



**Independent Acoustic
Consultancy Practice**

Environmental Noise Assessment

**Land off Elizabeth Way
Trowbridge**

6058/ENS1_Rev1

Environmental Noise Assessment

Project:	Land off Elizabeth Way
Site Address:	Hilperton Trowbridge Wiltshire BA14
HA Reference:	6058/ENS1_Rev1
Date:	16/07/2021
Client:	Bellway Homes (South West) 1 st Floor - 2540 The Quadrant Aztec West Almondsbury Bristol BS32 4AQ
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		Description	Amendments to site proposals - plots 32 & 128/129 garden walls are to be increased to 2.2m high.	
			Prepared by:	Checked by:
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1. INTRODUCTION

We understand a residential development consisting of 151no dwellings is proposed on Land off Elizabeth Way, Hilperton, Trowbridge, Wiltshire, BA14. The site is situated in proximity of the Elizabeth Way road; where the nearest proposed dwelling-house is approximately 25m away.

The Local Planning Authority have requested a noise impact assessment is submitted to accompany the reserved matters application.

This report has therefore been commissioned to assess existing ambient and background noise levels impinging on the site from local sources.

Survey results have been used for comparison with typical Local Authority Planning conditions and current planning guidance.

2. CRITERIA

2.1 Planning Conditions

The following noise related planning conditions have been included on the planning consent;

“13

Prior to the commencement of development a noise mitigation scheme shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall achieve the habitable room standard as detailed in BS8233:2014 'Guidance on sound insulation and noise reduction for buildings' with no relaxation for exceptional circumstances unless agreed in writing with the local planning authority and must include details of post construction validation. The approved noise and vibration attenuation measures shall thereafter be retained and maintained in working order for the duration of the use in accordance with the approved details.

REASON: In the interest of Residential Amenity.

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Prior to the commencement of development a scheme of measures to ensure noise levels in all private amenity spaces within that phase or sub phase do not exceed the BS8233:2014 upper guideline value of 55dB shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall include details of post construction validation. Thereafter the development shall be carried out in accordance with the approved details and a separate validation report shall be submitted to and approved in writing by the Local Planning Authority prior to occupation.

REASON: In the interest of Residential Amenity.”

2.2 British Standard 8233:2014

British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings' includes internal noise criteria of habitable rooms in residential dwellings, as shown below;

Table 2.1 – BS 8233:2014 Internal Ambient Noise Criteria for Habitable Rooms

Location	Desired		Reasonable *	
	07:00 to 23:00	23:00 to 07:00	07:00 to 23:00	23:00 to 07:00
Living room	35 dB $L_{Aeq,16hr}$	-	40 dB $L_{Aeq,16hr}$	-
Dining room/area	40 dB $L_{Aeq,16hr}$	-	45 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$	40 dB $L_{Aeq,16hr}$	35 dB $L_{Aeq,8hr}$

* NOTE 7 states “Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.

In addition BS 8233:2014 states: “Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.”

Reference is therefore made to World Health Organisation (WHO) ‘Guidelines for Community Noise, 1999’ which states “For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991)”.

Section 7.7.3.2 of BS 8233:2014 entitled ‘Design criteria for external noise’ states;

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs to be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.”

The above criteria in BS 8233:2014 apply for sources without specific character, previously termed “anonymous noise”. BS 8233:2014 7.7.1 advises:

“NOTE: Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.”

3. ENVIRONMENTAL NOISE SURVEY

Reference is made to a previous environmental noise survey, conducted on this site in 2016 by RSK consultants (Report 296450 [04] - Noise Impact Assessment dated 23rd May 2017). In that report they detail survey results of continuous monitoring undertaken over five days at 2no positions on the site. Results indicated that the ambient & background sound climate across the site was controlled by road traffic noise on Elizabeth Way.

The report goes on to detail results of predicted daytime and night-time road traffic noise levels, based on predicted 2026 traffic flow data for Elizabeth Way (provided by WSP Group). Comparing results of the 2016 survey with 2026 predicted road traffic noise levels, RSK provide the following conclusion;

“The close alignment in between the 2016 noise survey data (i.e. Scenario 01) and the 2026 noise model results (i.e. Scenario 02) suggest that the traffic at Elizabeth Way has already reached a stable situation, with no relevant increases in road traffic noise expected for the site during the following years. The noise model is therefore considered representative of the current and future noise environment for the site and therefore its outputs have been analysed for noise assessment purposes.”

Therefore, the environmental survey conducted for this reserved matters application has been carried out in order to validate the predicted 2026 road traffic noise levels for Elizabeth Way, as detailed in the RSK report.

Results from both our survey and those detailed in the RSK report are used as a basis for carrying out a full noise impact assessment.

3.1 Procedures

3.1.1 CRTN Measurements

Sample measurements were taken in accordance with the Department of Transport's 'Calculation of Road Traffic Noise' (CRTN) Shortened Measurement Procedure on Thursday, 01 July 2021. Parameters recorded include $L_{\max}$ and L_{eq} levels including 1/3 octave band spectra.

Figure 3.1 – Site Plan Showing Monitoring Locations (Hunter Acoustics Survey)



Site plan in Figure 3.1 above shows the CRTN measurement positions used, namely:

Table 3.1 – CRTN Measurement Location Details

Position	Description
A	Located approx. 10m from Elizabeth Way road. 1.5m above local ground height with complete line of sight to passing road traffic – free-field.
B	Located approx. 27m from Elizabeth Way road, at a position representative of the nearest proposed dwelling on the site plan. 1.5m above local ground height – free-field.

3.1.2 Sample Measurements

Additional sample measurements were taken on Thursday, 01 July 2021. Parameters recorded include $L_{\max}$ and L_{eq} levels including 1/3 octave band spectra.

Site plan in Figure 3.1 shows the sample measurement positions used, namely:

Table 3.2 – Sample Measurement Location Details

Position	Description
1	Located approx. 25m from Elizabeth Way road.
2	Located approx. 60m from Elizabeth Way road.
3	Located approx. 65m from Elizabeth Way road.
4	Located approx. 75m from Elizabeth Way road.
5	Located approx. 70m from Elizabeth Way road.
6	Located approx. 115m from Elizabeth Way road.
7	Located approx. 25m from Elizabeth Way road.
8	Located approx. 65m from Elizabeth Way road.

Note: All microphone positions approximately 1.2m above local ground level – free field.

3.2 Meteorological Conditions

Weather conditions during the manned monitoring period were dry and sunny with an occasional light breeze.

3.3 Measurement Equipment

The following measurement equipment was used during the Hunter Acoustics survey:

Table 3.3 – Noise Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
Norsonic AS	Type 1 - Integrating - averaging Sound Level Meter	118	31808	14 August 2020	U35464
	Preamplifier	1206	30892	14 August 2020	Included
	Microphone	1225	62659	14 August 2020	35463
Norsonic AS	Calibrator (113.95dB @ 999.27Hz)	1251	24202	14 August 2020	U35462
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-14577-E0	22 June 2020	TCRT20/1313
	Preamplifier	MA220	7485	22 June 2020	TCRT20/1313
	Microphone	Capsule	A15594	22 June 2020	TCRT20/1313

Measurement systems were calibrated before and after the surveys and no variation occurred.

Note: Copies of traceable calibration certificates for all equipment are available upon request.

3.4 Results

3.4.1 CRTN Measurements

Results of sample measurements taken in accordance with the Department of Transport's 'Calculation of Road Traffic Noise – Shortened Measurement Procedure' are shown in Table 3.4 below;

Table 3.4 – CRTN Measurement Results

CRTN Position A	L_{Aeq} (dB)	L_{A10} (dB)	$L_{Amax,F}$ (dB)	CRTN Position B	L_{Aeq} (dB)	L_{A10} (dB)	$L_{Amax,F}$ (dB)
12:33 - 12:43hrs	71.2	75.8	83.6	12:33 - 12:43hrs	57.5	61.3	67.1
13:48 - 13:58hrs	71.7	76.1	84.5	13:48 - 13:58hrs	58.6	61.8	70.0
14:00 - 14:10hrs	71.5	75.7	84.3	14:00 - 14:10hrs	58.1	61.4	67.9
Mean L_{A10}	75.9			Mean L_{A10}	61.5		
**16hr L_{Aeq}	72.9			**16hr L_{Aeq}	58.5		

**Predicted in accordance with CRTN

Note: CRTN measurements were carried out simultaneously at both positions in order to establish an accurate delta between them.

L_{eq} and $L_{max,F}$ spectra measured at position B (representative of the closest proposed dwelling to the road, within the site plan) are included in Figure B.1 in Appendix B.

3.4.2 Sample Measurements

Results of sample measurements are shown in Table 3.5 below.

Table 3.5 – Sample Measurement Results

Position	Time (hh:mm)	Duration (mm:ss)	L_{Aeq} (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
1	12:43	10:00	55.8	67.4	44.7
2	12:55	05:06	49.1	57.5	41.4
3	13:01	05:00	53.4	66.1	45.8
4	13:09	05:04	49.5	57.4	44.1
5	13:16	05:02	48.2	57.3	40.5
6	13:23	05:00	40.5	53.2	37
7	13:31	06:00	58.2	67	48.6
8	13:38	05:00	44.8	52.4	40.5

3.5 Discussion

Our daytime noise survey has been carried out in order to confirm current road traffic noise levels across the site; and to check whether they validate noise levels detailed in RSK's Noise Impact Assessment report. RSK's summary table is shown in Table 3.6 below;

Table 3.6 - Comparison between measured 2016 noise levels (scenario 1) and predicted 2026 noise levels (scenario 2)

Location	Measured level ¹ , L _{Aeq, T} dB (Scenario 01)		Predicted Level ² , L _{Aeq, T} dB (Scenario 02)		Difference between modelled and measured noise levels, dB	
	Day	Night	Day	Night	Day	Night
CRTN NML	68.6	59.9	68.9	62.3	+0.3	+2.4
NML01	55.5	50.6	55.0	48.5	-0.5	-2.1
NML02	53.2	49.2	55.3	48.8	+2.1	-0.4

⁽¹⁾ Noise measurement levels at 1.5 m above ground

⁽²⁾ Noise modelled levels at 1.5 m above ground

Comparing our daytime survey results with those outlined in Table 3.6 above indicates reasonable alignment (with both 2016 & 2026 values). Therefore, the 2026 predicted road traffic noise levels are deemed sufficient for the basis of our assessment.

The 2026 scenario indicates the daytime period as being critical (>5dB difference between daytime and night-time).

4. NOISE MAP MODELLING

Three dimensional noise map modelling has been undertaken using the proprietary NoiseMap Five environmental noise mapping software package, which in turn uses calculation methods of Calculation of Road Traffic Noise (CRTN).

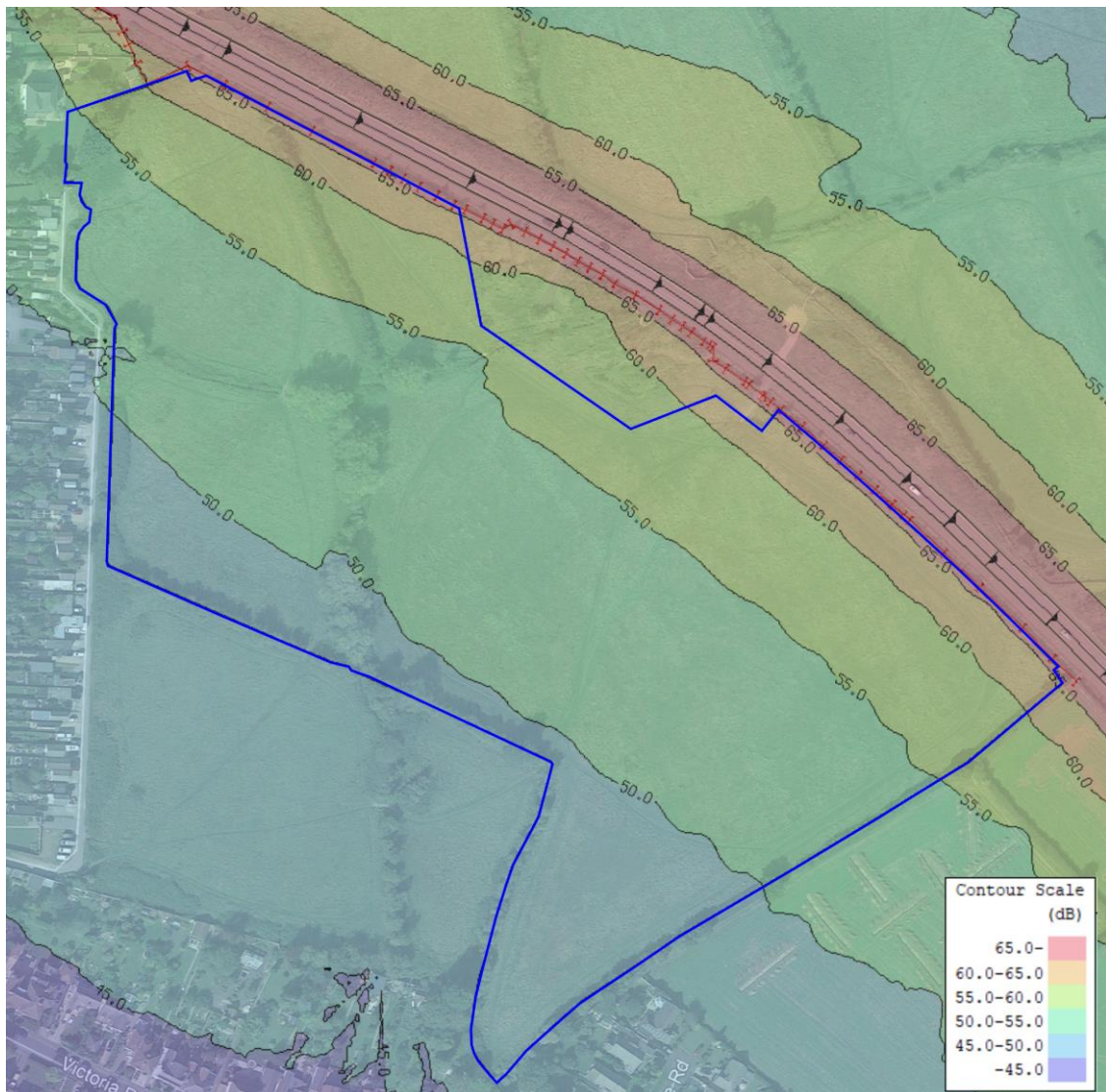
Models have been set up to predict daytime and night-time noise levels across the site from road traffic, based on measured noise levels discussed in section 3.4 of this report and predicted 2026 noise levels (as detailed in RSK report).

The model takes into account distance and screening losses from existing and new structures, allowing garden noise levels to be assessed, as well as predicting noise levels at proposed residential facades.

4.1 Undeveloped Site

The noise map model in Figure 4.1 below shows predicted road traffic noise levels during the critical daytime period (0700-2300hrs) at 1.5m above local ground level across the undeveloped site.

Figure 4.1 – Daytime Model (Undeveloped Site) $L_{Aeq,16hr}$ Contours at 1.5m Height

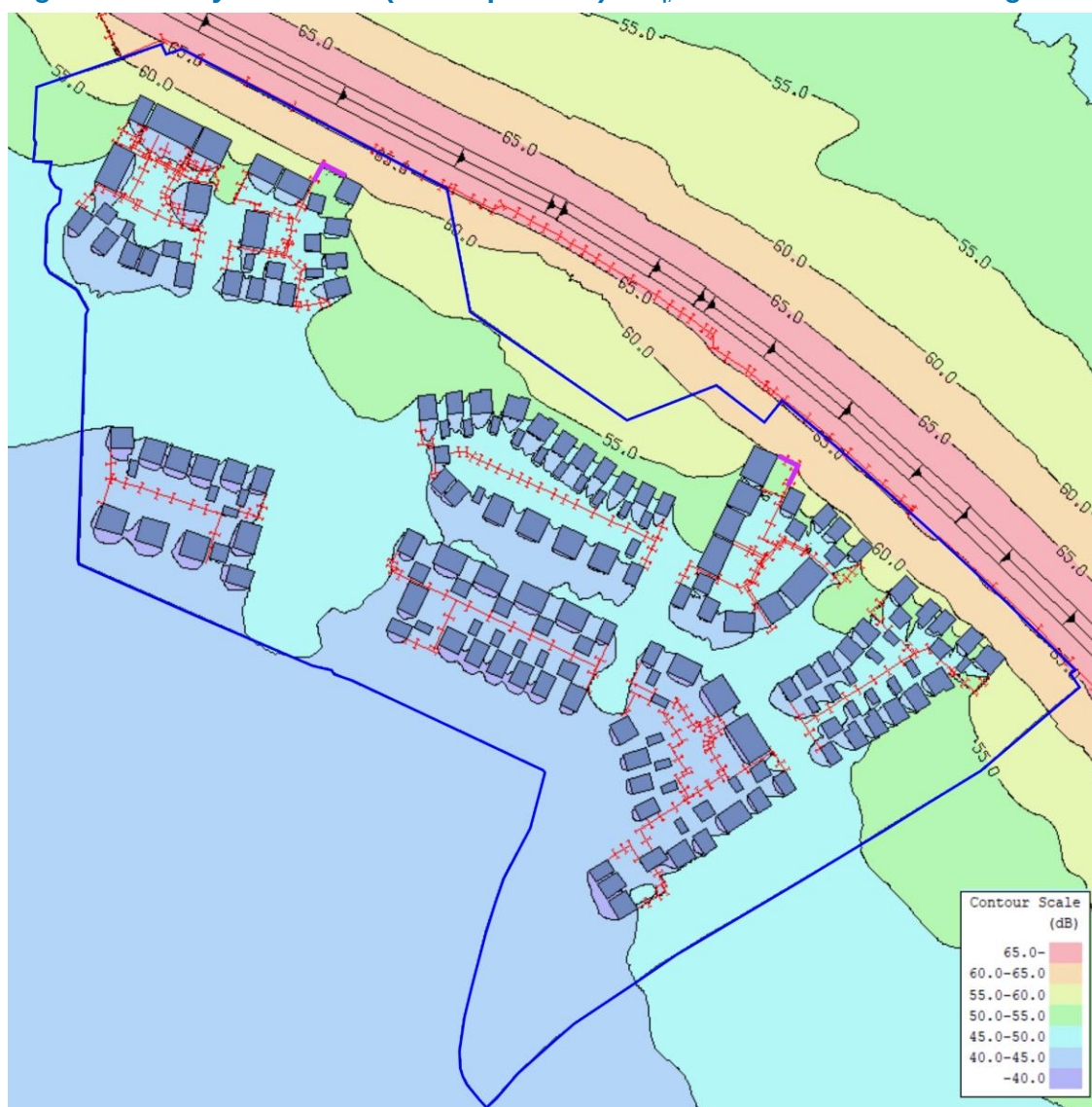


Note: existing 1m high closed-boarded fence, located along the north-eastern site boundary to the road, has been included in the model.

4.2 Developed Site

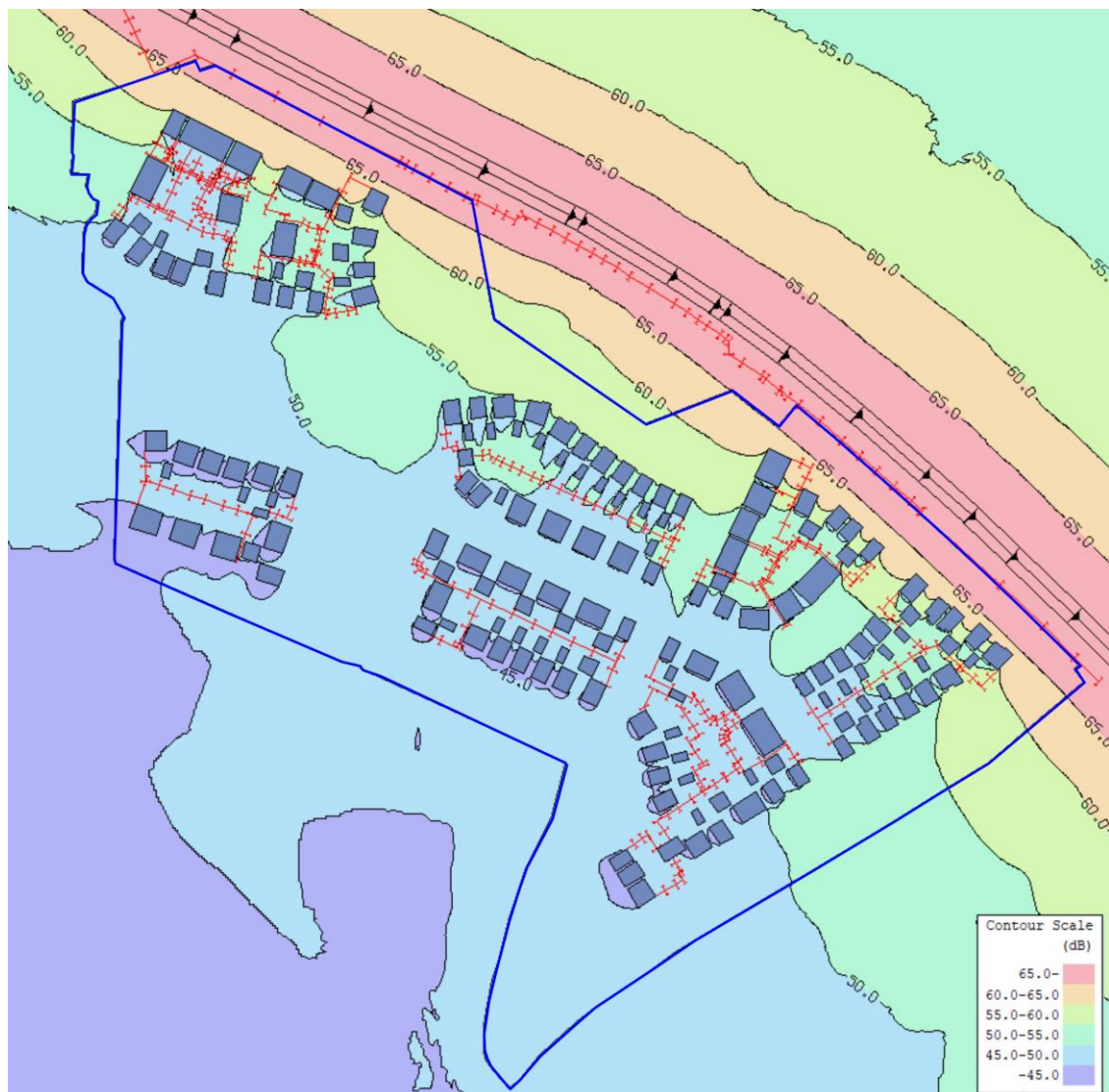
The proposed housing layout plan referenced in Appendix D has been used for the developed model.

Noise map models in Figure 4.2 and Figure 4.3 below show predicted road traffic noise levels during the critical daytime period (0700-2300hrs) at 1.5m and 4.5m above local ground level on the developed site respectively.

Figure 4.2 – Daytime Model (Developed Site) $L_{Aeq,16hr}$ Contours at 1.5m Height

*Note: 1.8m high closed boarded fences have been modelled around gardens (where indicated on site plan proposals). 2.2m high walls have been included to Plots 32, 128 & 129 as required – these are marked in **PURPLE**.*

Figure 4.3 – Daytime Model (Developed Site) $L_{Aeq,16hr}$ Contours at 4.5m Height

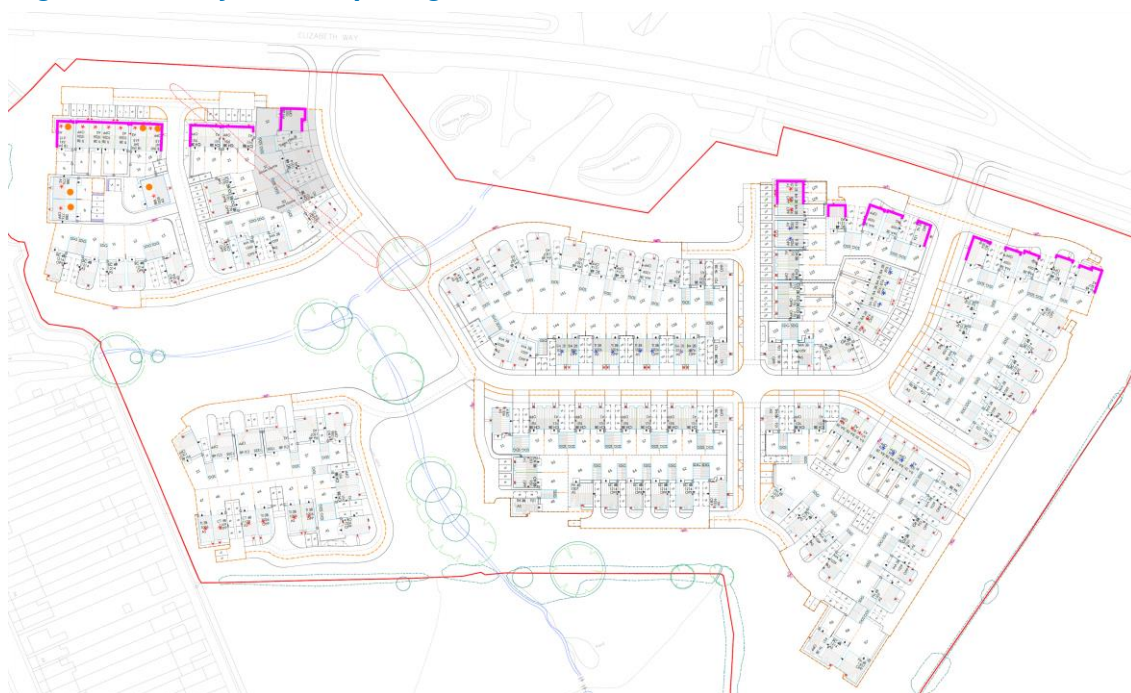


5. EXTERNAL BUILDING FABRIC ASSESSMENT

Based on survey results and noise map models, we have carried out an external building fabric assessment with the aim of controlling noise intrusion to habitable rooms to meet 'desirable' internal ambient noise values quoted in BS 8233:2014 (see section 2.2 of this report).

Critical façades are shown on site plan in Figure 5.1 below, marked up with **MAGENTA** lines. A summary table of the plots highlighted is shown in Table 5.1.

Figure 5.1 – Façades Requiring Additional Sound Insulation Measures



Note: Habitable rooms include bedrooms, lounges, dining rooms and kitchen/diners but not kitchens or bathrooms.

Table 5.1 – Plots Requiring Additional Sound Insulation Measures

Plot No.	Façade(s) Requiring Additional Sound Insulation Measures
5&6	Westerly façade & northerly façade facing Elizabeth Way (EW)
1-4	Northerly façade facing EW
19	Westerly façade & northerly façade facing EW
20-22	Northerly façade facing EW
32	ALL facades with exception to the southerly façade, facing away from EW.
128	East & west facades (front & rear)

129	East & west facades (front & rear) and gable end, facing EW
106	Front northerly façade and gable ends facing EW
107	Westerly façade & northerly façade facing EW
108	Northerly façade facing EW
109	Easterly façade & northerly façade facing EW
101	Westerly façade & northerly façade facing EW
102-104	Northerly façade facing EW
105	Easterly façade & northerly façade facing EW

All habitable rooms (at all floor levels) on façades highlighted above require up-rated acoustic glazing and ventilation as specified below. Standard thermal double glazing and trickle ventilation should be sufficient on remaining façades (not highlighted).

This assessment has been carried out based on the following assumptions;

- Noise intrusion is calculated to a bedroom with dimensions of 4m (l) x 3m (w) x 2.5m (h)
- Façade area, exposed to road traffic of 10m² (l x h)
- Glazing area of 2m²

5.1 External Walls

The following external wall constructions have been used in our analysis;

- 100mm Brick / 100mm cavity (fully filled with insulation) / 100mm Block

The following SRI performance figures are taken from BS 8233:2014 for 'Brick and block external wall'. The proposed constructions should be capable of achieving these figures as a minimum;

Table 5.2 – External Wall Sound Reduction Index Figures

Element	Description	Sound Reduction Index, <i>R</i> (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
External Wall	Brick / Cavity / Block	40	44	45	51	56

The successful tenderer must provide independent laboratory test data showing their wall systems meet the above performance requirements.

5.2 Roof

The following roof constructions have been used in our analysis;

- Pitched tiles on felt roof, 9mm plasterboard ceiling + 2 layers of insulation 100mm + 300mm (400mm total).

The following minimum SRI performance figures are taken from BS 8233:2014: "tiles on felt roof with 100mm mineral wool on plasterboard ceiling";

Table 5.3 – Roof Sound Reduction Index Figures

Element	Description	Sound Reduction Index, <i>R</i> (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Pitched Roof	Tiles on felt, 9mm plasterboard ceiling, 100mm mineral wool insulation	28	34	40	45	49

5.3 Glazing

The housing layout plan in Figure 5.1 shows façades where windows require up-rating. The following sound reduction index figures shall be met for glazing on these critical façades:

Table 5.4 - Glazing Sound Reduction Index Figures

Element	Description	Sound Reduction Index, <i>R</i> (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Glazing	For budgetary guidance: based on Pilkington 6mm / 6 – 16mm / 4mm	21	20	25	38	37

A typical glazing system that should be capable of achieving the quoted SRI figures (based on Pilkington test data) is included in the table for initial budgetary guidance, however;

The successful glazing suppliers shall provide independent laboratory test data confirming their proposed systems (including frames/seals) meet the quoted octave band sound reduction performance figures above.

For all other façades standard thermal double-glazing and trickle ventilation is indicated to be sufficient.

5.4 Ventilation

It is understood background ventilation is to be provided by means of controllable trickle ventilators, generally located in head of window. Dwellings are to have an air permeability of $>5\text{m}^3/(\text{hm}^2)$ @ 50 Pascals (Pa). (As detailed in the 'Construction Specification' document referenced in Appendix D).

Habitable rooms are to provide minimum $5,000\text{mm}^2$ free airflow background ventilation with mechanical ventilation providing intermittent extract to wet rooms – this is indicated to be in line with a Building Regulations Approved Document F 'System 1' background ventilation strategy.

This strategy relies on windows being closed; however, occupiers may still open windows for purge ventilation rates, or under normal ventilation conditions if they so choose to, and so glazing would not be 'fixed pane'.

All habitable rooms on critical façades highlighted **MAGENTA** require trickle ventilators that are acoustically treated so to achieve the following performance;

Table 5.5 – Acoustic Trickle Ventilator Specifications

Element	Description	$D_{n,e}$ at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Ventilator	For budgetary guidance: based on Greenwood 5000EA + 1 acoustic set	39	38	31	44	43

For budgetary guidance the above ventilator figures are based on Greenwood 5000EA + 1 acoustic set ventilators. The successful tenderer shall provide independent laboratory test data showing their vent meets the above performance requirements.

The above ventilator has a sufficient Equivalent Area (EA) to meet the minimum $5,000\text{mm}^2$ requirement.

5.4.1 General

Do not include standard trickle ventilation within window frames on critical façades.

All ventilation systems should follow the guidance of the Domestic Ventilation Compliance Guide 2010.

Final proposals should be confirmed with Building Control and Environmental Health prior to orders being placed.

5.5 Overheating

Our assessment recommends acoustic glazing and outlines a means of providing background ventilation on critical facades, to control noise intrusion. This is based on windows normally being closed (excluding purge ventilation).

If there is a risk of overheating on any of the facades, requiring windows to be opened more frequently, a more detailed assessment would be required – please advise.

6. EXTERNAL NOISE ASSESSMENT (GARDENS)

Private garden areas are generally located behind the dwellings, maximising screening to the road.

The noise map model in Figure 4.2 indicates the $L_{Aeq,16hr}$ 55dB in gardens criterion is achieved in all private garden areas to dwelling-houses. This is with a 2.2m high barrier (wall or closed-boarded fence) installed to Plots 32, 128 & 129, shielding road traffic noise from Elizabeth Way.

Therefore no additional noise mitigation measures for garden areas are deemed necessary.

7. CONCLUSION

An environmental noise assessment has been carried out for the proposed residential development on Land off Elizabeth Way, Hilperton, Trowbridge, Wiltshire, BA14.

Road traffic is indicated to control the ambient noise climate day and night.

Noise surveys have been carried out across the site. Additional sample measurements were undertaken to aid calibration of a noise map model.

The noise survey indicates that the daytime is the critical period (day/night difference > 5dB).

Noise map models have been generated to show noise propagation across both the undeveloped and developed sites.

An external building fabric assessment has been carried out. Critical facades requiring additional sound insulation measures have been highlighted and specifications for external wall, roof, ventilation and glazing are included.

An assessment of external noise in gardens has been undertaken and shows that all gardens meet the $L_{Aeq,16hr}$ 55dB garden criterion with the inclusion of a 2.2m high barrier installed to plots with gardens in proximity of the road. Therefore no additional noise mitigation measures for garden areas are deemed necessary.

APPENDIX A - ACOUSTIC TERMINOLOGY

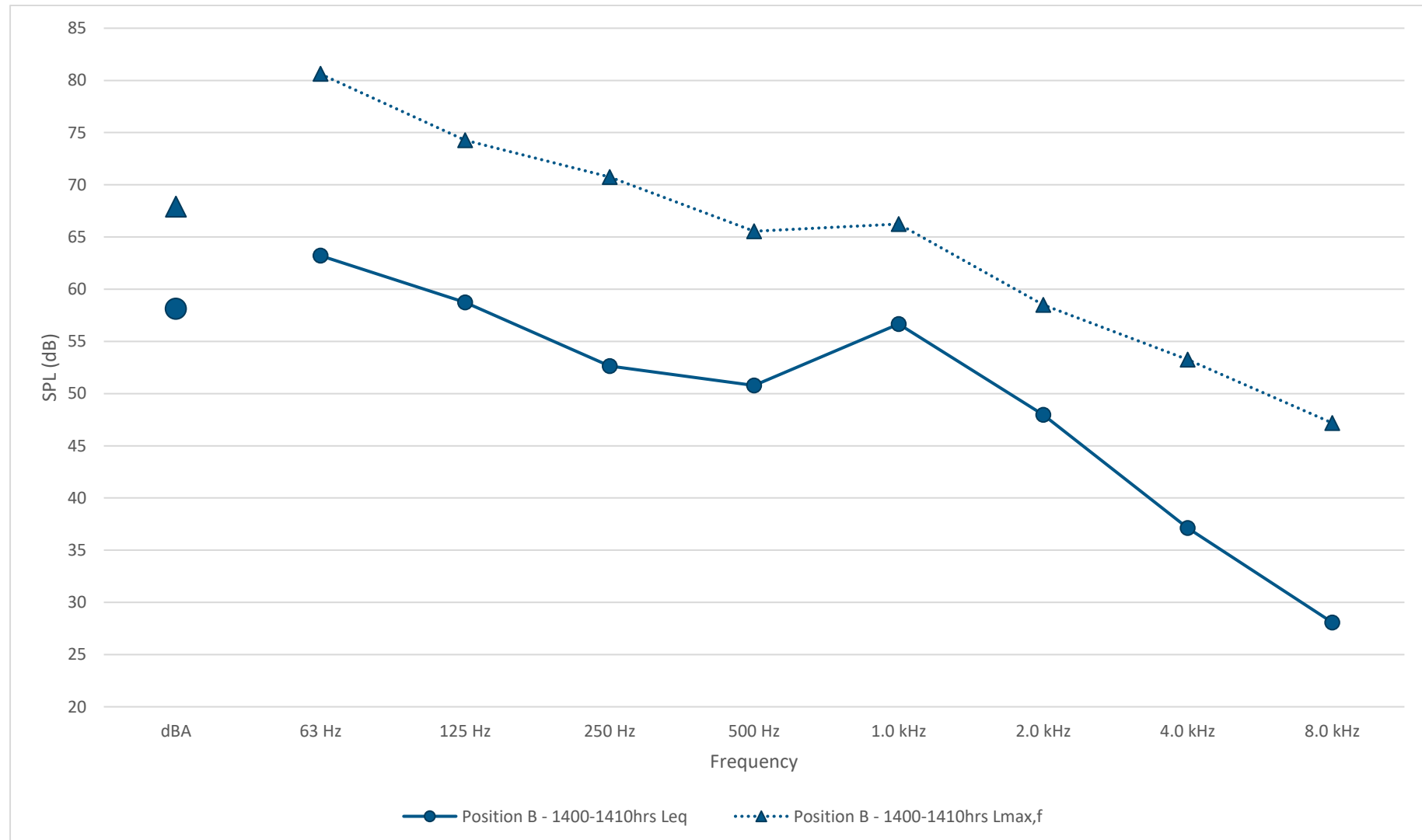
Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver

APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – L_{eq} and $L_{max,F}$ Octave Band Spectra Measured at Position B (Thursday, 01 July 2021)



APPENDIX C - NOISE MAP MODELS

Figure C.1 – Daytime Noise Map (Undeveloped Site) $L_{Aeq,16hr}$ Contours at 1.5m Height

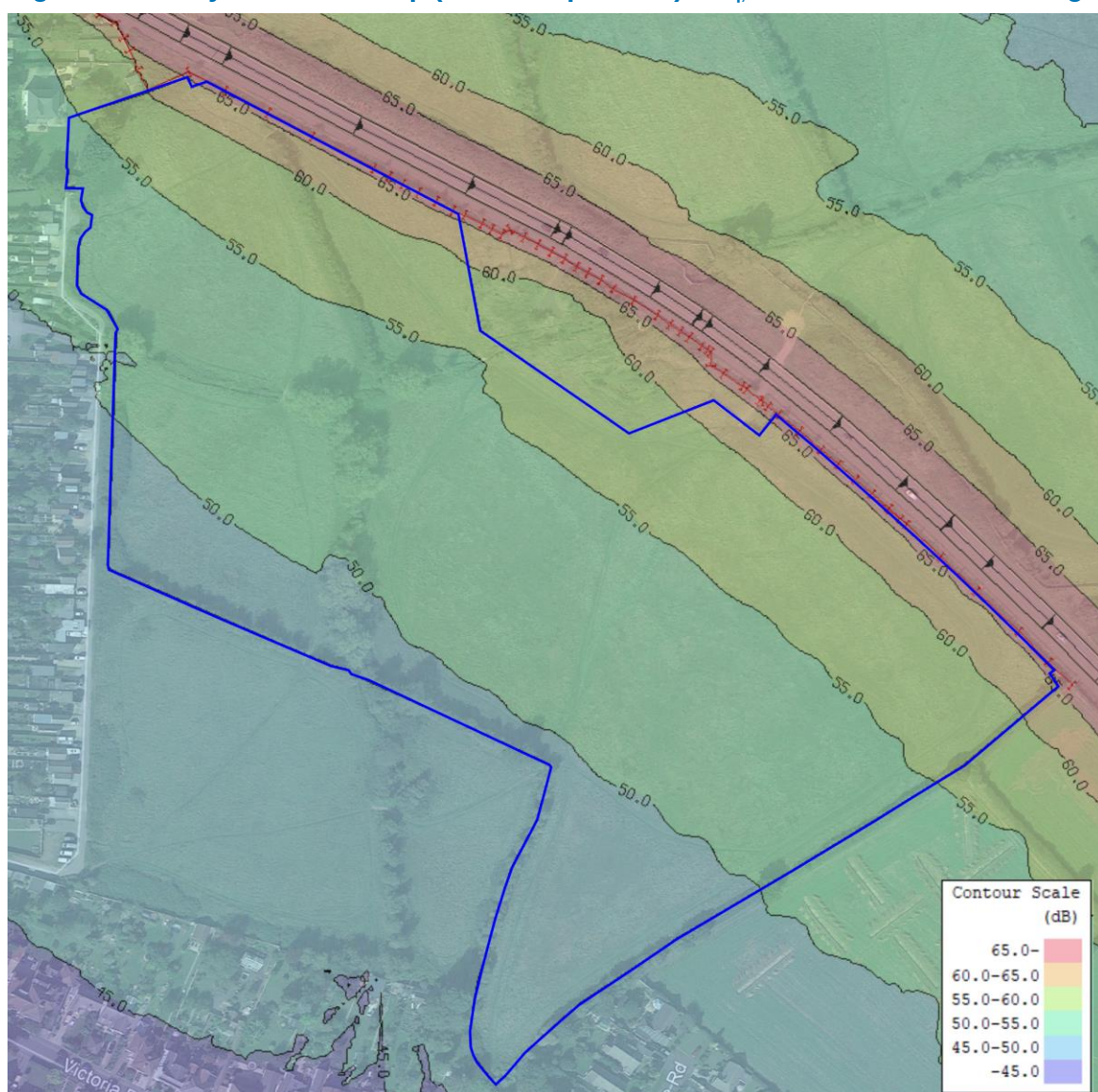


Figure C.2 – Night-time Noise Map (Undeveloped Site) $L_{Aeq,8hr}$ Contours at 1.5m Height

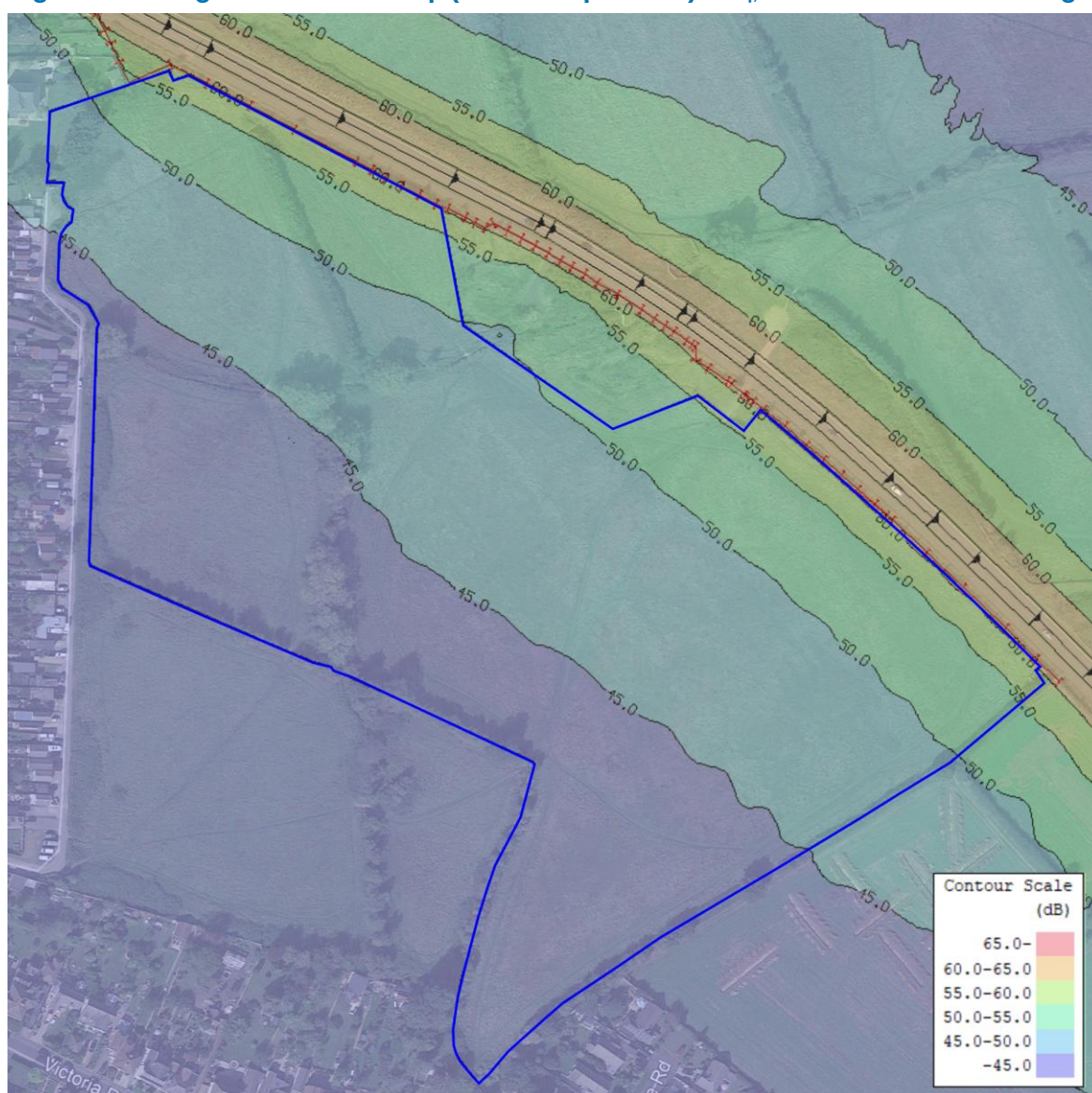


Figure C.3 – Daytime Noise Map (Developed Site) $L_{Aeq,16hr}$ Contours at 1.5m Height

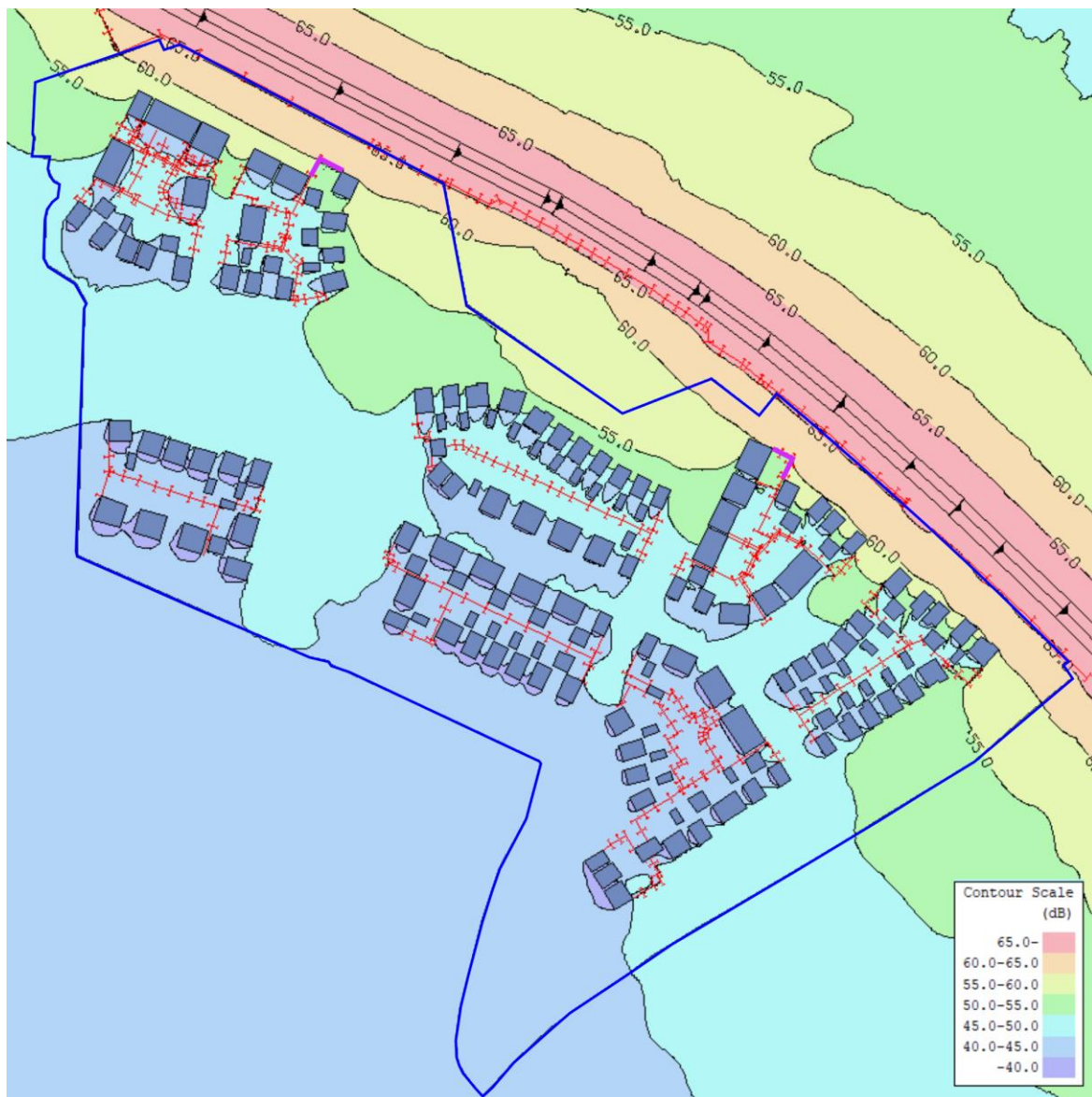


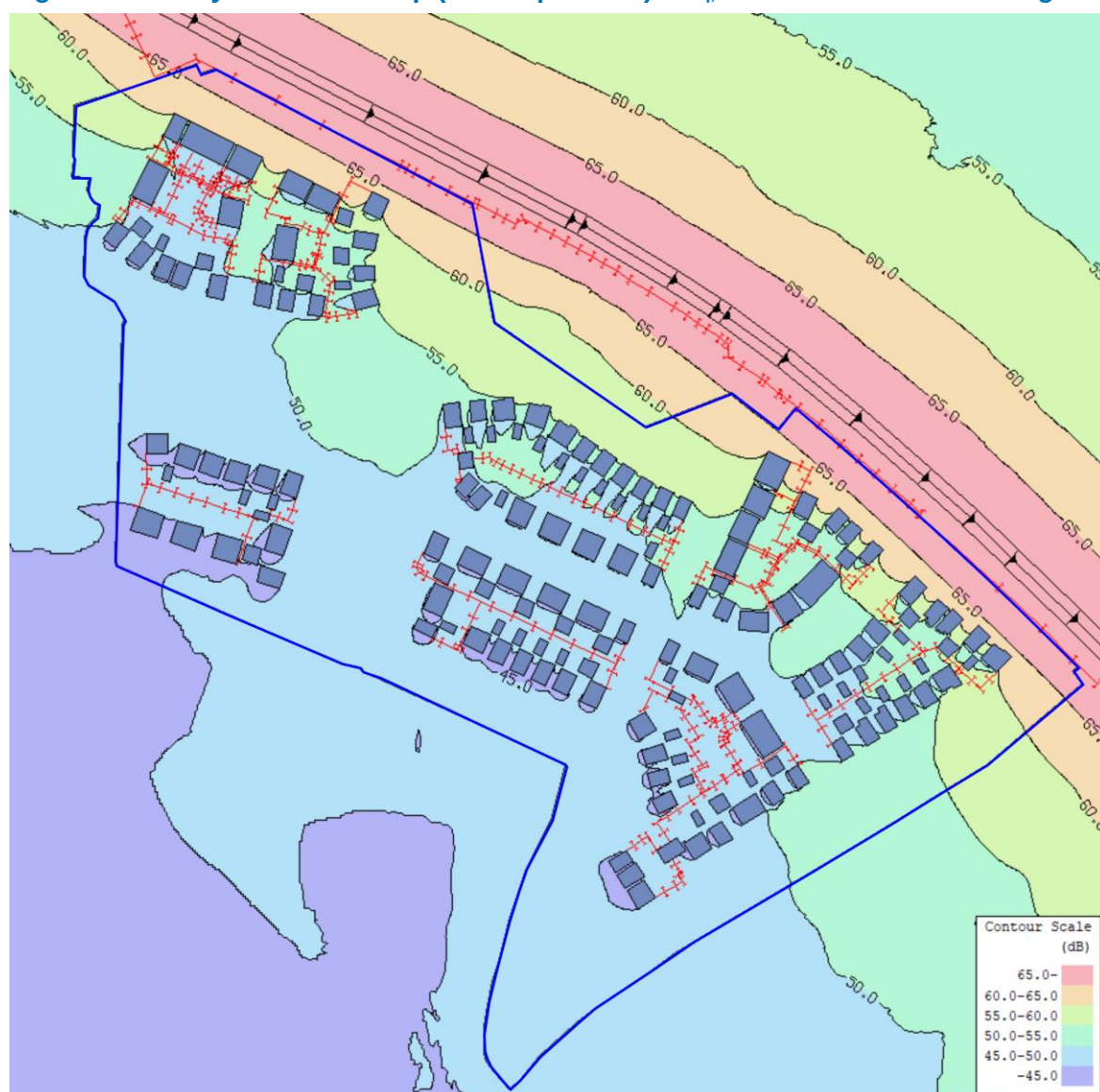
Figure C.4 – Daytime Noise Map (Developed Site) $L_{Aeq,16hr}$ Contours at 4.5m Height

Figure C.5 – Night-time Noise Map (Developed Site) $L_{Aeq,8hr}$ Contours at 1.5m Height

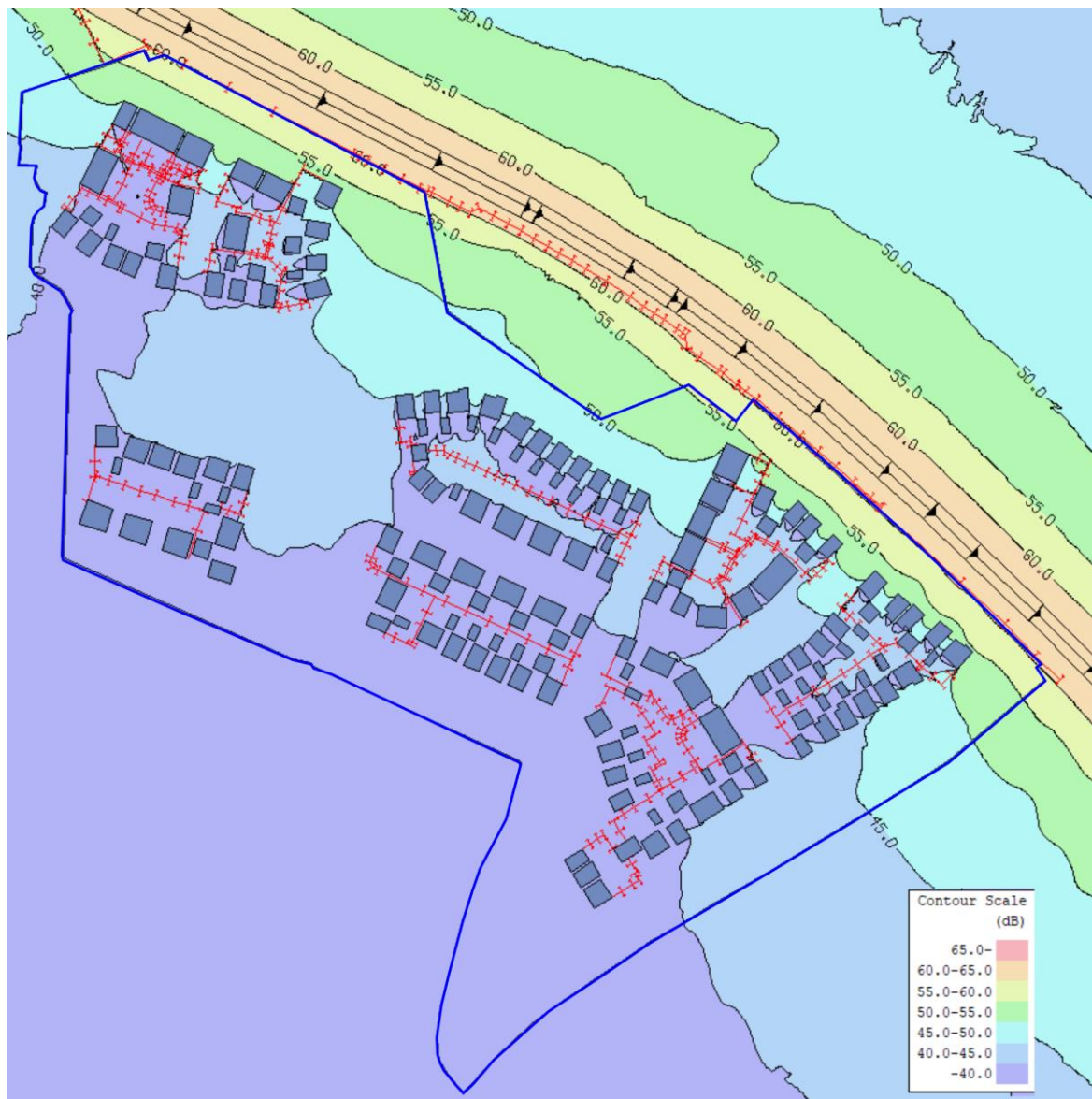
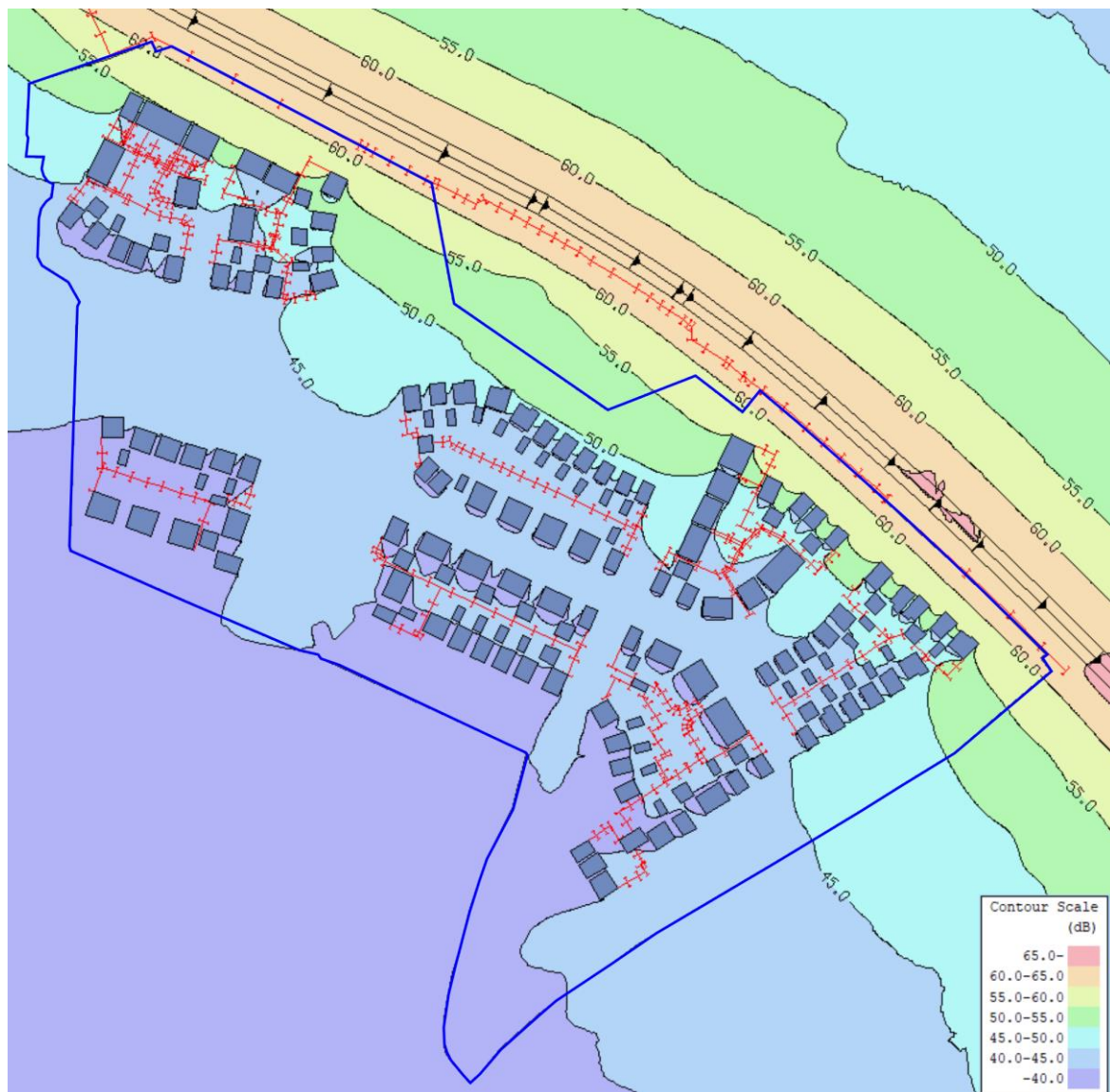


Figure C.6 – Night-time Noise Map (Developed Site) $L_{Aeq,8hr}$ Contours at 4.5m Height



APPENDIX D - DRAWING LISTS

The following drawings and documents have been used in our assessment;

Table D.1 – Thrive Architects Drawing List

Drawing Title	Drawing Number	Rev	Date
Site Layout	BELL210101 – SW / SL.01	P17	08/12/2020

Table D.2 – Midland Survey Drawing List

Drawing Title	Drawing Number	Rev	Date
Topographical Survey	2206/1	-	03/2015
Topographical Survey	2206/2	-	03/2015
Topographical Survey	2206/3	-	03/2015

Table D.3 – RSK Environment Document List

Document Title	Document Number	Rev	Date
Noise Impact Assessment	296450 (04)	-	23/05/2017

Table D.4 – Bellway Homes Document List

Document Title	Document Number	Rev	Date
Construction Specification (v. 3.3)	-	-	02/10/2018