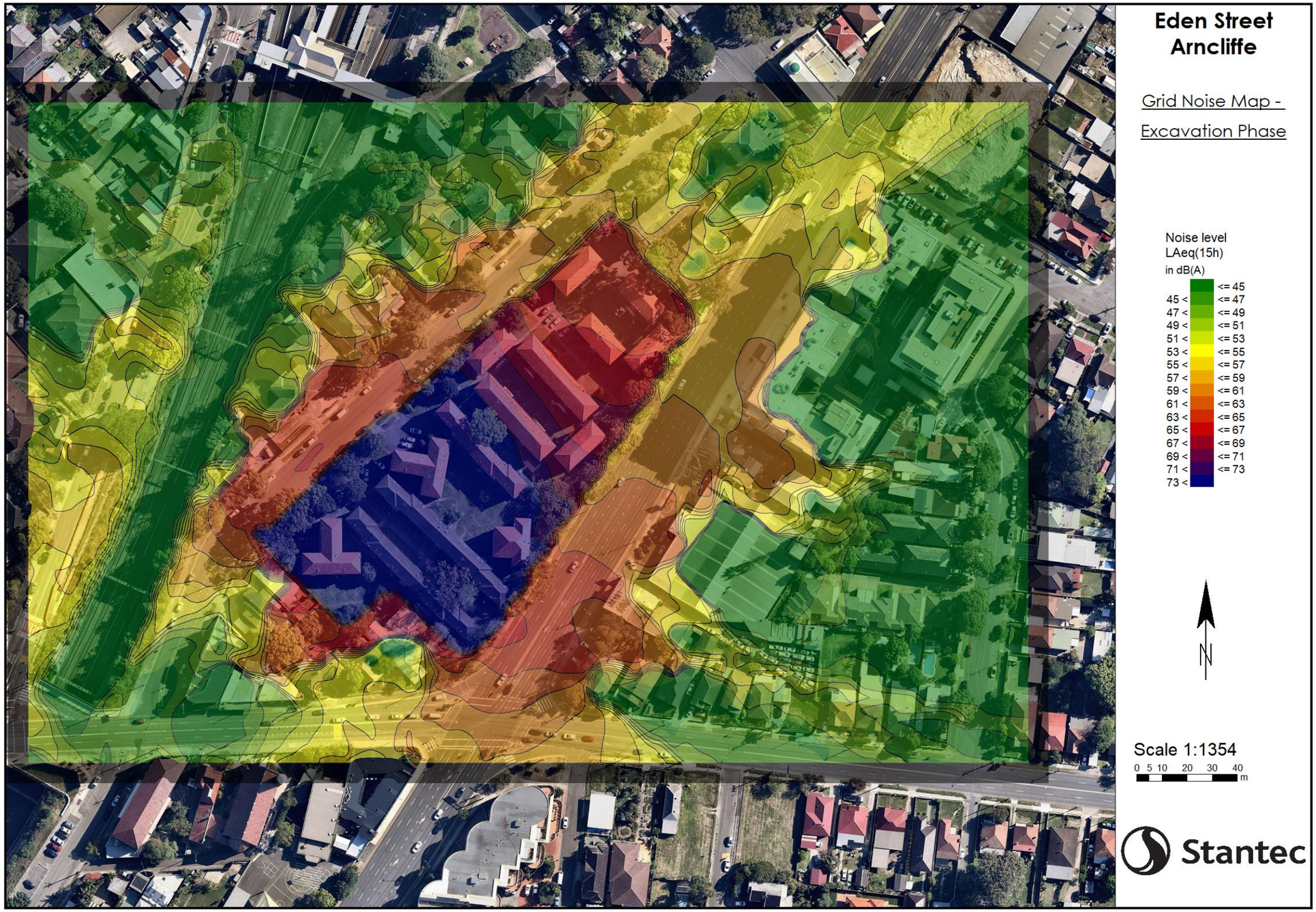


Figure 21: Construction Phase with mitigation

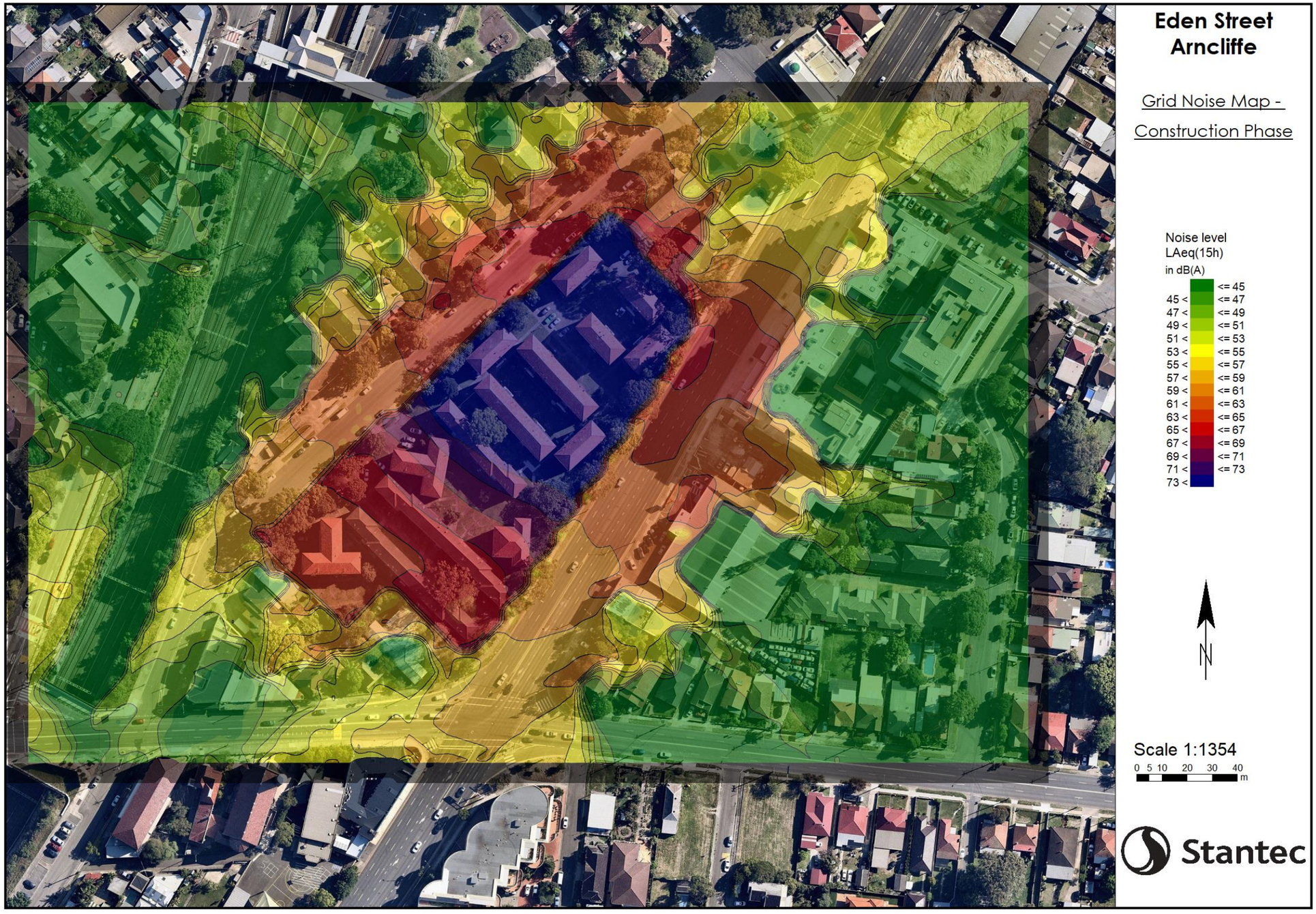
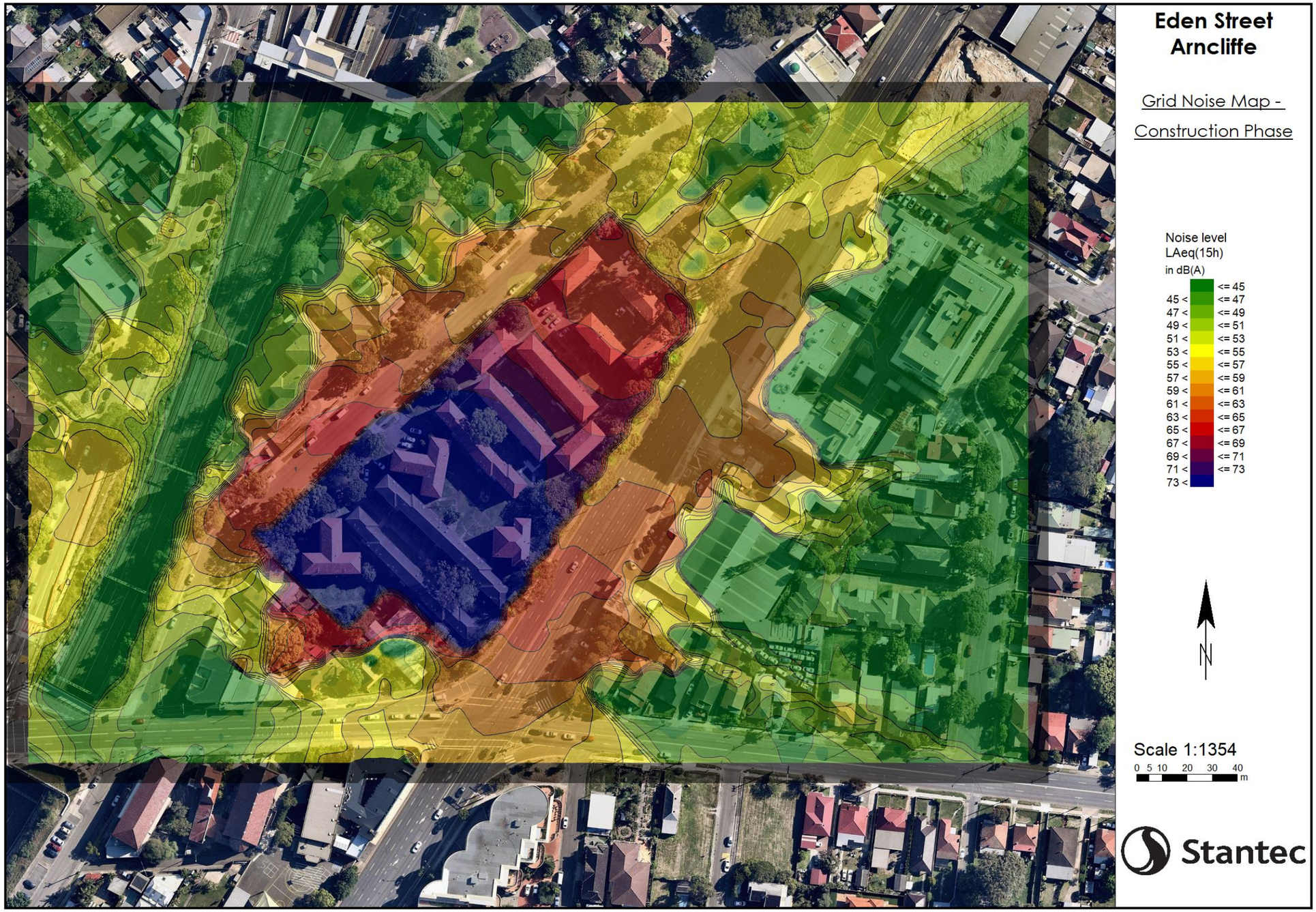
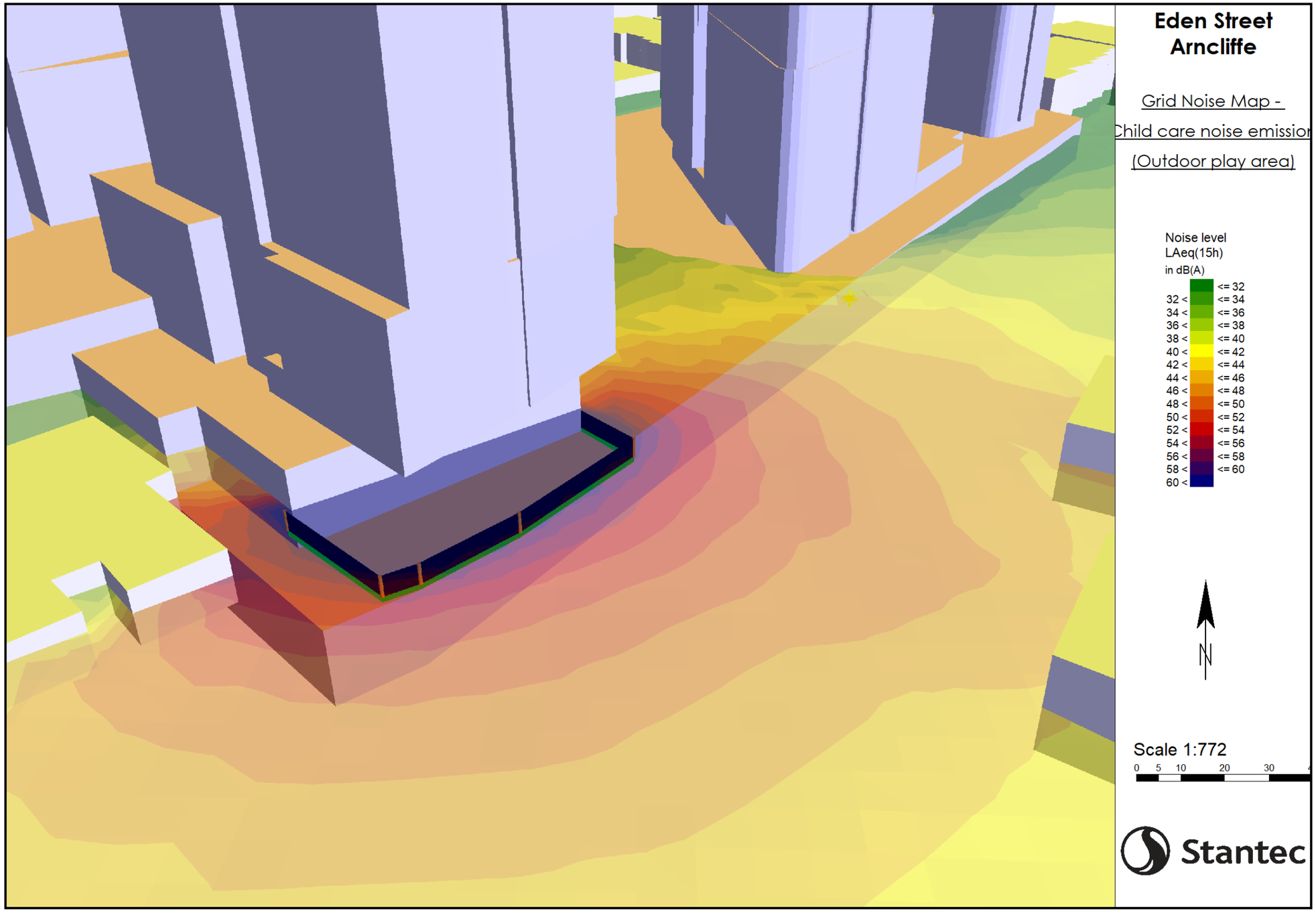


Figure 22: Construction Phase with mitigation



Appendix F – Childcare Noise Emissions Modelling & Mapping



Appendix G – Response to LAHC Comments

Stantec

Memo

Project:	26-42 Eden Street and 161-179 Princes Highway, Arncliffe	**Project No:**	301350058
To:	Billbergia	**Date:**	29 June 2021
From:	Mathew McGrory		

RE: LAHC Comments – Mechanical Services Noise Assessment for Building C

This letter has been prepared by Stantec to address the comments/queries raised by the Land and Housing Corporation (LAHC). The comments addressed within this memo include the following:

- *"Noted recommendations for noise attenuation measures to the plant area on Building C/D podium but not clear on actual impact.*
- *Could the consultant clarify what the anticipated noise level will be at balconies and windows of the near by Building C units? Taking into account the estimated operational noise of the air con units and exhaust fans at full power?"*

A preliminary noise assessment has been undertaken to predict the cumulative noise impacts from the proposed mechanical plant to the façade of Building C against the relevant noise criteria established within the Acoustic Report for SSDA. The main contributing mechanical noise sources on Building C façade include the retail plant located on Level 01 & Level 02 and has included the proposed mitigation measures as shown within the acoustic report. Note that the assessment has only been conducted with the data provided by the mechanical engineer to date, additional information and plant is expected and will be addressed throughout later stages of design.

The predicted noise levels at the most affected point of the façade of Tower C is shown in Table 1 below.

Location	Predicted Noise Level $L_{eq,\ 15\ min}$ dB(A)	Noise Criteria $L_{eq,\ 15\ min}$ dB(A)
Building C façade	42	43 (night-time)

Table 1: Predicted Noise Level of Mechanical Plant at Building C Façade

Based on the assessment provided above, the predicted noise levels of the proposed mechanical plant are compliant with the relevant noise criteria. Nevertheless, a detailed review of the mechanical plant will be conducted prior to Construction Certificate to ensure further noise controls are incorporated within the design to meet the relevant noise criteria.

Yours sincerely

Mathew McGrory
Acoustics Section Manager
Stantec Australia Pty Ltd

Design with
community in mind

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207 Pacific Highway
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Tel +61 +61 2 8484 7000

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Stantec