RS Acoustic Engineering

Proposed Residential Development
Holt Road, Wrexham

Noise Assessment Report



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This report has been prepared for the exclusive use of Willowford Homes Ltd for the purpose described herein. The findings are based on site observations, measurements and information available at the time of the survey. Noise levels may vary due to changes in environmental conditions, operational activities and other external influences.

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1. Introduction

1.1 RS Acoustic Engineering Ltd has been appointed by Willowford Homes Ltd to undertake a noise assessment with regard to a proposed development on land to the north of Holt Road, Wrexham, LL13 9SA.

1.2 A planning application has been submitted to Wrexham County Borough Council (ref: P/2026/0055) for 3 detached dwellings with associated landscaping and vehicle parking. There are two existing cottages which are currently vacant and in a state of disrepair. The cottages will be demolished to make way for the new dwellings.

1.3 A noise assessment has been undertaken taking into consideration the guidance contained in Technical Advice Note 11 *Noise*, British Standard 8233:2014 *Guidance on sound insulation and noise reduction for building and* ProPG's *Planning & Noise*.

1.4 The guidance and recommendations given in Approved Document F *Ventilation* and Approved Document O *Overheating* have also been taken into consideration.

1.5 An environmental noise survey has been undertaken by RS Acoustic Engineering to establish the prevailing ambient noise climate during the daytime, evening and night-time period.

1.6 The measured sound level data has been used to determine the acoustic performance requirements for the building envelope construction and to determine whether it will be suitable to naturally ventilate habitable rooms via opening windows.

1.7 Noise ingress through open and closed windows has been assessed and ambient noise within garden areas has also been considered.

1.8 The survey and assessment were conducted by Mr Ryan Swales ($BSc_{(Hons)}$, MIOA), Principal Acoustic Consultant and Member of the Institute of Acoustics.

1.9 The results of the noise survey have been presented, along with the assessment criteria and a discussion of the results with respect to the appropriate guidance and targets.

1.10 Recommendations regarding sound insulation, ventilation and overheating are also provided within this report.

2. Assessment Guidance & Acoustic Criteria

Wrexham County Borough Council Requirements

2.1 Wrexham County Borough Council have provided the following comments regarding the planning application (Ref: P/2026/0055):

RPT 2 - REPORT REQUIRED

(WCBC 53)

Due to the presence of A5156 and A534 near to the proposal. This section is unable to make a recommendation without a noise assessment:

The noise survey shall determine noise levels for both Day (07:00 - 23:00 hours) and Night (23:00 - 07:00 hours), having regard to Planning Policy Wales (PPW) Guidance, Technical Advice Note (TAN) 11 - Noise Guidance on sound insulation and noise reduction for buildings BS8233. The report of the noise survey findings shall include:

a) Noise levels arising from day / night time activities in the vicinity of the proposed development site and the impact upon the proposed accommodation, and

b) A detailed scheme of noise insulation and / or attenuation measures so designed to safeguard the amenity of the occupants of the proposed accommodation.

Technical Advice Note (Wales) 11: Noise

2.2 Paragraph 10 of TAN 11 states the following:

Local planning authorities should consider whether proposals for new noise-sensitive development would be incompatible with existing activities, taking into account the likely level of noise exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future. Such development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise and should not normally be permitted where high levels of noise will continue throughout the night.

2.3 With regard to mitigating the impact of noise, Paragraph 11 states the following:

Measures introduced to control the source of, or limit exposure to, noise should be proportionate and reasonable, and may include:

i. engineering: reduction of noise at point of generation (e.g. using quiet machines and/or quiet methods of working); containment of noise generated (e.g. insulating buildings which house machinery and/or providing purpose-built barriers around sites); protection of surrounding noise-sensitive buildings (e.g. improving sound insulation in these buildings and/or screening them by purpose-built barriers);

ii. lay-out: adequate distance between noise source and noise-sensitive building or area; screening by natural barriers, other buildings, or non-critical rooms in a building;

iii. administrative: limiting operating time of noise source; restricting activities allowed on the site; specifying an acceptable noise limit.

2.4 When assessing a proposal for a new residential development near a source of noise, TAN 11 also states local planning authorities should determine into which of the four noise exposure categories (NECs) the proposed site falls, taking into account both daytime and night-time noise levels.

2.5 A recommended range of noise levels is given for each of the NECs for dwellings exposed to noise from road, rail, air and mixed sources.

2.6 Based on the measured ambient sound pressure levels, the development site falls within NEC B for the daytime and night-time period.

2.7 The following guidance is given with regard to NEC B:

Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.

British Standard 8233:2014: Guidance on sound insulation and noise reduction for buildings

2.8 BS 8233 provides guidance regarding acoustic criteria and noise levels appropriate for various types of space that have different functions.

2.9 With regard to dwellings, appropriate internal ambient sound levels are given in Table 2.1 for bedrooms, living rooms and dining rooms. The guidelines take into consideration the effect of internal noise on sleep and also the effect of noise on resting, listening and communicating.

Table 2.1 - Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	---
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	---
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

2.10 Note 7 of the standard states the following:

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

2.11 Note 5 also states:

If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.

2.12 With regard to outdoor living areas (gardens), the following guidance is given:

"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 can 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."

World Health Organisation: Guidelines for community noise (1999)

2.13 To help avoid sleep disturbance within bedrooms, this historical guidance document recommends that the night-time internal ambient sound level should not exceed 30 dB $L_{Aeq,T}$ and the maximum sound level should not typically exceed 45 dB $L_{AFmax,T}$.

2.14 The corresponding values directly outside of bedroom windows are therefore 45 dB $L_{Aeq,8hour}$ and 60 dB $L_{AFmax,T}$. This is based on the assumption that a partially open window provides approximately 15 dB of sound attenuation (from external noise).

2.15 With regard to sleep disturbance and maximum L_{AFmax} sound levels, the study undertaken by Vallet & Vernet (1991) suggests that for good sleep, indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night.

Professional Practice Guidance on Planning & Noise (2017)

2.16 Professional Practice Guidance on Planning and Noise (ProPG) has been produced in order to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

2.17 The NPPF encourages improved standards of design. This guidance document encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise.

2.18 The scope of ProPG is restricted to the consideration of new residential development that will be exposed predominantly to airborne noise from transportation sources.

Internal noise level guidelines

2.19 The recommended ProPG internal noise level guidelines are presented in Table 2.2. The guidelines reflect and extend current practice contained within BS 8233:2014.

Table 2.2 - ProPG internal noise level guidelines

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	---
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	---
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB $L_{Amax,F}$

2.20 Where the local planning authority accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment.

2.21 In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "*whole dwelling ventilation*" in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position.

2.22 It should also be noted that the internal noise level guidelines are generally not applicable under "*purge ventilation*" conditions as defined by Building Regulations Approved Document F, as this should only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food).

External noise and amenity areas

2.23 The ProPG external amenity area noise assessment reflects and extends the advice contained in BS 8233 and is summarised as follows:

"(i) If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

(ii) The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.

(iii) These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.

(iv) Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.

(v) Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- *a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *a relatively quiet, protected, publically accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations."*

Approved Document O: Overheating (The Building Regulations 2010)

2.24 Approved Document O (ADO) came into effect on 23 November 2022 for use in Wales. The approved document provides guidance on how to comply with Part O of the Building Regulations and applies to new residential buildings only.

2.25 The aim of requirement O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

2.26 In the Welsh Ministers view requirement O1 is met by designing and constructing the building to achieve both of the following.

a. *Limiting unwanted solar gains in summer.*

b. *Providing an adequate means of removing excess heat from the indoor environment.*

2.27 In the Welsh Ministers view, compliance with requirement O1 can be demonstrated by using either of the two following methods.

a. *The simplified method for limiting solar gains and a means of removing excess heat, as set out in Section 1.*

b. The dynamic thermal modelling method, as set out in Section 1.

2.28 In the Welsh Ministers' view, requirement O1(2)(a) is met in a new residential building if the building's overheating mitigation strategy for use by occupants takes account of noise at night, pollution, security, protection from falling and protection from entrapment.

2.29 Section 2 of the document states the following with regard to noise and opening windows:

2.1 The standards in this section may mean that the standards of the simplified method cannot be met. For example, if external noise is an issue, it is unlikely that windows would be opened by an occupant and therefore the minimum free areas of the simplified method cannot be met. In such cases, dynamic thermal modelling should be used.

Noise at night

2.2 High levels of external noise could limit the use of cross-ventilation to mitigate the risk of summer overheating. External noise is a material consideration considered when applying for Planning permission and mitigating measures may be required in the design in order to obtain Planning permission and controlled through a condition imposed on the consent. In exceptional cases, this could include non-openable windows. More commonly, windows will be openable in order to enable natural ventilation to occur at less sensitive times of day, when there is lower noise, when people are not present in the room, or when they are present but not engaged in noise-sensitive activities. But those windows may need to be kept closed at times to maintain acceptable indoor acoustic conditions, for example when people are using the rooms for sleep or office work. A noise issue may be identified at the Planning stage but rely on occupants to close windows at noise-sensitive times rather than prevent them from ever opening them, and in those cases overheating strategies should assume windows will be closed during noise-sensitive periods even if they are not fixed closed.

2.3 When removing excess heat as part of the overheating strategy, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23:00 – 07:00. Building control bodies may accept as evidence that this requirement is satisfied:

a. documentation to demonstrate that the local planning authority did not consider external noise to be an issue at the site at the planning stage or;

b. if the local planning authority did consider external noise to be an issue that should be controlled through a condition at planning stage, then documentation to demonstrate that the proposals for heat removal (during the sleeping hours of 23.00 – 07.00) are accommodated within or do not conflict with documentation provided to the local planning authority to satisfy any related planning permission condition(s). (For example any expectation that windows on one or more façade, or in certain rooms, will need to be kept closed during noise-sensitive periods.)

2.4 Where active measures (e.g. mechanical system) are used for removing excess heat within the overheating strategy, the noise generated by these measures, particularly within bedrooms and living rooms should be considered. Noise generated by ventilation/cooling systems (which may travel through ducts) and noise from the fan unit may disturb the occupants of the building and so discourage their use. Therefore, the designer should consider minimising noise by careful design and the specification of quieter products. Further guidance on mechanical ventilation systems can be found in Approved Document F.

3. Environmental Noise Survey

Survey methodology

3.1 An environmental noise survey has been conducted to establish the prevailing ambient noise climate during the daytime and night-time period.

3.2 Continuous sound level monitoring was conducted over a 95.5-hour period at the east facing elevation of the existing cottages. The measurement microphone was fixed to the façade at first floor level, approximately 3 metres from the ground.

3.3 Measurements were conducted from 12:30 hours on Thursday 10 through to 12:00 hours on Monday 14 September 2026.

3.4 Sample measurements were also conducted during the daytime period to the rear of the cottages to determine the reduction in sound level due to acoustic screening.

3.5 Measurements were subject to sound reflections from the façade (i.e. as opposed to free-field) and a measurement interval of 2-minutes was used for the survey. One-third octave band and A-weighted broadband sound pressure levels were recorded during the survey.

3.6 The site location, surrounding area and survey measurement positions are shown in Figure 3.1 and Figure 3.2 overleaf.

3.7 The current site plan, floor plans and elevations are presented in Appendix A.

Figure 3.1 - Site location and survey measurement positions (source: Google Earth)

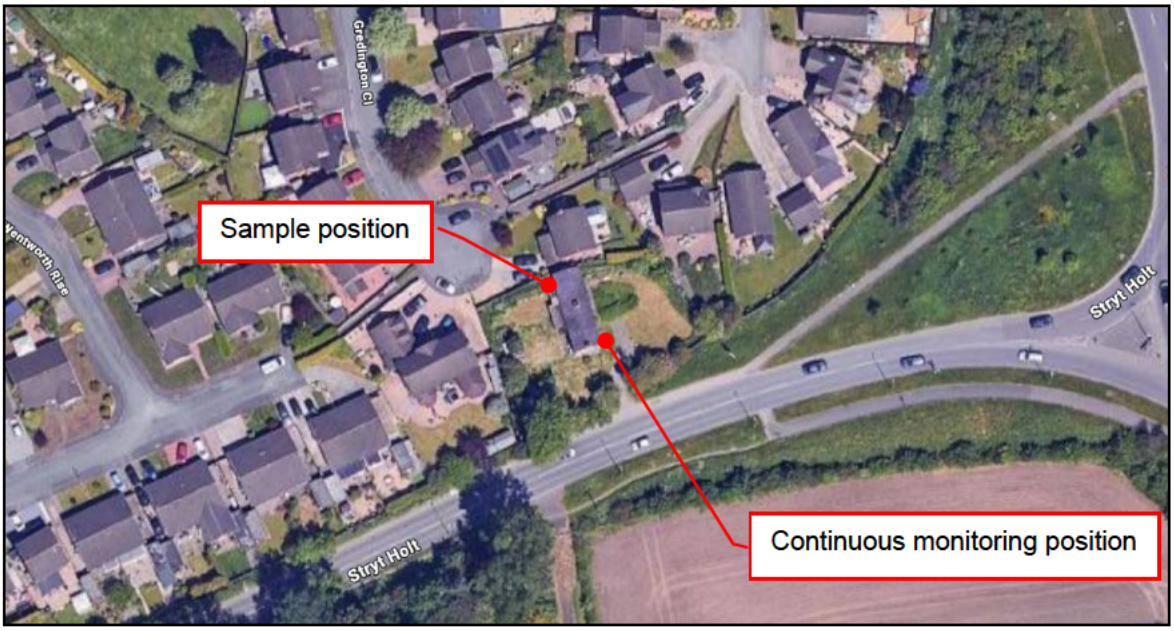
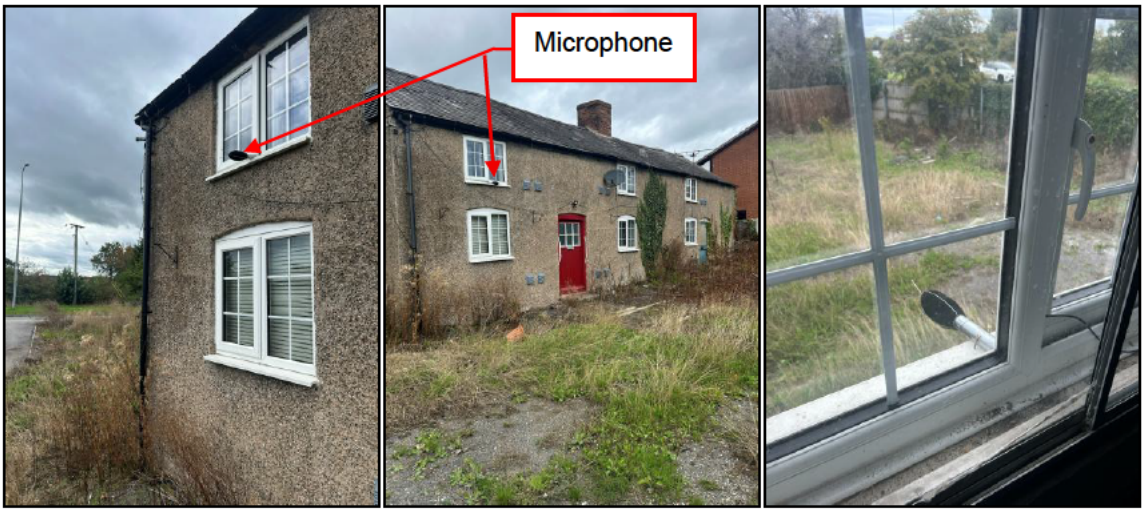


Figure 3.2 - Photographs showing continuous measurement position



Survey equipment

3.8 The survey was conducted using the following Class-1 specification equipment:

- NTi XL2 sound level meter, microphone type MC230A, pre-amplifier type MA220.
- Brüel & Kjaer 2250 sound level meter, microphone type 4189, pre-amplifier type ZC0032.
- Larson Davis CAL200 Acoustic calibrator.

3.9 Calibration of the sound level meter and microphone used for the measurements is traceable to UKAS accredited laboratories.

3.10 The calibration of both sound level meter and microphone was checked using a 1 kHz tone at 94 dB prior to and following the measurements performed. Calibration drift was less than 0.1 dB.

Weather conditions

3.11 The weather conditions during the survey were generally dry and fine with sunny intervals and intermittent light cloud cover. There was an occasional light breeze and wind speed measurements taken on-site were between 0.1 and 1.0 m/s^{-1}.

3.12 The air temperature during the survey ranged between 8°C and 19°C. The overall weather conditions were suitable to obtain representative measurements.

Observations and comments regarding the acoustic environment

3.13 The dominant and most consistent source of noise at the site is road traffic on the A5156 and A534 to the east and Holt Road (Stryt Holt) to the south.

3.14 There is a service station located to the north-east approximately 150 metres from the site boundary. There is no audible noise from the service station at the development site.

3.15 Other audible sources of noise include high altitude aircraft and domestic activity at neighbouring residential properties.

3.16 During the survey, there was no audible noise of an industrial or commercial nature impacting on the site (e.g. from building services plant, machinery and equipment).

Measured noise indices

3.17 Although a wide range of statistical sound level data was recorded during the survey, the L_{Aeq} and L_{AFmax} indices are of most interest for this assessment:

- $L_{Aeq,T}$ - The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period and commonly used to describe the 'ambient' sound level.
- $L_{AFmax,T}$ - The A-weighted 'maximum' sound pressure level that occurred during a given period, T. Commonly used for the assessment of occasional and transient loud noises.

3.18 Sound pressure level measurements are taken with an A-weighting (denoted by a subscript 'A', e.g. L_{Aeq}) to approximate the frequency response of the human ear.

3.19 Further information regarding the basic quantities used for the description of noise in community environments can be found in BS 7445-1:2003.

Results summary

3.20 Table 3.1 presents a summary of the measured ambient L_{Aeq} and L_{AFmax} sound pressure levels at the continuous monitoring position. Measured values have been rounded to the nearest whole number.

Table 3.1 - Summary of continuously measured sound pressure levels

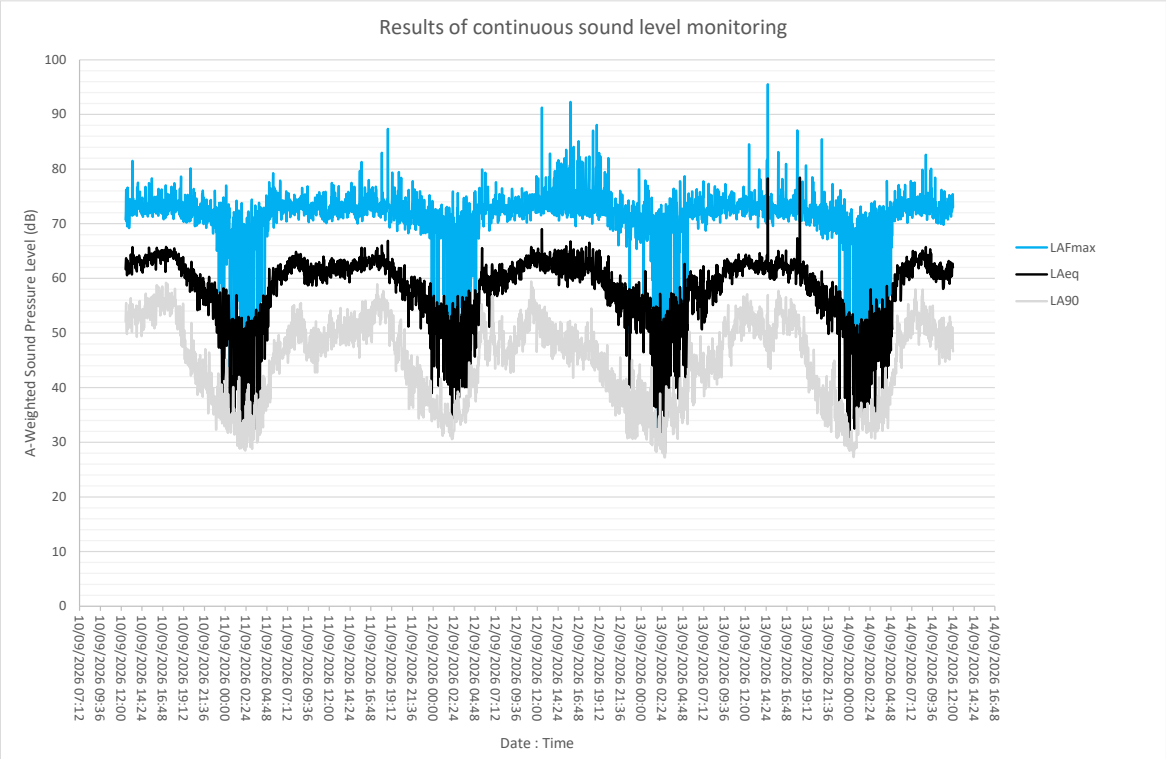
Date	Period	Duration, T (hours)	$L_{Aeq,T}$ dB	10th Highest[1] $L_{AFmax,T}$ dB	15th Highest[2] $L_{AFmax,T}$ dB
Thursday 10/09/2026	Daytime (12:30-23:00)	10.5	62	---	---
	Night-time (23:00-07:00)	8	57	76	75
Friday 11/09/2026	Daytime (07:00-23:00)	16	62	---	---
	Night-time (23:00-07:00)	8	56	75	74
Saturday 12/09/2026	Daytime (07:00-23:00)	16	62	---	---
	Night-time (23:00-07:00)	8	56	76	75
Sunday 13/09/2026	Daytime (07:00-23:00)	16	62	---	---
	Night-time (23:00-07:00)	8	56	75	74
Monday 14/09/2026	Daytime (07:00-12:00)	5	62	---	---

[1]The 10th highest measured value. [2]The 15th highest measured value (note: indoor sound pressure levels should ideally not exceed 45 dB L_{Amax} more than 10-15 times per night). ---Daytime values are not presented since there is no L_{AFmax} target for the daytime period.

3.21 The daytime ambient sound pressure level was approximately 62 dB $L_{Aeq,16hour}$ and the night-time ambient sound pressure level was approximately 56 to 57 dB $L_{Aeq,8hour}$.

3.22 The measured sound pressure levels are presented graphically in Figure 3.3.

Figure 3.3 - Graph showing results of continuous sound level monitoring



Sample measurement position

3.23 The daytime ambient sound pressure levels ranged between 49 to 50 dB $L_{Aeq,2min}$.

3.24 The measured sound pressure levels were approximately 12 dB lower than those measured simultaneously at the continuous monitoring position.

4. Assessment & Discussion

Building envelope construction and acoustic performance

4.1 External walls are expected to be of a brickwork/cavity/blockwork construction. The sound insulation performance of such a construction is typically in the region of 45 to 55 dB R_w+C_{tr}.

4.2 A tiled roof construction with mineral wool (loft) insulation and an internal plasterboard finish typically provides a sound insulation performance in the region of 39 to 43 dB R_w+C_{tr}.

4.3 Standard double glazing typically provides a sound insulation performance in the region of 25 to 30 dB R_w+C_{tr}.

- 6 mm glass / 16 mm - 20 mm cavity / 4 mm glass (28 - 30 dB R_w+C_{tr})
- 6 mm glass / 16 mm - 20 mm cavity / 6 mm glass (27 - 29 dB R_w+C_{tr})
- 4 mm glass / 16 mm - 20 mm cavity / 4 mm glass (25 - 27 dB R_w+C_{tr})

4.4 Laminated (acoustic) double glazing as is commonly used within dwellings provides a sound insulation performance in the region of 31 to 37 dB R_w+C_{tr}.

- 6 mm glass / 16 mm - 20 mm cavity / 10.8 mm acoustic laminate (35 - 37 dB R_w+C_{tr})
- 6 mm glass / 16 mm - 20 mm cavity / 8.8 mm acoustic laminate (33 - 35 dB R_w+C_{tr})
- 6 mm glass / 16 mm - 20 mm cavity / 6.8 mm acoustic laminate (31 - 33 dB R_w+C_{tr})

4.5 The glazing is expected to be the weakest element with regard to the building envelope sound insulation (excluding ventilator units).

4.6 As an example, Pilkington Optiphon or Stadip Silence is a high performing acoustic laminate that can be used within double glazed systems.

- www.pilkington.com/en-gb/uk/products/product-categories/noise-control/pilkington-optiphon/
- SGG STADIP SILENCE® | Saint-Gobain Building Glass (saint-gobain-building-glass.com)

4.7 The acoustic performance of a particular construction may differ slightly between manufacturers and therefore the sound insulation performance should be verified where possible.

4.8 The quantity R_w is the weighted sound reduction index expressed in dB. It is a single number quantity for rating airborne sound insulation. The 'C_{tr}' term is added to the single number rating R_w to take account of the characteristics of particular sound spectra (e.g. road traffic).

4.9 To achieve the optimum performance, external windows should be well sealed around the frame when installed. Large gaps between the frame and the brickwork and poorly sealed frames can notably reduce performance.

Noise ingress with windows closed

4.10 Noise ingress calculations are presented below for the proposed habitable rooms on the front and rear elevations.

4.11 For the habitable rooms on the front elevation, the 16-hour daytime ambient sound pressure level has been used in the calculations (62 dB $L_{Aeq,16hour}$). For the habitable rooms on the rear elevation, the ambient sound pressure level has been reduced by 12 dB to account for acoustic screening.

4.12 The calculations take into account the typical sound insulation performance of each building element, surface area and internal room dimensions.

4.13 Standard thermal double glazing consisting of 4 mm glass / 16 to 20 mm cavity / 4 mm glass has been assumed for the habitable room. The measured octave band sound levels and the typical reverberation time for a habitable room have also been taken into consideration.

Living room, kitchen/dining room & snug

4.14 Table 4.1 to Table 4.3 present the calculation results for the ground floor living room, open-plan kitchen/dining room and snug.

Table 4.1 - Noise ingress calculation: Living room with standard double glazing

Living room **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				27.8	23.9	31.8	41.6	43.8	37.9			
L_{in}				30.2	33.1	24.2	18.4	8.2	1.1			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.3		21.0	17.0	25.0	35.0	37.0	31.0		29	(-1,-4)
Brickwork / blockwork cavity wall		7.3		40.0	44.0	45.0	51.0	56.0	60.0		51	(-1,-4)
$L_{out,s}$												
$L_{out,2m}$	Add Element			58.0	57.0	56.0	60.0	52.0	39.0		62	
$L_{out,free\ field}$				55.0	54.0	53.0	57.0	49.0	36.0		59	
Element 1				27.8	23.9	31.8	41.6	43.8	37.9			
Plane façade	ΔL_{fs}	9.6		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		27.8	23.9	31.8	41.6	43.8	37.9			
$L_{p,out,2m}$				58.0	57.0	56.0	60.0	52.0	39.0		62	
$L_{p,in}$				30.2	33.1	24.2	18.4	8.2	1.1		27	dBA

Table 4.2 - Noise ingress calculation: Kitchen/dining room with standard double glazing

Kitchen/dining **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				24.9	21.0	28.9	38.8	40.9	35.0			
L_{in}				21.1	24.0	15.1	9.2	-0.9	-8.0			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		8.2		21.0	17.0	25.0	35.0	37.0	31.0		29	(-1,-4)
Brickwork / blockwork cavity wall		16.3		40.0	44.0	45.0	51.0	56.0	60.0		51	(-1,-4)
$L_{out,s}$												
$L_{out,2m}$	Add Element			46.0	45.0	44.0	48.0	40.0	27.0		50	
$L_{out,free\ field}$				43.0	42.0	41.0	45.0	37.0	24.0		47	
Element 1				24.9	21.0	28.9	38.8	40.9	35.0			
Plane façade	ΔL_{fs}	24.5		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		24.9	21.0	28.9	38.8	40.9	35.0			
$L_{p,out,2m}$				46.0	45.0	44.0	48.0	40.0	27.0		50	
$L_{p,in}$				21.1	24.0	15.1	9.2	-0.9	-8.0		18	dBA

Table 4.3 - Noise ingress calculation: Snug with standard double glazing

Snug **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				25.2	21.3	29.2	39.0	41.2	35.4			
L_{in}				32.8	35.7	26.8	21.0	10.8	3.6			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.3		21.0	17.0	25.0	35.0	37.0	31.0		**29**	**(-1,-4)**
Brickwork / blockwork cavity wall		7.3		40.0	44.0	45.0	51.0	56.0	60.0		**51**	**(-1,-4)**
$L_{out,s}$												
$L_{out,2m}$	Add Element			58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{out,free\ field}$				55.0	54.0	53.0	57.0	49.0	36.0		**59**	
Element 1				25.2	21.3	29.2	39.0	41.2	35.4			
Plane façade	ΔL_{fs}	9.6		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		25.2	21.3	29.2	39.0	41.2	35.4			
$L_{p,out,2m}$				58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{p,in}$				32.8	35.7	26.8	21.0	10.8	3.6		**30**	**dBA**

4.15 The calculation results indicate a daytime internal sound level of approximately 18 to 30 dB $L_{Aeq,16hour}$ with standard thermal double glazing.

4.16 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ for living rooms and 40 dB $L_{Aeq,16hour}$ for dining rooms will therefore be easily achieved with windows closed. The predictions indicate a notable improvement on the recommended design targets.

4.17 There is no night-time sound level target for living rooms and dining rooms.

Bedrooms

4.18 Table 4.4 to Table 4.7 present the calculation results for the first-floor bedrooms.

Table 4.4 - Noise ingress calculation: Bedroom 1 with standard double glazing

Bedroom 1 **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				25.3	23.0	30.7	39.9	42.4	37.1			
L_{in}				20.7	22.0	13.3	8.1	-2.4	-10.1			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.2		21.0	17.0	25.0	35.0	37.0	31.0		**29**	**(-1,-4)**
Brickwork / blockwork cavity wall		7.2		40.0	44.0	45.0	51.0	56.0	60.0		**51**	**(-1,-4)**
Tiled roof, insulation, plasterboard ceiling		11.3		31.0	37.0	43.0	48.0	52.0	53.0		**47**	**(-2,-5)**
$L_{out,s}$												
$L_{out,2m}$	Add Element			46.0	45.0	44.0	48.0	40.0	27.0		**50**	
$L_{out,free\ field}$				43.0	42.0	41.0	45.0	37.0	24.0		**47**	
Element 1				25.3	23.0	30.7	39.9	42.4	37.1			
Plane façade	ΔL_{fs}	20.7		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		25.3	23.0	30.7	39.9	42.4	37.1			
$L_{p,out,2m}$				46.0	45.0	44.0	48.0	40.0	27.0		**50**	
$L_{p,in}$				20.7	22.0	13.3	8.1	-2.4	-10.1		**16**	**dBA**

Table 4.5 - Noise ingress calculation: Bedroom 2 with standard double glazing

Bedroom 2 **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				24.9	22.4	30.2	39.5	41.9	36.5			
L_{in}				21.1	22.6	13.8	8.5	-1.9	-9.5			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.2		21.0	17.0	25.0	35.0	37.0	31.0		**29**	**(-1,-4)**
Brickwork / blockwork cavity wall		5.5		40.0	44.0	45.0	51.0	56.0	60.0		**51**	**(-1,-4)**
Tiled roof, insulation, plasterboard ceiling		9.9		31.0	37.0	43.0	48.0	52.0	53.0		**47**	**(-2,-5)**
$L_{out,s}$												
$L_{out,2m}$	Add Element			46.0	45.0	44.0	48.0	40.0	27.0		**50**	
$L_{out,free\ field}$				43.0	42.0	41.0	45.0	37.0	24.0		**47**	
Element 1				24.9	22.4	30.2	39.5	41.9	36.5			
Plane façade	ΔL_{fs}	17.6		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		24.9	22.4	30.2	39.5	41.9	36.5			
$L_{p,out,2m}$				46.0	45.0	44.0	48.0	40.0	27.0		**50**	
$L_{p,in}$				21.1	22.6	13.8	8.5	-1.9	-9.5		**17**	**dBA**

Table 4.6 - Noise ingress calculation: Bedroom 3 with standard double glazing

Bedroom 3 **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				25.5	23.2	31.0	40.2	42.6	37.3			
L_{in}				32.5	33.8	25.0	19.8	9.4	1.7			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.2		21.0	17.0	25.0	35.0	37.0	31.0		**29**	**(-1,-4)**
Brickwork / blockwork cavity wall		7.2		40.0	44.0	45.0	51.0	56.0	60.0		**51**	**(-1,-4)**
Tiled roof, insulation, plasterboard ceiling		12.1		31.0	37.0	43.0	48.0	52.0	53.0		**47**	**(-2,-5)**
$L_{out,s}$												
$L_{out,2m}$	Add Element			58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{out,free\ field}$				55.0	54.0	53.0	57.0	49.0	36.0		**59**	
Element 1				25.5	23.2	31.0	40.2	42.6	37.3			
Plane façade	ΔL_{fs}	21.5		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		25.5	23.2	31.0	40.2	42.6	37.3			
$L_{p,out,2m}$				58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{p,in}$				32.5	33.8	25.0	19.8	9.4	1.7		**28**	**dBA**

Table 4.7 - Noise ingress calculation: Bedroom 4 with standard double glazing

Bedroom 4 **Noise Break In (ISO 12354-3)**												
Formula/Comment	***Single Value***		***63***	***125***	***250***	***500***	***1000***	***2000***	***4000***	***8000***	***Rw***	***(C,C$_{tr}$)***
				24.3	21.6	29.4	38.8	41.2	35.7			
L_{in}				33.7	35.4	26.6	21.2	10.8	3.3			
Materials												
4mm glass/16 - 20 mm cavity/4mm glass		2.2		21.0	17.0	25.0	35.0	37.0	31.0		**29**	**(-1,-4)**
Brickwork / blockwork cavity wall		7.2		40.0	44.0	45.0	51.0	56.0	60.0		**51**	**(-1,-4)**
Tiled roof, insulation, plasterboard ceiling		8.2		31.0	37.0	43.0	48.0	52.0	53.0		**47**	**(-2,-5)**
$L_{out,s}$												
$L_{out,2m}$	Add Element			58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{out,free\ field}$				55.0	54.0	53.0	57.0	49.0	36.0		**59**	
Element 1				24.3	21.6	29.4	38.8	41.2	35.7			
Plane façade	ΔL_{fs}	17.6		0.0	0.0	0.0	0.0	0.0	0.0			
Visible	x_{fs}	0.0		24.3	21.6	29.4	38.8	41.2	35.7			
$L_{p,out,2m}$				58.0	57.0	56.0	60.0	52.0	39.0		**62**	
$L_{p,in}$				33.7	35.4	26.6	21.2	10.8	3.3		**30**	**dBA**

4.19 The calculation results indicate a daytime internal sound level of approximately 16 to 30 dB $L_{Aeq,16hour}$ with standard thermal double glazing.

4.20 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ for bedrooms will therefore be easily achieved with windows closed. The predictions indicate a notable improvement on the recommended design targets.

4.21 Since the night-time L_{Aeq} sound level is circa 5 dB lower than the daytime sound level, the night-time target of 30 dB $L_{Aeq,8hour}$ will also be easily achieved within bedrooms.

4.22 The recommended maximum sound level target of 45 dB L_{AFmax} will also be achieved within bedrooms during the night.

- 76 dB $L_{AFmax,2min}$ – 32 dB R_w+C_{tr} = 44 dB $L_{AFmax,2min}$

4.23 Based on this assessment, standard thermal double glazing will be suitable for all elevations. Acoustically laminated double glazing is unnecessary.

4.24 A suitable glazing construction would be 4 mm glass/16 to 20 mm cavity/4 mm glass, 6 mm glass/16 to 20 mm cavity/6 mm glass or alternatively 4 mm glass/16 to 20 mm cavity/6 mm glass.

Noise ingress with windows open

Sound attenuation of an open window

4.25 The level of sound attenuation through an open window is dependent on the type and size of window, the extent of opening, the angle of sound incidence and the acoustic characteristics of the source in question.

4.26 With regard to the sound insulation provided by partially open windows, BS 8233 provides the following guidance:

If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB[3]. [3)] Note that the level difference through a window partially open for ventilation can vary significantly depending on the window type and the frequency content of the external noise. If the specific details of the window and external noise are known the value for insulation may be adjusted accordingly.

4.27 The *Acoustics Ventilation and Overheating: Residential Design Guide* states 13 dB is an appropriate estimate of the typical outside-to-inside level difference for a partially open residential window (based on field and laboratory measurements from two studies).

4.28 For this assessment, a sound insulation performance of approximately 13 to 15 dB has been assumed for a partially open window.

Resulting internal sound level with windows open - front elevation

4.29 The ambient L_{Aeq} sound pressure level is 62 dB $L_{Aeq,16hour}$ during the daytime and 56 to 57 dB $L_{Aeq,8hour}$ during the night-time.

4.30 When assessing noise ingress through an open window, it is appropriate to correct the measured façade sound levels by approximately -3 dB to give an equivalent ‘free-field’ sound level.

4.31 The corresponding free-field sound pressure levels are therefore 59 dB $L_{Aeq,16hour}$ during the daytime and 53 to 54 dB $L_{Aeq,8hour}$ during the night-time.

4.32 On this basis, the estimated internal ambient sound pressure level is approximately 44 to 46 dB $L_{Aeq,16hour}$ during the daytime and 38 to 41 dB $L_{Aeq,8hour}$ during the night-time.

Daytime

- 59 dB $L_{Aeq,16hour}$ – 13 dB = 46 dB $L_{Aeq,16hour}$
- 59 dB $L_{Aeq,16hour}$ – 15 dB = 44 dB $L_{Aeq,16hour}$

Night-time

- 54 dB $L_{Aeq,8hour}$ – 13 dB = 41 dB $L_{Aeq,8hour}$
- 54 dB $L_{Aeq,8hour}$ – 15 dB = 39 dB $L_{Aeq,8hour}$
- 53 dB $L_{Aeq,8hour}$ – 13 dB = 40 dB $L_{Aeq,8hour}$
- 53 dB $L_{Aeq,8hour}$ – 15 dB = 38 dB $L_{Aeq,8hour}$

4.33 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ and the night-time target of 30 dB $L_{Aeq,8hour}$ will therefore not be achieved with windows open.

4.34 The maximum sound level target of 45 dB L_{AFmax} will also not be achieved during the night-time within the front bedrooms.

BS 8233 comments regarding alternative ventilation to habitable rooms

4.35 BS 8233 states where occupants rely on closed windows to meet the internal noise limits, there needs to be appropriate alternative ventilation that does not compromise the facade sound insulation or resulting internal sound level.

4.36 The standard also states the following:

The Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

4.37 Since the targets will not be achieved with windows open, it is recommended that an alternative means of ventilation is provided to the living room, snug and bedrooms (bedroom 3 and 4) on the front elevation (in addition to simply opening windows).

4.38 Taking into consideration the measured sound pressure levels, it would be appropriate to install a good quality acoustic (sound attenuating) ventilator unit to the window frame of the habitable room.

4.39 Installing a ventilator unit directly through a wall that provides the equivalent areas described in Approved Document F can also be an acceptable route to compliance (as opposed to installing the ventilator unit within the window frame).

4.40 The ventilator unit should provide a sound insulation performance of at least 36 dB $D_{n,e,w}$ in the open position.

4.41 Further guidance regarding acoustic ventilator types and performance is provided in Section 5 of this report.

4.42 Fully opening windows will be suitable for providing rapid or purge ventilation (e.g. to remove odour from painting and decorating or from burnt food). Internal noise level guidelines are generally not applicable under "*purge ventilation*" conditions as defined by Approved Document F of the Building Regulations 2010.

4.43 Alternatively, a mechanically assisted ventilation system (MVHR or PIV system) could be installed within the new dwellings (i.e. as opposed to installing sound attenuating ventilator units).

4.44 Extract fans will be required to remove stale moist air from kitchens, bathrooms and utility rooms.

Resulting internal sound level with windows open - rear elevation

4.45 The free-field sound pressure level is expected to be approximately 12 dB lower at the rear elevation and therefore the estimated internal ambient sound pressure level is approximately 32 to 34 dB $L_{Aeq,16hour}$ during the daytime and 26 to 29 dB $L_{Aeq,8hour}$ during the night-time.

Daytime

- 47 dB $L_{Aeq,16hour}$ – 13 dB = 34 dB $L_{Aeq,16hour}$
- 47 dB $L_{Aeq,16hour}$ – 15 dB = 32 dB $L_{Aeq,16hour}$

Night-time

- 42 dB $L_{Aeq,8hour}$ – 13 dB = 29 dB $L_{Aeq,8hour}$
- 42 dB $L_{Aeq,8hour}$ – 15 dB = 27 dB $L_{Aeq,8hour}$
- 41 dB $L_{Aeq,8hour}$ – 13 dB = 28 dB $L_{Aeq,8hour}$
- 41 dB $L_{Aeq,8hour}$ – 15 dB = 26 dB $L_{Aeq,8hour}$

4.46 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ and the night-time target of 30 dB $L_{Aeq,8hour}$ will therefore be achieved with windows open.

4.47 The maximum sound level target of 45 dB L_{AFmax} will also be achieved during the night-time within the bedrooms on the rear elevation.

~~4.48~~ It is important to note that the estimations above do not include the slight sound reduction that can occur due to soft absorptive finishes within the room (e.g. carpet, curtains, upholstery etc). In practice, internal sound levels are likely to be marginally lower than those estimated in this assessment.

4.49 It will therefore be appropriate to naturally ventilate habitable rooms on the rear elevation via opening windows. Where required to satisfy Approved Document F, standard non-acoustic hit-and-miss trickle vents can be installed to provide background ventilation with windows closed.

4.50 A window with a 'night-latch' position is not adequate for background ventilation due to the risk of draughts, security issues and difficulty of measuring the equivalent area.

Overheating, night-time noise and opening windows

4.51 With regard to noise at night and opening windows, Approved Document O states the following:

When removing excess heat as part of the overheating strategy, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23:00 – 07:00.

4.52 The survey and assessment results indicate that it will be suitable during the night to open bedroom windows on the rear elevation to help cool and remove excess heat.

4.53 An alternative means of removing excess heat should be provided for the bedrooms on the front elevation (in addition to opening windows).

Garden ambient sound levels

4.54 With regard to outdoor living areas (gardens), BS 8233 provides the following guidelines:

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 can 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.

4.55 ProPG also states the following with regard to noise levels:

The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.

4.56 The measured daytime façade sound pressure level is approximately 62 dB $L_{Aeq,16hour}$ and the free-field sound pressure level is approximately 59 dB $L_{Aeq,16hour}$.

4.57 As a result of reorientating the new dwellings to face Holt Road, the rear garden areas will be acoustically screened from passing road traffic. The ambient sound pressure level will therefore be notably lower in the rear gardens of the new dwellings when compared to the existing cottages.

4.58 Taking into consideration the reduction in sound pressure level due to acoustic screening (from neighbouring properties and the new dwellings once constructed) the free-field ambient sound pressure level is expected to be approximately 47 dB $L_{Aeq,16hour}$.

4.59 It is therefore anticipated that the daytime ambient sound level will easily achieve the guideline values of 50 to 55 dB $L_{Aeq,16hour}$.

4.60 The anticipated ambient sound level is ideal for outdoor amenity space and it is unlikely that future residents will be adversely affected by road traffic noise.

4.61 An acoustic fence along the garden/property boundary line is therefore unnecessary.

5. Ventilation & Noise Mitigation Options

Acoustically rated ventilator units

5.1 Manually controlled trickle ventilators (the most common type of background ventilators) can be located over the window frames, in window frames or just above the glass. Background ventilators are intended to normally be left open.

5.2 Ventilation should be controllable. Controls may be either manual (i.e. operated by the occupant) or automatic. Background ventilators should be at least 1700 mm above floor level, to reduce cold draughts, but still be easy for the occupant to reach.

5.3 Installing a background ventilator directly through a wall that provides the equivalent areas described in Approved Document F can also be an acceptable route to compliance.

5.4 Sound attenuating (acoustically rated) ventilator units can be installed to habitable rooms on the front elevation in order to allow background ventilation whilst maintaining a high sound insulation performance from the façade.

5.5 The ventilator unit should provide a sound insulation performance of at least **36 dB $D_{n,e,w}$** in the open position.

5.6 This performance recommendation is not an onerous requirement and is easily achieved with most proprietary products.

5.7 For guidance, example manufacturers of acoustically-rated ventilator units include:

- EHA² | Aereco
- 2500EA/5000EA AC1 (greenwood.co.uk)
- glazed in acoustic vents - Airvent DGL SUPER (brookvent.co.uk)

5.8 The minimum ‘equivalent area’ of background ventilators for natural ventilation should follow the guidance in Table 1.7 of Approved Document F for each room type.

5.9 Bathrooms, toilets, utility rooms and circulation areas do not require sound attenuating ventilator units. Standard non-acoustic trickle vents may be fitted to achieve the required equivalent area.

5.10 It should be noted that a window with a ‘night-latch’ position is not adequate for background ventilation, due to the risk of draughts, security issues and the difficulty of measuring the equivalent area.

Mechanically assisted ventilation

5.11 A further alternative option with regard to ventilating and cooling habitable rooms whilst achieving a high facade sound insulation would be to use a mechanical ventilation system, such as a heat recovery system (MVHR) or positive input ventilation system (PIV).

5.12 Example suppliers of MVHR and PIV systems include:

- www.nuaire.co.uk/residential/positive-input-ventilation
- www.envirovent.com/specifier/products/heat-recovery-systems/
- www.envirovent.com/specifier/products/positive-input-ventilation/
- MVHR | Greenwood

5.13 Appropriate dwelling ventilation rates will depend on the number of bedrooms within the dwelling and the anticipated occupancy rate (refer to Approved Document F for guidance). Such systems

can also be supplied with a 'boost' function in order to reduce the need to open windows for purge ventilation.

5.14 With a loft mounted motor and control unit, particular attention should be paid to the construction of bedroom ceilings and the mounting of the motor unit in order to minimise the noise transmission into adjacent rooms. It is commonplace for a double-boarded ceiling construction and acoustically enhanced loft-hatch to be used where there is a loft mounted motor/control unit.

5.15 To avoid unintended air pathways, background ventilators should not be installed with mechanical ventilation with heat recovery.

Air conditioning system

5.16 Air-conditioning can be used to provide effective cooling and air filtration to habitable rooms.

5.17 For example, a split-type air conditioning system provides internal units that can be mounted on the wall, ceiling or directly on the floor.

5.18 Example manufacturers of domestic air conditioning systems/units include:

- www.aircon.panasonic.eu/GB_en/residential/
- www.daikin.co.uk/en_gb/product-group/air-to-air-heat-pumps.html

5.19 Checks should be made regarding the suitability of the unit in terms of room size and cooling capability.

6. Conclusion

6.1 Based on the measured ambient sound pressure levels, the development site falls within NEC B for the daytime and night-time period.

6.2 TAN 11 provides the following comment with regard to sites that fall within NEC B:

Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.

6.3 Standard thermal double glazing and a traditional building envelope construction will provide sufficient sound insulation for all habitable rooms.

6.4 A suitable glazing construction would be 4 mm glass/16 to 20 mm cavity/4 mm glass, 6 mm glass/16 to 20 mm cavity/6 mm glass or alternatively 4 mm glass/16 to 20 mm cavity/6 mm glass.

6.5 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ and the night-time target of 30 dB $L_{Aeq,8hour}$ will be easily achieved with windows closed.

6.6 The daytime and night-time sound level targets will not be achieved with windows open on the front elevation. Appropriate ventilation can be provided by installing sound attenuating ventilator units to the external walls and/or window frames of habitable rooms (for fresh air supply) and installing intermittent or continuous extract fans to kitchens and bathrooms (to extract moist and polluted air).

6.7 It is anticipated that the daytime and night-time targets will be achieved within the kitchen/dining room and two bedrooms on the rear elevation with windows open. Whole dwelling ventilation can be provided by installing standard non-acoustic ventilator units to the window frames/external walls of habitable rooms.

6.8 Fully opening windows will be suitable for providing rapid or purge ventilation on both elevations when necessary (e.g. to rapidly dilute and extract indoor air pollutants and water vapour).

6.9 It will be suitable during the night to open bedroom windows on the rear elevation to help cool and remove excess heat from the room. An alternative means of removing excess heat should be provided for the bedrooms on the front elevation.

6.10 Appropriate daytime ambient sound levels are anticipated for the proposed rear gardens. Noise barriers are unnecessary for the development site.

6.11 Subjectively, the site is suitable for residential development in terms of being able to provide good acoustic standards. Changes to the site layout are unnecessary with regard to road traffic noise.

6.12 Should the local ambient noise levels increase slightly over time, for example due to an increase in road traffic flow, the internal sound levels will still satisfy the recommended design targets.

Appendix A

Proposed site plan, floor plans and elevations

Figure A.1 - Site location plan



Figure A.2 - Proposed site plan

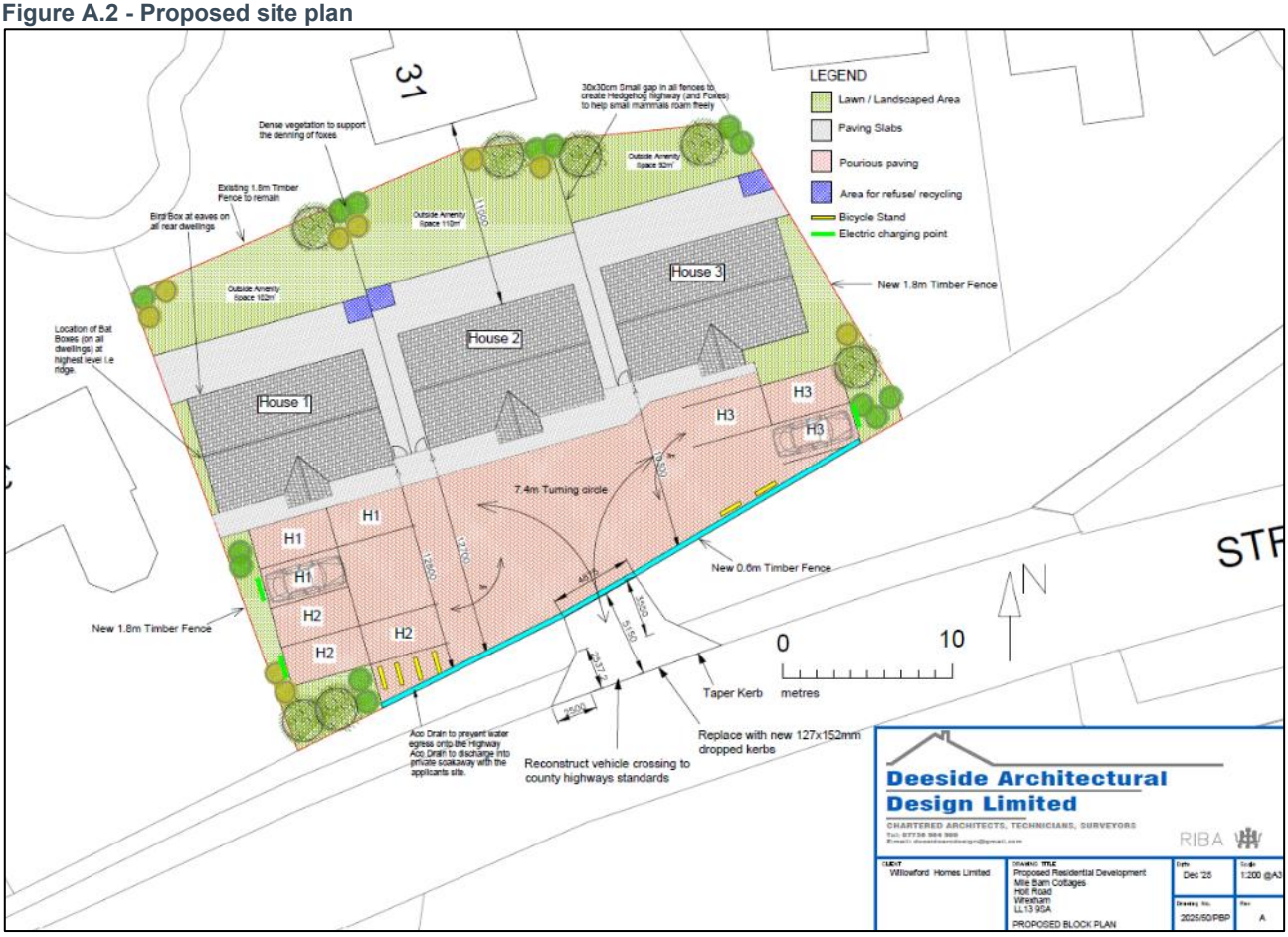


Figure A.3 - Proposed floor plans

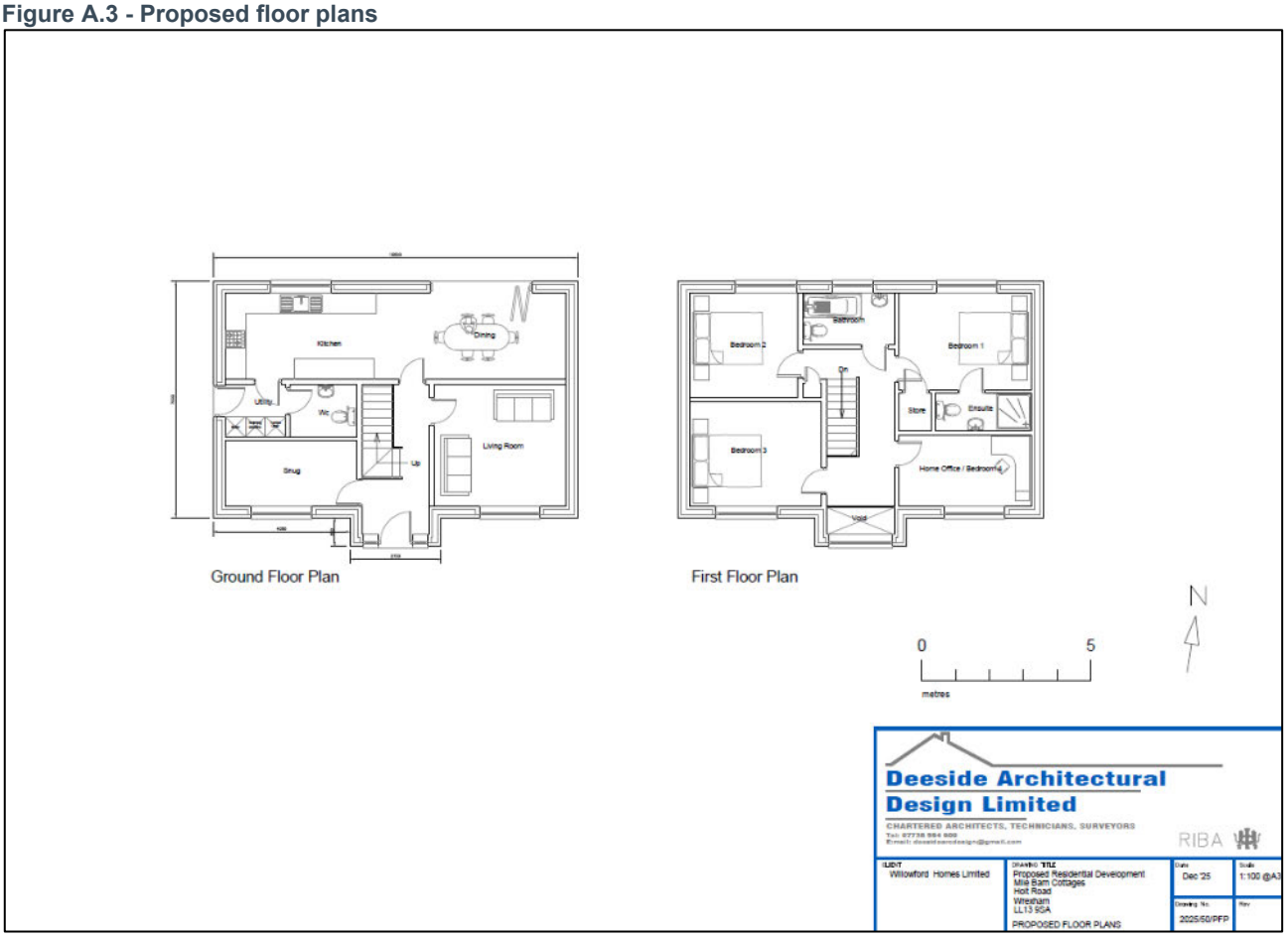
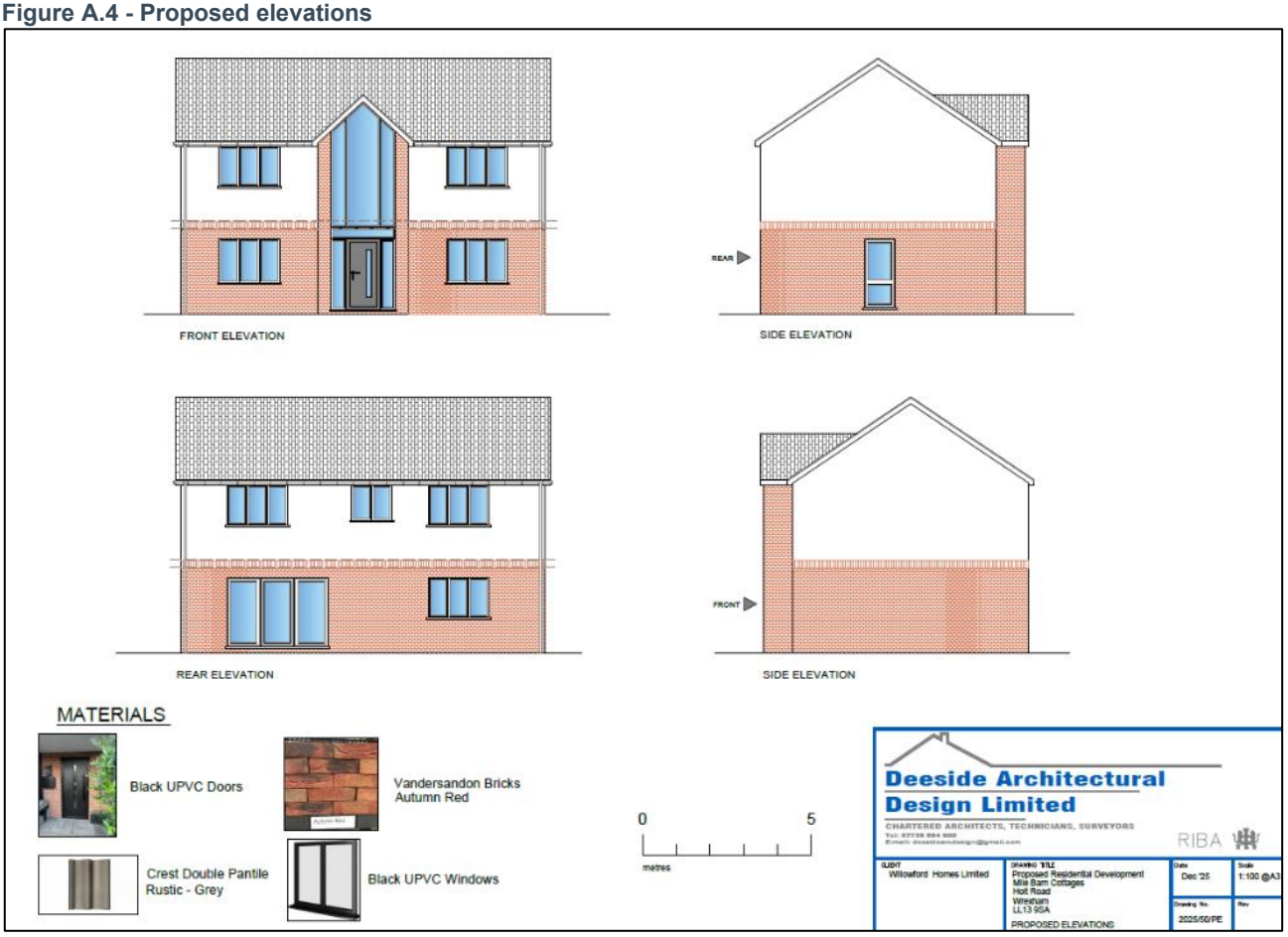


Figure A.4 - Proposed elevations



Appendix B
Assessment terminology

Assessment terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa).
dB(A)	The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc, according to the parameter being measured.
Acoustic environment	Sound from all sources as modified by the environment.
Ambient sound level	The totally encompassing sound in a given situation at a given time; it is usually composed of sound from many sources, near and far.
Equivalent continuous sound level - $L_{Aeq,T}$	The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period (commonly used to describe the 'ambient' sound level).
Maximum sound level - $L_{AFmax,T}$	The A-weighted 'maximum' sound pressure level that occurred during a given period, T (commonly used for the assessment of intermittent loud noises).
Background sound level - $L_{A90,T}$	The sound pressure level that is exceeded for 90% of the measurement time interval, T. $L_{A90,T}$ is often used to describe the 'background' sound level.
Habitable room	Any room used or intended to be used for sleeping, cooking, living or eating purposes (enclosed spaces such as bath or toilet facilities, service rooms, corridors, laundries, hallways, utility rooms or similar spaces are excluded from this definition).
R_w	The weighted sound reduction index expressed in dB. A single number quantity for airborne sound insulation rating.
Free-field level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other significant reflective surfaces. Generally as measured outside and away from buildings (>3.5metres).