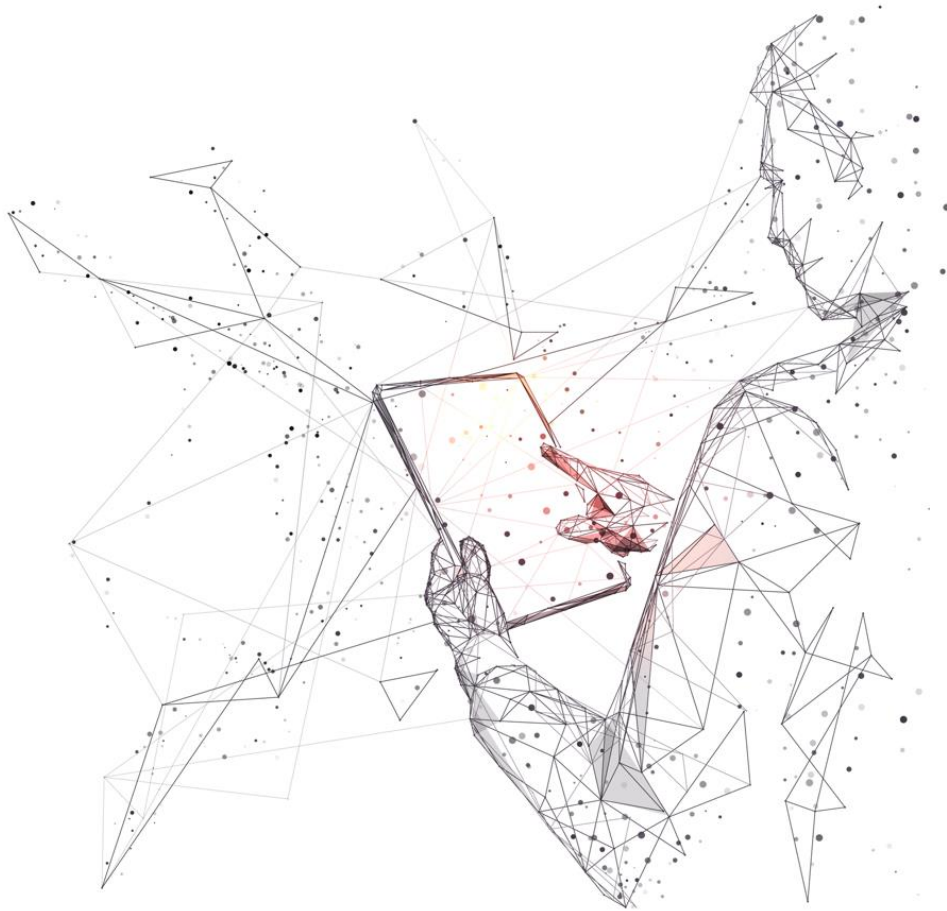


AUGUST 8, 2024



**BS8233 ASSESSMENT OF
LAND AT BUNKERS HILL,
BERSHAM ROAD,
WREXHAM,
LL14 4HT
- REVISION V3**

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Table of Contents

1. INTRODUCTION
2. DEVELOPMENT DESCRIPTION
3. NOISE ASSESSMENT CRITERIA
4. RESULTS
5. OBSERVATIONS AND FURTHER DISCUSSIONS
6. GLAZING, STRUCTURAL AND VENTILATION REQUIREMENTS
7. FURTHER DISCUSSION AND CONCLUSION

APPENDIX A – ACOUSTIC TERMINOLOGY

APPENDIX B – CERTIFICATES OF CALIBRATION

APPENDIX C – WEATHER CHART

APPENDIX D – BS8233:2014 ANNEX G CALCCS

1.0 Introduction

- 1.01 E2 Consultants have been commissioned to undertake a noise impact survey and assessment for the Land at Bunkers Hill, Bersham Road, Wrexham, LL14 4HT.
- 1.02 The methodology used for this assessment will be BS8233 as this is a new development within the designated area.
- 1.03 The report will look at the resulting internal noise levels post construction in accordance with the BS8233 standard.

2.0 Development Description

- 2.0.1 The proposed dwelling is to be located adjacent to an existing property that sits on the corner of Bersham Road and Berse Lane in Bersham, Wrexham.
- 2.0.2 The development lies in a mainly residential area just a short distance from open fields and a small number of amenities.

- 2.0.3 The main noise source likely to disrupt the inhabitants of the new dwelling is the traffic, mainly from the A483. There will be some along the B5099/Bersham Road although this is not expected to be the dominant noise source for the area.
- 2.0.4 With the above sources in mind the monitoring took place in the open area where the proposed development will be located. Measurements took place over a 24hr period to gather data on background noise levels for the area. This is not expected to vary significantly over the weekend with highest levels most likely during weekdays.
- 2.0.5 As the original measurements taken in May were done both when construction was on site and with the A483 wet they have been repeated for a true reflection on the ambient daytime noise levels of the proposed garden areas.

2.1 Locations of Monitors

- 2.1.1 One Type 1 sound level meter was installed on a tripod in the open area.
- 2.1.2 Figure 1 shows the area where the monitors were installed. All locations are displayed on site map in figure 2

Figure 1



- 2.1.3 Measurements were made in 15 minute periods, on 1 second averaging, to allow for the removal of anomalies and increased accuracy. The data was averaged into $L_{Aeq16hr}$ daytime and L_{Aeq8hr} night-time with data also recorded for L_{AMax} in both day and night periods for the BS8233:2014 assessment.
- 2.1.4 The monitoring was conducted using 1 x Type 1 NTi XL2 sound level meter, outdoor case with batteries and outdoor microphone protection.

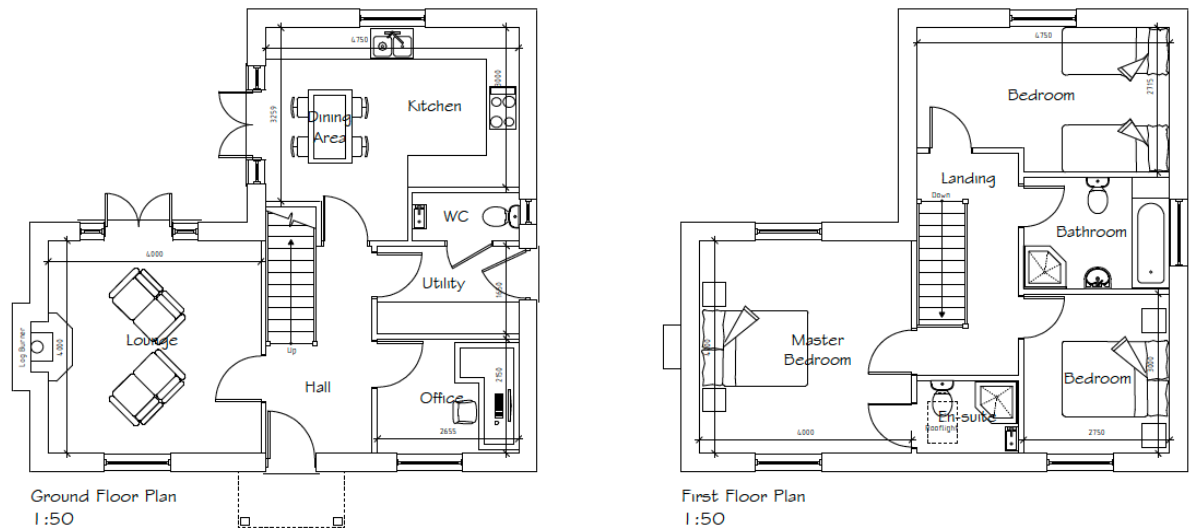
- 2.1.5 The measurements were taken by a fully qualified engineer with AMIOA status with the institute of Acoustics.
- 2.1.6 All measurements were taken after a field calibration was undertaken to ensure accuracy and repeatability of measurements.
- 2.1.7 Further data such as wind speed, wind direction, rainfall intensity, temperature and cloud cover were all recorded at the beginning and end of the assessment at the monitoring location.
- 2.1.8 Any anomalies (such as noise by the engineer during setup and collection of the kit) were removed from the survey for a true reflection of the ambient levels in the vicinity. This was done by recording audio throughout the survey at each location and listening back through the files during the analysis process to confirm what was recorded manually during the survey.
- 2.2.9 Care was taken to inform any residents in the area that audio recording was taking place.

2.2 Plan Views of Site with Designated Work Areas



Figure 3

2.3 Proposed Site Layout (example floor)



3.0 Noise Assessment Criteria

- 3.0.1 The Planning Policy Wales sets out the Government's economic, environmental and social planning policies. Section 3.22 states;

"Planning authorities should develop and maintain places that support healthy, active lifestyles across all age and socio-economic groups, recognising that investment in walking and cycling infrastructure can be an effective preventative measure which reduces financial pressures on public services in the longer term. The way a development is laid out and arranged can influence people's behaviours and decisions and can provide effective mitigation against air and noise pollution."

- 3.0.2 The guidance also sees traffic consideration and management as key when it comes to noise impact assessments. Section 4.1.45 states

"Local authorities must adopt an integrated approach to traffic management. They should consider how different measures can complement one another and contribute to the achievement of wider planning and transport objectives, implementing the Active Travel Act and reducing exposure to air and noise pollution, taking into account the needs of the disabled and less mobile sections of the community."

- 3.0.3 Section 6 of the document also tackles the likely social and well-being impacts of the preservation of 'distinctive and natural places'. Section 6.7.1 refers to the need to protect the soundscape of areas;

"Clean air and an appropriate soundscape, contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected through preventative or proactive action through the planning system. Conversely, air, noise and light pollution can have negative effects on people, biodiversity and the resilience of ecosystems and should be reduced as far as possible."

This is then continued in reference to noise in section 6.7.4;

"The planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution alongside action to tackle high pollution hotspots. In doing so, it should consider the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment and identify and pursue any opportunities to reduce, or at least, minimise population exposure to air and noise pollution, and improve soundscapes, where it is practical and feasible to do so."

- 3.0.4. It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:
- The effect may be determined by reference to guideline noise values. British Standard (BS) 8233:2014 and World Health Organisation (WHO) "Guidelines for Community Noise" contain such guidelines.
 - Another method is to compare the resultant noise level against the background noise level (LA90) of the area. This is the method employed by BS 4142:2014 to determine the likelihood of complaint from noise of an industrial nature. It is best suited to the assessment of steady or pseudo-steady noise.
- 3.0.5 British Standard 8233:2014 is principally intended to assist in the design of new dwellings; however, the Standard does state that it may be used in the assessment of noise from new sources being brought to existing dwellings.
- 3.0.6 The WHO guideline values are appropriate to what are termed "critical health effects". This means that the limits are at the lowest noise level that would result in any psychological or physiological effect.

The WHO/BS 8233 guideline noise values are summarised in the following table:

Table 1

Guidance Document	L _{AeqT}	L _{AMax}	Outcome
World Health Organisation “Community Noise 2000”	55dB		Serious annoyance, daytime and evening. (Continuous noise, outdoor living areas)
	50dB		Moderate annoyance, daytime and evening. (Continuous noise, outdoor living areas).
	35dB		Moderate annoyance, daytime and evening. (Continuous noise, dwellings, indoors)
	30dB		Sleep disturbance, night-time (indoors)
		60dB	Sleep disturbance, windows open at night. (Noise peaks outside bedrooms, external level).
		45dB	Sleep disturbance at night (Noise peaks inside bedrooms, internal level)
BS 8233:2014 “Sound Insulation and noise reduction for buildings”	55dB		Upper limit for external steady noise. (gardens and patios).
	50dB		Desirable limit for external steady noise. (gardens and patios).
	L _{Aeq} 16 hours = 35 dB		Resting, living room day. (Internal – steady noise)
	L _{Aeq} 16 hours = 40 dB		Dining, dining room day. (Internal – steady noise)
	L _{Aeq} 16 hour = 35 dB		Sleeping, bedroom day (Internal – steady noise)
	L _{Aeq} 8 hours = 30 dB		Sleeping, bedroom day (Internal – steady noise)

3.0.7 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. All surveys are conducted on 1 hour daytime and 15 minute night values – based on 1 second readings on a Type 1 sound level meter. The readings are taken every 5 mins for noise to allow the elimination of erroneous data if required.

3.0.8 The WHO guidelines are also concerned with the $L_{A\text{Max}}$ for night-time sleep disturbance. The guideline states:

“For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB $L_{A\text{Fmax}}$ more than 10-15 times per night”

3.0.9 On this basis, for the purpose of assessing night-time $L_{A\text{Fmax}}$ noise events, it is considered appropriate to adopt the 10th highest $L_{A\text{Fmax}}$ noise event occurring in a typical night-time (23:00 – 07:00) period.

3.0.10 Audio recordings are taken throughout the measurements to allow for further assessments on high levels. Listening to the audio and performing tonal analysis will allow anomalies to be removed from the data, if required.

4.0 Results – Updated Measurements

4.1 Noise Assessment V2– 11.27am 01/08/24 – 11.47am 02/08/24

Table 2

Location	L _{Aeq_16hr}	L _{Aeq_8hr}	L _{Amax} (10th highest)
Day	55.4dBA		
Night		46.0dBA	61.4dBA

4.1.1 Comments: Constant traffic pass-by noise & 'hum'. No tonal features. Dry conditions

Figure 3 - Daytime

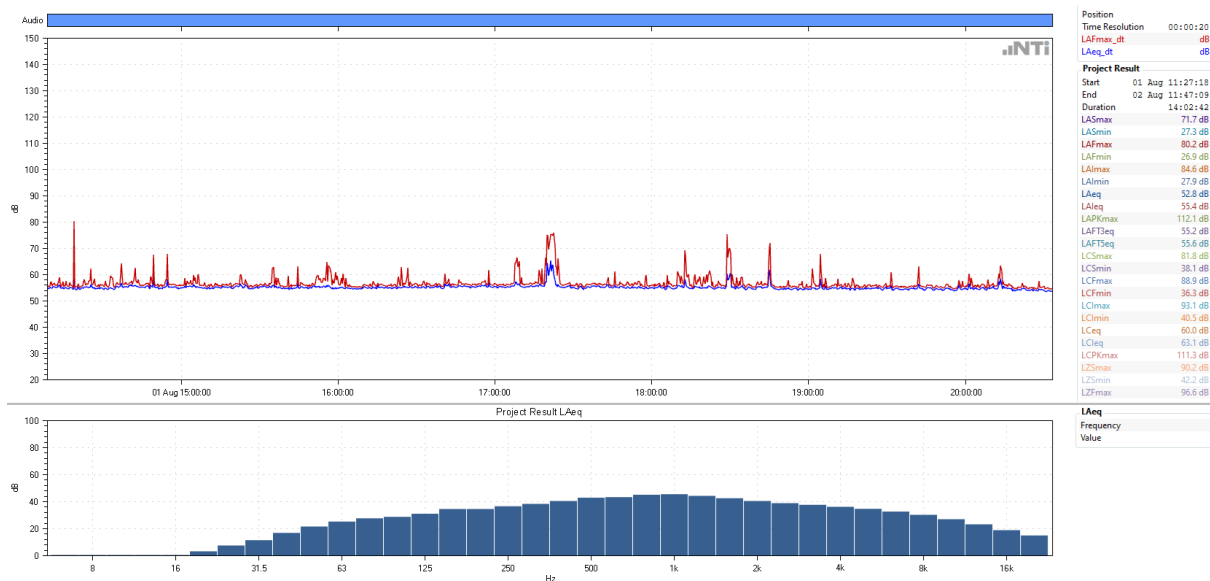
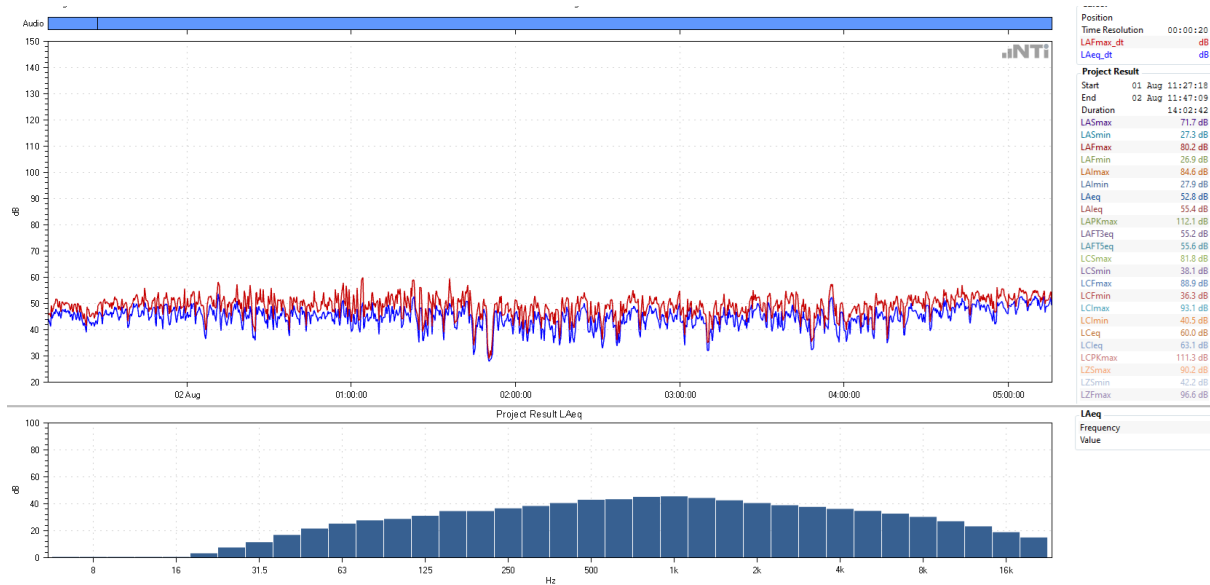


Figure 4 – Night-time



4.3 Comparison of Results to BS8233

Table 4

Location	L _{AeqT} (16hr Day & 8hr Night)	L _{AMax}	BS8233 & WHO Internal noise	BS8233 & WHO External Noise	Difference to L _{Aeq} (internal/extern al)	Difference to Max (internal)
Day (0700-2300)	55dBA		35dBA	55dBA	(+20dBA/ +0dBA)	-
Night (2300-0700)	46dBA	61dBA (10 th Highest)	30dBA (45dBA L _{AMax})	(60dBA L _{AMax})	(+16dBA)	(+16dBA)

5.0 Observations and Further Discussions

- 5.0.1 The measured L_{Aeq} values for both the day and the night periods are shown in table 4. The day period at the proposed property is 20dBA above the limit for indoor noise levels.
- 5.0.2 The night value is 16dBA above the recommended value for internal noise to prevent sleep disturbance.
- 5.0.3 BS8233 assumes that a standard double-glazed window will provide up to 15dB reduction when open (with some council guidelines leaning on the side of caution and assuming a 10dB reduction). Either option would mean that any glazed window in the building cannot be relied upon as the source of ventilation without the chance of sleep disturbance being had by the inhabitants of the proposed dwellings to the front of the building. Trickle/acoustic vents will therefore be required throughout the property; to avoid the need to open windows to ventilate.
- 5.0.4 The L_{AMax} value to prevent the likelihood of sleep disturbance is set at 60dBA external and 45dBA internal. Based on the highest value from the tenth-highest daily value measured during the week the reading for L_{AMax} night at the front of the property was 61dBA. This value is 16dB above the required value externally for sleep disturbance.
- 5.0.5 With the above comments in mind the dwellings should be fitted with double glazing that provides a minimum noise reduction of around Rw 20dBA (as the highest value was the daytime difference in the living areas). As the majority of modern double-glazed windows produce this figure there is no requirement for special type, gas filling or triple glazing to reduce noise. These figures will now be checked against the calculation methodology in BS8233 annex G to provide exact specifications in section 6.

5.1 BS8233 Calculation Sheet

(living area)

Time Period		Overall dBA	Octave Band Frequency (Hz)					
			125	250	500	1000	2000	4000
L _{Aeq}	Daytime	55.4	44	47	49	50	48	45

Room Details	(m)	Living Room Area
Height	2.2	
Width	4	
Length	4	
Sample Room Volume	35.2	
Sample Room Surface Area	35.2	

Element	Area/No.of	Element Specification
External Wall	8.8	Traditional brick and block with ties and insulation
Windows	1.5	4 mm / (6 - 16 mm) / 4 mm Pilkington
Ceiling	16	
Ventilation	1	Standard non-acoustic trickle ventilator typically ≥ D _{n,e,w} 30dB

Element SRI

Element	Area/No.of	Octave Band Frequency (Hz)						Single Figure Rating
		125	250	500	1000	2000	4000	
Walls	4	47	49	49	58	68	79	57
Windows	1	21	17	25	35	38	31	29
Ceiling	1	28	34	40	45	49	52	
Ventilation (D _{n,e})	1	30	30	30	30	30	28	35

Overall Sound Reduction

Calculated Internal SPL

		Octave Band Frequency (Hz)					
		125	250	500	1000	2000	4000
Leq,2	26.1	8.0	17.8	19.7	20.3	18.8	18.2
Limit	35						
Value under limit	8.9						

6.0 Glazing, Structural and Ventilation Recommendations

6.1 External Walls

6.1.1 External walls of the proposed building are understood to be traditional 9" brick:

Table 5

Description	Octave Band Centre Frequency (Hz) Sound Reduction Index R dB					
	125	250	500	1k	2k	4k
Traditional solid brick & block with cavity insulation	47	49	49	58	68	79

6.2 Glazing

6.2.1 Suitable sound insulation performance of all windows and patio doors of the development may be achieved to the rear with standard double-glazing type 4-airgap-4, typically $\geq R_w 30\text{dB}$. An example product for noise reduction to the front of the property is shown in table 6.

Table 6

Description	Octave Band Centre Frequency (Hz) Sound Reduction Index R dB						Rw (C; Ctr)	Rw+Ctr
	125	250	500	1k	2k	4k		
Pilkington 4 mm / (6 - 16 mm) / 4 mm	21	17	25	35	37	31	29 (-1,-4)	25dB

6.3 Ventilation

6.3.1 It is anticipated that a basic ventilation system will be needed to be incorporated into the scheme design to reduce the impact of the L_{AMax} levels, such that residents of the properties are able to have background ventilation without necessarily needing to open windows.

Table 7

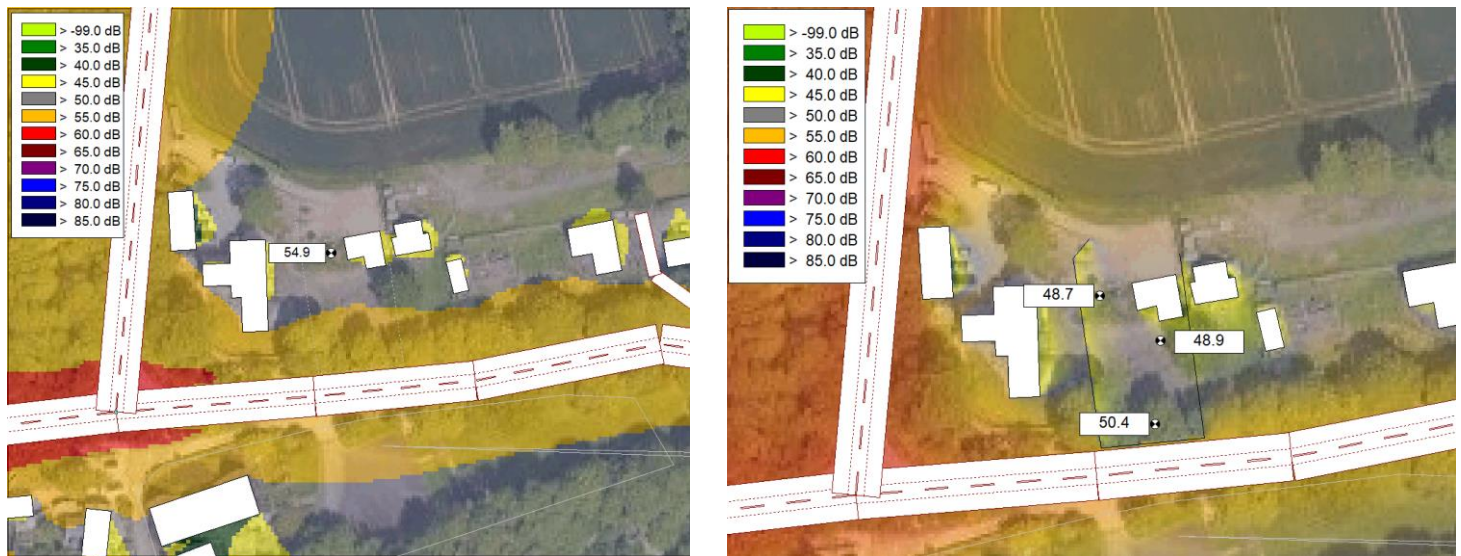
Description	Octave Band Centre Frequency (Hz) Sound Reduction Index $D_{n,e}$ dB					
	125	250	500	1k	2k	4k
Standard non-acoustic trickle ventilator typically $\geq D_{n,e,w} 30\text{dB}$	30	30	30	30	30	28

7.0 Further Discussion and Conclusion

7.0.1 The glazing specification listed in section 6 would be more than suitable based on the calculation methodology in Annex G of BS8233:2014 for noise impact on bedrooms. The example in table 6 would meet specification for both living areas during the day and bedrooms at night.

7.0.2 The outdoor levels are currently measured as 55dBA L_{Aeq_16hrs} in the free-field open space. With the construction of the proposed dwelling and appropriate solid fencing to contain the rear garden there will be more than adequate shielding to reduce the levels within the outdoor space by the required minimum 5dB. As can be seen from figure 4 below, the building and fencing (providing the Western boundary fencing is of a density of at least 10kg/m²) will reduce the outdoor space to 48-50dBA. This model has been created using CadnaA modelling software in accordance with ISO9613.

Figure 5 – background and screened models



7.0.3 The screening means that the entire garden/outdoor space is predicted to be within the 48-50dB mark and therefore complies with BS8233:2014 desirable limit for outdoor areas. As can be seen from the model, the areas closest to the proposed dwelling and the western fence line provide the areas where the outdoor space is below 50dBA L_{Aeq_16hrs} .

7.0.4 The measured values differ by around 3dB from the original assessment. This is mainly due to the presence of construction traffic (which was, however, largely excluded from the measurement) but mainly due to the dual carriageway, the A483 being wet. A 3dB change in level would be an expected variation from wet to dry roads and therefore the second set of measurements are accepted as reliable. The 'flat' nature of the graph in figure 3 shows the dominance of the road as the noise source in the area. The majority of other noises on the recordings were from birds and occasional farm traffic in the distance.

8.0 Credentials

Name	Title	Credentials
James Flitton BSc AMIOA	Acoustic Consultant	CSCS Professionally Qualified person
		Associate Member Institute of Acoustics
		IOA Diploma in Acoustics & Noise Control
		Affiliate Member of IDE
		Affiliate Member of IOR

Signed



Appendix A – Acoustic Terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near (LAeq,T).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20 \mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres

Parameter	Description
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
L_{Aeq,T}	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
L_{max,T}	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L _{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10,T}	A noise level index. The noise level exceeded for 10% of the time over the period T. L ₁₀ can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. L _{A10,18h} is the A-weighted arithmetic average of the 18 hourly L _{A10,1h} values from 06:00-24:00.
L_{90,T}	A noise level index. The noise level exceeded for 90% of the time over the period T. Generally used to describe background noise level.

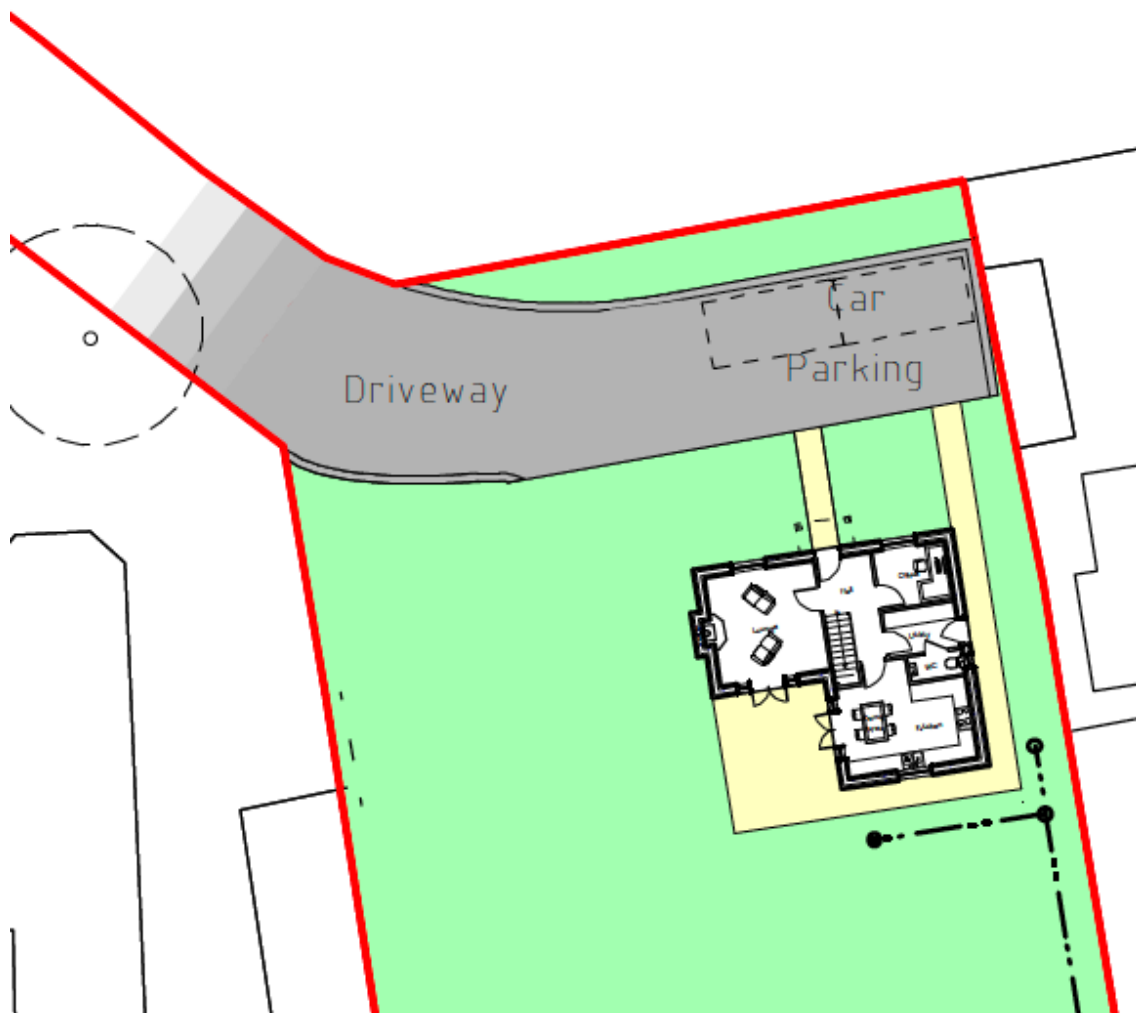
Appendix B - Noise Survey Instrumentation

Type	Manufacturer	Model	Serial Number	Last Cal	Cal Due
SLM	NTi	XL2-TA	A2A-22077-F0	07/02/2023	06/02/2025
Pre-amp	NTi	MA220	11392	07/02/2023	06/02/2025
Microphone	NTi	MC230A	A24696	07/02/2023	06/02/2025
Calibrator	NTi	CAL200	19829	20/11/2023	19/11/2024

Appendix C – Weather Conditions Chart Used

Weather Conditions				
Measurement Location	Date/Time	Description	Beginning of Survey	End of Survey
		Temperature:		
Cloud Cover Symbol Scale in oktas (eighths)  0 Sky completely clear  1  2  3  4 Sky half cloudy  5  6  7  8 Sky completely cloudy  (9) Sky obstructed from view	Precipitation:			
	Cloud cover (oktas - see guide)			
	Presence of fog/snow/ice			
	Presence of damp roads/wet ground			
	Wind Speed (m/s)			
	Wind Direction			
	Conditions that may cause temperature inversion (i.e. calm nights with no cloud)			

Appendix D – Proposed floor plans for the residential dwelling



Appendix E – BS8233:2014 Annex G Calcs

		Octave Band Frequency (Hz)					
		125	250	500	1000	2000	4000
Leq,ff	A	44	47	49	50	48	45
Dn,e		30	30	30	30	30	28
$\frac{A_o}{S} 10^{\frac{-D_{n,e}}{10}}$	B	0.00040	0.00040	0.00040	0.00040	0.00040	0.00064
$\frac{R_{wi}}{S_f} 10^{\frac{-R_{wi}}{10}}$	C	0.00135	0.00340	0.00054	0.00005	0.00003	0.00014
$\frac{R_{ew}}{S_f} 10^{\frac{-R_{ew}}{10}}$	D	0.00002	0.00001	0.00001	0.00000	0.00000	0.00000
$\frac{R_{rr}}{S_f} 10^{\frac{-R_{rr}}{10}}$	E	0.00288	0.00072	0.00018	0.00006	0.00002	0.00001
10log10(B+C+D+E)	F	-23.3	-23.4	-29.5	-32.9	-33.4	-31.0
A (furnished)		11	14	16	16	15	14
$\text{Log}10 \frac{S}{A}$		0.4	0.2	0.2	0.2	0.2	0.2
Leq,2	A+F+G+3	24.0	26.8	22.7	20.3	17.8	17.2
A-weighting		-16	-9	-3	0	1	1
LAeq,2		8.0	17.8	19.7	20.3	18.8	18.2
Total	26.1						