20 WHITELADIES ROAD, BRISTOL

NOISE REPORT FOR PLANNING

Acoustics Report A2162 R01

31st July 2024

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Report to:	Aspect 360 Attention: Colin Pemble
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1 Introduction

Ion Acoustics is appointed by Eastman Estates to provide a noise assessment for the planning application for a proposed House of Multiple Occupation (HMO). The proposal is to refurbish the existing building to provide residential accommodation on the ground, first, and second floors. This report is to support a planning application. The site is on Whiteladies Road and therefore exposed to road noise, similar schemes where planning permission has been sought have had noise conditions imposed, and it is expected that similar conditions may apply for this scheme. In particular, this is expected to relate to external noise affecting the dwellings. This report is produced to provide information on requirements for those conditions for submission to Bristol City Council.

This report includes the assessment of noise from the existing environment, and the sound insulation requirements to control external noise sources.

To determine existing noise levels in the area, a noise survey was conducted over the period Tuesday 11th – Wednesday 12th June 2024. The site was found to be mainly affected by road noise from traffic on Whiteladies Road to the east of the premises. The rear of 20 Whiteladies Road was inspected and is sufficiently quiet with no apparent significant noise sources affecting the western rear façade, however, road traffic noise calculations have been made to the rear from Whiteladies Road, as well as from the front. This report describes:

- The methodology and results of the noise survey;
- Noise levels affecting the proposed premises;
- Assessment of building envelope sound insulation requirements;
- Appropriate noise limits for any new mechanical services plant, if they are proposed.

2 Scheme Details

2.1 Site Location

Figure 1 shows an aerial photo of the development site (circled in red), and the noise measurement position, MP1. Whiteladies Road is a primary thoroughfare, connecting the centre to the northern areas of Bristol. It is often busy with traffic and has a lot of public activity in various forms in the surrounding areas.

Figure 1: Aerial view of site with measurement locations displayed © Google Maps

2.2 Proposed Scheme

The building is a three-storey building that is being converted into an HMO. There will be eight bedrooms that will be constructed across the three floors and a kitchen/living room. There are no sensitive adjacencies so it is not expected that any noise emissions assessments will be required.

Four of the bedrooms will be overlooking Whiteladies Road (Bedrooms 4, 7, and 8). There is limited activity to the rear of the property which overlooks buildings associated with the MOD Facility and Toolstation.

The floorplans for 20 Whiteladies Road are given in Figures 2, 3, and 4.

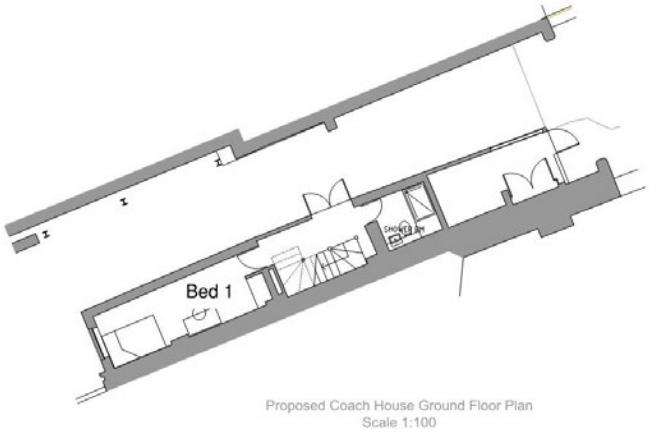

Figure 2 – Ground Floor Plan

Figure 3 – First Floor Plan

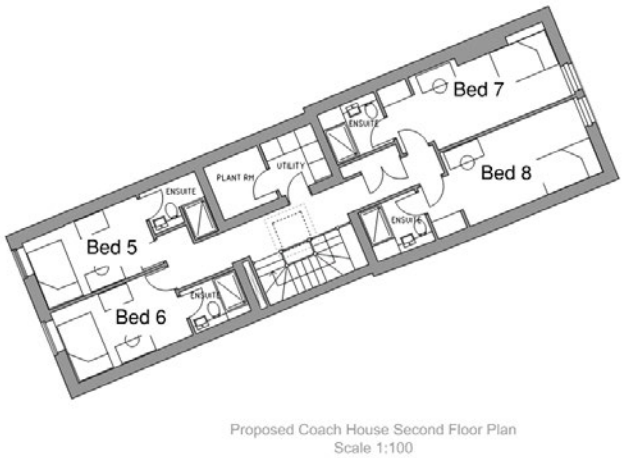

Figure 4 – Second Floor Plan

3 Planning Conditions and other Guidance

Similar schemes have been given conditions concerning noise as part of the planning permissions. These typically would require an assessment of external noise affecting the new dwellings from road noise, the public, and any plant and other activity noise.

3.1 Bristol City Council Guidance

The requirements for previous similar schemes in Bristol have been given conditions in respect of noise as part of the planning permissions. Typical requirements from BCC include the following:

"No development shall take place until a scheme of noise insulation measures for the development has been submitted to and approved in writing by the Council. The scheme of noise insulation measures shall include details the glazing and ventilation specification for bedrooms and living rooms.

The noise assessment shall be carried out by a suitably qualified acoustic consultant/engineer and shall take into account the provisions of BS 8233: 2014 Guidance on sound insulation and noise reduction for buildings.

The recommended design criteria for dwellings are as follows:

Daytime (07.00 - 23.00) 35 dB LAeq 16 hours in all rooms & 50 dB in outdoor living areas.

Night time (23.00 - 07.00) 30 dB LAeq 8 hours & LAmax 45 dB in bedrooms."

3.2 BS 8233: 2014 - Internal Noise Criteria

BS 8233: 2014 "Guidance on sound insulation and noise reduction for buildings" contains noise limits for developments of a residential nature that are usually set in terms of two noise parameters: the ambient Level, L_{Aeq}, and the maximum Level, L_{AFmax}. The L_{AFmax} is the highest noise level in a given period and is determined by individual events such as vehicle pass-bys. An L_{AFmax} limit is usually only applied at night when sleep disturbance is most likely to be an issue. The L_{Aeq} is defined as the steady-state noise level which has the same energy as the actual time-varying noise over the same time period. It is effectively the average noise level.

Appropriate internal noise levels are recommended in BS 8233:2014, shown in Table 1.

Table 1: Indoor Ambient Noise Levels from BS 8233: 2014

Activity	Location	Day (07:00 to 23:00)	Night (23:00 to 07:00)
Resting	Living rooms	35 dB $L_{Aeq,\ 16\ hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,\ 16\ hour}$	-
Sleeping - night Resting - day	Bedrooms	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$

WHO guidelines propose internal limits of L_{Aeq} 35dB for living rooms, and L_{Aeq} 30dB and L_{AFmax} 42dB inside a bedroom at night. ProPG (Section 3.4) states that a level of L_{AFmax} 45dB Should be exceeded no more than ten times during the night.

The internal noise criteria in BS 8233: 2014 are followed by several notes:

"Note 1: Table 1 provides recommended levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

Note 2: The levels shown in Table 1 are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port in high levels of traffic at certain times of the night an appropriate alternative period, e.g. 1 hour, may be used but the level should be selected to ensure consistency with the levels of recommended in Table 1.

Note 3: These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night on New Year's Eve.

Note 4: 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_{AFmax} depending on the character and number of events per night. Sporadic noise events could require separate values.

Note 5: If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Note 6: 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 achieved.

Note 7: Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form.

The noise limits proposed for this assessment are stated below in terms of bedrooms and living rooms.

- All Rooms Daytime: L_{Aeq} 35 dB (07.00 to 23.00 hours)
- Bedrooms at Night: L_{Aeq} 30 dB (23.00 to 07.00 hours), and L_{AFmax} 45dB not exceeded more than ten times.

3.3 National Planning Policy Framework

In 2012 the National Planning Policy Framework (NPPF) replaced a number of Planning Policy Statements with a single document which is intended to promote sustainable development. The NPPF was revised in December 2023[1] and certain aspects of the guidance changed.

The NPPF sets out the Government's planning policies for England. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies. Sections of the NPPF relating to noise are stated below:

180. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

191. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;

3.4 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) sets out the Government's policy on environmental, neighbourhood and neighbour noise for England. The policy sets out three aims:

- "avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impact on health and quality of life; and
- Where possible, contribute to the improvement of health and quality of life."

The NPSE introduces the following terms which are also used in NPPF:

"NOEL – No Observed Effect Level

NOEL is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

LOAEL is the level above which adverse effects on health and quality of life can be detected.

[1] https://www.gov.uk/government/publications/national-planning-policy-framework--2

SOAEL – Significant Observed Adverse Effect Level

SOAEL is the level above which significant adverse effects on health and quality of life occur."

However, neither the NPSE, nor the NPPF Planning Practice Guidance, define numeric criteria for the NOEL, LOAEL, or SOAEL. Instead, it is recommended in the NPSE that the limits of each effect level should be defined for each situation and location. The WHO "Guideline for Community Noise" and BS 8233:2014 recommend internal noise design targets for habitable rooms for the avoidance of negative health effects and to promote quality of life.

3.4.1 Planning Practice Guidance – Noise (Web Publication)

The planning practice guidance website provides advice of the application of the NPPF and the NPSE. The noise page "advises on how planning can manage potential noise impacts in new development".

Where residential development is planned close to sources of noise, the guidance gives examples of mitigation which may be included at the design stage: *"including noise barriers; and optimising the sound insulation provided by the building envelope"*.

The guidance also gives some further advice on interpretation of SOAEL as the level at which noise is noticeable and disruptive and where "*the noise causes a material change in behaviour and/or attitudes. E.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficult in getting back to sleep…*"

3.5 ProPG: Planning and Noise

The Professional Practice Guidance on Planning and Noise (May 2017) provides guidance on transport noise affecting new residential developments. The guidance was prepared by a working group formed of members of the Institute of Acoustics (IoA), the Association of Noise Consultants (ANC) and the Chartered Institute of Environmental Health (CIEH). It has no formal planning status but represents good industry practice. It is specifically for assessing noise from sites where transportation noise sources dominate. The guidance promotes a two-stage assessment approach:

Stage 1 – Initial Site Noise Risk Assessment; and,

Stage 2 – Full assessment and systematic appraisal of four key elements.

The stage 1 initial risk assessment indicates the likely risk of adverse effects from noise, assuming in the first instance that no mitigation was included within the proposals. The risk assessment is based on the measured or predicted noise levels during a "typical worst case" 24-hour period. Figure 1 of the document (adapted below as Figure 2) presents the Stage 1 assessment and indicates that higher noise levels result in increased noise risk without mitigation. Figure 2 does not directly relate noise levels to specific risk categories, although the ProPG states that a negligible noise risk proudly correlates to noise levels not exceeding 50dB $L_{Aeq,16hr}$ (daytime) and 40dB $L_{Aeq,8hr}$ (night).

Day $L_{Aeq, 16\ Hr}$	50 dB	55 dB	60 dB	65 dB	70 dB
Negligible		Low	Medium		High
Night $L_{Aeq, 8\ Hr}$	40 dB	45 dB	50 dB	55 dB	60 dB

Figure 2: ProPG Stage 1 Noise Risk Assessment (adapted from ProPG Figure 1)

Where the initial noise assessment indicates a higher risk of adverse noise effects, a stage 2 assessment is required. The stage 2 assessment is more involved than the stage 1 and requires systematic consideration of four elements:

Element 1 – Good Acoustic Design Process

The acoustic design of a building and any mitigation should be considered at an early stage of the design process. Following a good acoustic design process is considered a part of achieving a good design as required by the NPSE and NPPF. Guidance on the requirements for providing an Acoustic Design Statement (ADS) is given in Figure 2 of the ProPG.

Element 2 – Internal Noise Level Guidelines

Guidance on internal noise levels can be found in BS8233:2014 guidance on sound insulation and noise reduction for buildings. Figure 2 of the ProPG summarises the guidance from BS8233 but with several additions. The internal noise criteria are presented in Figure 2 of ProPG, and the relevant notes are presented in the text below Table 1 of this report.

Element 3 – External Amenity Area Noise Assessment

The guidance of the ProPG reflects and extends on the advice of BS8233 and PPG Noise. The guidance in the ProPG presents five points for consideration, the first being "If the 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".

Element 4 – Assessment of Other Relevant Issue

"Other relevant issues" within the context of the ProPG include relevant national and local policies, which may have a bearing on the development.

Regarding developments located in higher-risk areas, ProPG says:

> *"This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS."*

It goes on to explain what is meant by Good Acoustic Design:

> *"Good acoustic design is not just compliance with recommended internal and external noise exposure standards. Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the inhabitants' quality of life or other sustainable design objectives and requirements.*

"Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided; occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents."

3.6 Ventilation and Overheating: AVOG

The Acoustics, Ventilation, and Overheating Guidance (AVOG) was published by the Association of Noise Consultants (ANC) in January 2020[2]. AVOG is guidance for acoustic practitioners and others involved in planning, developing, designing, and commissioning new dwellings to achieve an appropriate balance of internal noise levels, ventilation, and overheating control regarding external transportation noise. It seeks to encourage an assessment of these issues at the planning stage. It is not mandatory guidance but represents current best practices for assessing the issue. In particular, AVOG advises considering when noise levels are such that it is reasonable to control overheating with openable windows and when it may be too noisy. Part O Building Regulations refer to internal noise levels under conditions controlling overheating (e.g. open windows) but only apply to new buildings and is not relevant in this case.

It is generally accepted that some degree of elevated noise is accepted when residents choose to open windows, especially for overheating control. The ANC AVOG suggests internal ambient noise levels of L_{Aeq} 50dB during the day and L_{Aeq} 42dB during the night are acceptable limits with the windows open to control overheating; however, it acknowledges that there is a greater risk of disturbance in proximity to these values. A guidance value in AVOG was also given for individual maxima of events of L_{AFmax} 65 dB.

4 Noise Survey

A baseline noise survey was carried out over the period Tuesday 11th June – Wednesday 12th June 2024 at a location on the front of the property, as shown in Figure 1. The meters were unattended except for set up and collection.

A Rion NL52 sound level meter with Type WS15 wind shield was used and calibrated with a Brüel & Kjær Type 4231 calibrator at the start and end of the survey. No significant drift in calibration was noted on collection. The meter was set up to log various noise indices (L_{Aeq}, $L_{Amax,F}$, L_{A90}, L_{A01}, L_{A10}) in consecutive 15-minute periods.

Weather conditions on set up were sunny, the temperature was 14°C, with north-westerly winds of 4m/s, and there was 50% cloud cover. On collection, the weather conditions were sunny, the temperature was 14°C, with north-westerly winds of 2m/s in a north-westerly direction, and 50% cloud cover.

[2] [redacted]

4.1 Location MP1 – Overlooking Broad Street

Measurements at location MP1 were made between 12:00 on 11th June and 12:15 on 12th June 2024. The measurement location is shown in Figure 3 and 4. The microphone was placed on a pole of out a window on the second floor at the front of the building at a position 1m from the façade. The microphone represented the most affected front window in respect of noise from Whiteladies Road and had a clear view to the road.

Figure 3: A photo of MP1 taken from Whiteladies Road looking west

Figure 4: MP1 from the 2nd floor flat overlooking Whiteladies Road looking east

5 Noise Survey Results

5.1 Noise Levels Measured at MP1 – Overlooking Whiteladies Road

Noise levels measured at MP1 are shown graphically in Figure 5 in terms of the 15-minute L_{Aeq}, L_{AFmax} and L_{A90} noise levels. The data is tabulated in Appendix A.

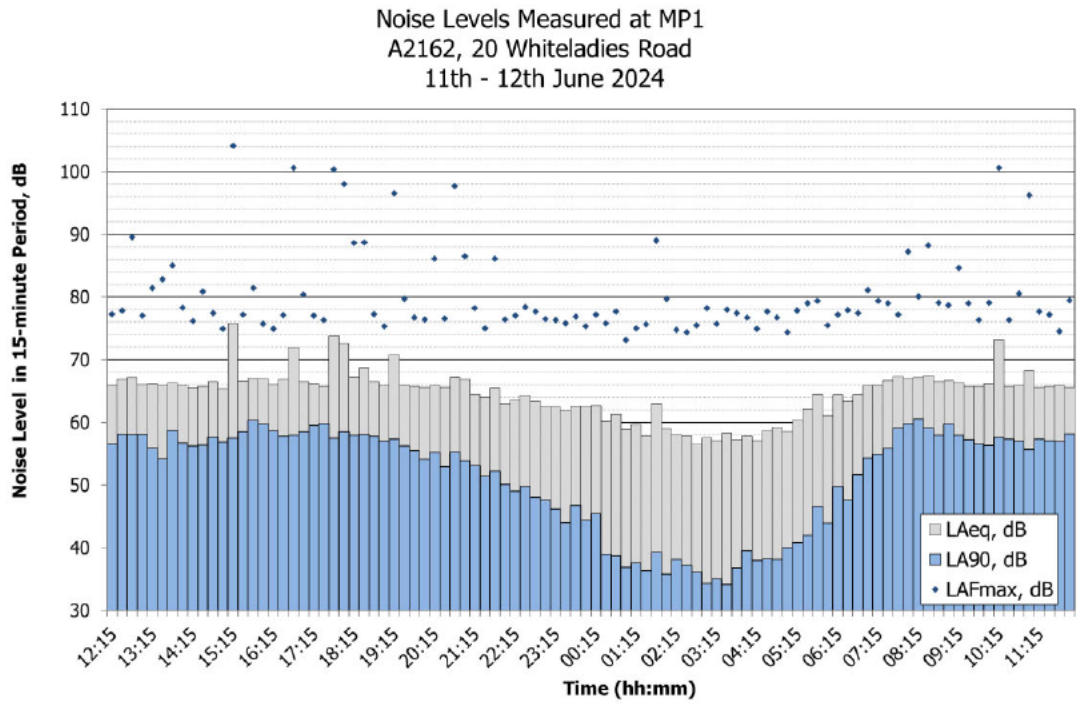

Figure 5: Noise Time History for MP1, overlooking Whiteladies Road

The ambient noise levels are dominated by traffic noise from Whiteladies Road, including from buses and emergency vehicles. During the night, the traffic flow is reduced, however, traffic noise is still present. The levels are moderately high, typically around L_{Aeq} 66dB, with some noticeable increases over shorter periods, usually associated with a higher L_{Amax} value. The ambient noise levels drop below L_{Aeq} 60dB in the night-time periods between 01:00hrs and 05:15 but still stays above L_{Aeq} 55 dB the night, between these periods. The maxima were generally caused by emergency sirens and traffic noise.

Due to the measurements being performed at 1m from the façade. The results are affected by reflections. To obtain equivalent free-field levels, the measurements have been reduced by 3dBA. Henceforth, results will be given in their equivalent free-field noise levels. Table 2 shows the results in terms of the 16-hour daytime and 8-hour night-time values.

Table 2: External Noise Levels at Location MP1 (free-field)

Day	Period	Duration	L_{Aeq}, dB	L_{AFmax},dB, 10 exceedances of level
Tuesday 11th – Wednesday 12th June	Day (12:30 to 23:00, 23:00 to 12:30)	16 hrs	64.6	-
	Night (23:00 to 07:00)	8 hrs	58.0	74.4

The typical sound spectra which have been derived relative to the dB(A) levels measured are provided in Table 3. The L_{Aeq} spectra are taken from the logarithmic average for both the daytime and the night-time L_{Aeq} indices, shown in Table 2. The L_{AFmax} value is taken from analysis of short-term data recorded to determine the 10 highest events (not just the 10 highest $L_{Amax,15min}$ values). The typical L_{max} spectrum is derived from a logarithmic average of the 10 loudest events recorded over the night of Tuesday 11th June to Wednesday 12th June. These combined with the typical levels presented in Table 2, will be used to derive building façade sound insulation requirements.

Table 3: Sound Spectra Corrections relative to dB(A) level measured on Site at MP1

Corrections							
Parameter	Octave band centre frequency, Hz (dB)						
	63	125	250	500	1000	2000	4000
Day, L_{Aeq}	+1.1	-4.1	-4.6	-6.2	-3.0	-6.9	-14.6
Night, L_{Aeq}	+/-0.0	-5.5	-4.6	-5.0	-2.4	-9.2	-13.9
Night, L_{AFmax}	-5.5	-8.1	-7.8	-3.9	-3.7	-8.6	-11.4

5.2 Typical Current Environmental Noise Levels

The noise levels used in the building calculations are shown below in Table 4, which are given as the $L_{Aeq,16hr}$, $L_{Aeq,8hr}$, and the L_{AFmax}.

Table 4: Summary Noise Levels at the Front of 20 Whiteladies Road

Location	Period	Values Used in Building Envelope Calculation (Free-Field)
Front – MP1	Day	$L_{Aeq,16hr}$ 64.6dB
	Night	$L_{Aeq,8hr}$ 57.9dB
	Night	L_{Amax} 74.4dB

6 Building Envelope Sound Insulation Assessment

A planning application is to be made for the scheme. As discussed, there will likely be a planning requirement to demonstrate that appropriate internal noise limits can be met and to prepare a sound insulation scheme. To assess this, consideration has been made for existing noise levels as measured affecting the front of the building.

6.1 Sound Insulation Methodology

Sound insulation calculations for the residential rooms have been prepared in accordance with BS EN 12354-3 to determine the extent of the sound insulation required to control noise levels to meet the noise limits discussed earlier in the report. Examples of these calculations are provided in Appendix B. All dimensions and room labels have been taken off the architect's scaled drawings.

There are not any specific noise sources at the rear of the property. Building envelope calculations have been made to the front of the property overlooking Whiteladies Road.

The window specification is given in terms of the sound reduction index, R_w, as determined in an acoustics laboratory.

6.2 Background Ventilation

Front of the Development

The rooms at the front of the flats comprises bedrooms and kitchen/living rooms. These rooms are labelled Bedroom 4 and Kitchen/Living room on the first floor, and Bedroom 7 and Bedroom 8 on the second floor.

Considering the noise levels shown in Table 4, the internal levels with windows open (assuming 13dB) are L_{Aeq} 51dB and 45dB for the day and the night time, respectively, which is over the standard internal BS8233 limits of $L_{Aeq,16hours}$ 35dB and $L_{Aeq,8hours}$ 30dB.

However, the levels are not exceptionally high and compliance with the limits can be achieved with fairly standard double glazing and acoustic trickle ventilation. R_w 33dB (eg 6/12/8) would be required for the windows in all rooms overlooking the road. Trickle vents in the order of $D_{ne,w}$ 38dB would be required for the kitchen/living room, Bedroom 7 and Bedroom 8. A $D_{ne,w}$ 40dB trickle vent would be required for Bedroom 4. The requirements are shown in Table 5. The spectra for the glazing and trickle vents used in calculations are shown in Table 5.

If Mechanical Ventilation such as MVHR is provided, then that would improve conditions and glazing specifications can be reduced.

Rear of the Development

Further calculations have been made for rooms to the rear of 20 Whiteladies Road, Bedrooms 1, 2, 3, 5, and 6. These rooms are further and have significant shielding from the road. Line source distance loss from the road has been calculated to the rear façade ($10LOGr/r_o$), and 10dB loss from shielding has been applied to the measured noise levels. There would likely be more shielding than the 10dB value used, however, it is a conservative estimate.

The calculated free-field noise levels at the rear of 20 Whiteladies Road are shown in Table 6.

Table 6: Free-field Calculated noise level to the Rear of 20 Whiteladies Road

Time period	Calculated Noise Level dB
Day $L_{Aeq,16hours}$ dB	51.3
Night $L_{Aeq,8hours}$ dB	44.6
Night $L_{AFMax,8hours}$ dB	60.7

Background Ventilation

Again, assuming 13dB attenuation for an open window the noise levels are slightly too high to rely on windows to be opened for background ventilation regarding the level limits in BS8233.

With standard double glazing and typical trickle ventilation, the rooms at the rear can comply with the noise limits.

6.3 AVOG Noise Limits

The scheme is a change of use, so the requirements of Building Regulation Part O do not apply. However, the requirements of AVOG commonly need to be considered. Regarding overheating control, a simplified assessment under the AVOG has been carried out in Table 7 including considering attenuation through an open window (-13dB). The most affected room has been shown for each time period.

Table 7: External free-field noise levels with window attenuation and AVOG limits at the front of the building (MP1).

Façade	Time Period	External Noise Level (Free field)	Window Attenuation - 13dB	AVOG Limit
Front	Day $L_{Aeq,16hours}$ dB	64.6	51.6	50
	Night $L_{Aeq,8hours}$ dB	58.0	45.0	42
	Night $L_{AFMax,8hours}$ dB	74.4	61.4	65
Rear	Day $L_{Aeq,16hours}$ dB	51.3	38.3	50
	Night $L_{Aeq,8hours}$ dB	44.6	31.6	42
	Night $L_{AFMax,8hours}$ dB	60.7	47.7	65

The noise levels at the front are too high during the day by a marginal 2dBA and at night by 3dBA for overheating to be controlled by openable windows. It may be that this small excess is considered acceptable considering the development is formed by material change of use. AVOG is a guidance document, and it is not part of formal planning regulations. It is therefore noted that there is no building regulation or other formal mandatory requirement, in this case.

At the rear of the building, with the windows open for overheating control (again assuming 13dB attenuation), the internal equivalent noise level would comply with AVOG limits. Windows would be permitted to be openable at the rear of the building regarding overheating and noise.

6.4 Sound Insulation Requirements

Below are the R_w requirements for the glazing to meet the internal noise limits shown in Table 9. The calculations have been prepared to demonstrate that suitable conditions can be achieved, and an example form of construction provided. Other forms of construction with difference performance may also be suitable such as secondary glazing.

Table 9: Trickle Vent and Glazing Requirements

Floor	Façade	Room	Example Window, R_w dB	Trickle Vent Requirement, $D_{ne,w}$ dB
Ground	Rear	Bedroom 1	R_w 32dB e.g. 5/6/5 double glazing	$D_{ne,w}$ 30dB e.g. standard trickle vent
First	Front	Bedroom 4	Rw 33dB e.g. 4/12/8 double glazing	Dne,w 40dB e.g. Passivent ALdB 450
		Kitchen/Living Room		Dne,w 38dB e.g. Typical Acoustic Trickle Vent
	Rear	Bedroom 2	Rw 32dB e.g. 5/6/5 double glazing	$D_{ne,w}$ 30dB e.g. standard trickle vent
		Bedroom 3		
Second	Front	Bedroom 7	33dB e.g. 4/12/8 double glazing	$D_{ne,w}$ 38dB e.g. Typical Acoustic Trickle Vent
		Bedroom 8		
	Rear	Bedroom 5	Rw 32dB e.g. 5/6/5 double glazing	$D_{ne,w}$ 30dB e.g. standard trickle vent
		Bedroom 6		

The specification for glazing and trickle ventilation types used in calculations are shown in Table 10. If alternative construction is selected, then typical minimum performance values are given in Table 10 in each octave band, although other options may be acceptable subject to meeting the internal noise limits.

Table 10: Spectra used in Calculations

Element	R_w/$D_{ne,w}$ dB Requirement	Octave Bands [Hz]						
		63	125	250	500	1000	2000	4000
Glazing	32	28	27	26	25	34	35	38
	33	23	26	22	28	38	41	42
Trickle Vent	30	28	29	22	32	30	29	23
	38	29	30	33	38	37	36	40
	40	35	44	42	36	40	42	52

Secondary glazing or MVHR may be used in place of the construction as shown in Table 10. In both cases they will be improvements to the sound insulation.

7 Summary

Ion Acoustics has undertaken a noise assessment for a proposed HMO on 20 Whiteladies Road in Bristol. The assessment has considered the potential noise impact from road activity on the proposed habitable rooms at the front and the rear of the building. A noise survey to determine the existing noise levels on site was carried out. The measurement results indicate higher noise levels at the front of the building overlooking Whiteladies Road, rather than at the rear.

The assessment has considered and set out the requirements in respect of sound insulation for windows and ventilation in respect of acoustics.

Location MP1 – Overlooking Whiteladies Road

Time	L_{Aeq} dB	$L_{Amax,F}$ dB	L_{AF90} dB	Time	L_{Aeq} dB	$L_{Amax,F}$ dB	L_{AF90} dB
11/06/2024 12:00	66.4	75.8	58.8	12/06/2024 00:15	62.7	77.2	45.4
11/06/2024 12:15	65.9	77.3	56.5	12/06/2024 00:30	60.2	75.8	38.9
11/06/2024 12:30	66.8	77.8	58.1	12/06/2024 00:45	61.3	77.7	38.7
11/06/2024 12:45	67.1	89.6	58.1	12/06/2024 01:00	58.9	73.1	36.9
11/06/2024 13:00	66.0	77.0	58.1	12/06/2024 01:15	59.6	75.0	37.6
11/06/2024 13:15	66.1	81.4	55.9	12/06/2024 01:30	57.8	75.6	36.3
11/06/2024 13:30	65.8	82.8	54.2	12/06/2024 01:45	62.9	89.0	39.3
11/06/2024 13:45	66.3	85.0	58.7	12/06/2024 02:00	59.0	79.7	35.8
11/06/2024 14:00	65.8	78.3	56.7	12/06/2024 02:15	58.0	74.8	38.1
11/06/2024 14:15	65.5	76.2	56.2	12/06/2024 02:30	57.8	74.4	37.2
11/06/2024 14:30	65.7	80.9	56.4	12/06/2024 02:45	56.4	75.5	36.1
11/06/2024 14:45	66.5	77.4	57.6	12/06/2024 03:00	57.5	78.2	34.3
11/06/2024 15:00	65.4	74.9	56.8	12/06/2024 03:15	57.1	75.7	35.0
11/06/2024 15:15	75.8	104.1	57.5	12/06/2024 03:30	58.3	78.0	34.1
11/06/2024 15:30	66.6	77.2	58.5	12/06/2024 03:45	57.2	77.4	36.8
11/06/2024 15:45	67.0	81.4	60.3	12/06/2024 04:00	57.8	76.7	39.5
11/06/2024 16:00	66.9	75.7	59.7	12/06/2024 04:15	57.1	74.9	38.0
11/06/2024 16:15	66.0	74.9	58.6	12/06/2024 04:30	58.7	77.7	38.2
11/06/2024 16:30	66.8	77.1	57.8	12/06/2024 04:45	59.2	76.7	38.1
11/06/2024 16:45	72.0	100.6	57.9	12/06/2024 05:00	58.5	74.4	40.0
11/06/2024 17:00	66.5	80.4	58.5	12/06/2024 05:15	60.3	77.8	40.8
11/06/2024 17:15	66.1	77.0	59.5	12/06/2024 05:30	62.1	79.0	42.0
11/06/2024 17:30	65.7	76.3	59.8	12/06/2024 05:45	64.5	79.4	46.6
11/06/2024 17:45	73.8	100.4	57.5	12/06/2024 06:00	61.1	75.5	43.9
11/06/2024 18:00	72.6	98.0	58.5	12/06/2024 06:15	64.4	77.2	49.8
11/06/2024 18:15	67.2	88.6	57.9	12/06/2024 06:30	63.4	77.9	47.6
11/06/2024 18:30	68.7	88.7	58.1	12/06/2024 06:45	64.4	77.4	51.7
11/06/2024 18:45	66.5	77.3	57.8	12/06/2024 07:00	65.8	81.1	54.3
11/06/2024 19:00	65.8	75.3	57.0	12/06/2024 07:15	65.9	79.4	54.9
11/06/2024 19:15	70.7	96.5	57.3	12/06/2024 07:30	66.7	79.0	55.8
11/06/2024 19:30	65.9	79.7	56.2	12/06/2024 07:45	67.3	77.2	59.1
11/06/2024 19:45	65.7	76.7	55.5	12/06/2024 08:00	66.9	87.2	59.8
11/06/2024 20:00	65.6	76.4	54.1	12/06/2024 08:15	67.1	80.1	60.5
11/06/2024 20:15	65.8	86.1	55.2	12/06/2024 08:30	67.5	88.2	59.1
11/06/2024 20:30	65.6	76.6	52.9	12/06/2024 08:45	66.5	79.1	57.9
11/06/2024 20:45	67.2	97.7	55.3	12/06/2024 09:00	66.7	78.7	59.7
11/06/2024 21:00	66.8	86.5	53.9	12/06/2024 09:15	66.3	84.6	57.9
11/06/2024 21:15	64.5	78.2	53.1	12/06/2024 09:30	65.7	79.0	57.2
11/06/2024 21:30	64.0	75.0	51.4	12/06/2024 09:45	65.7	76.3	56.5
11/06/2024 21:45	65.5	86.1	52.2	12/06/2024 10:00	66.1	79.1	56.3
11/06/2024 22:00	62.9	76.4	50.1	12/06/2024 10:15	73.2	100.6	57.6
11/06/2024 22:15	63.6	77.0	49.0	12/06/2024 10:30	65.7	76.3	57.3
11/06/2024 22:30	64.3	78.4	49.8	12/06/2024 10:45	65.8	80.6	57.0
11/06/2024 22:45	63.4	77.7	48.0	12/06/2024 11:00	68.2	96.2	55.7
11/06/2024 23:00	62.5	76.5	47.6	12/06/2024 11:15	65.6	77.7	57.3
11/06/2024 23:15	62.5	76.3	46.2	12/06/2024 11:30	65.7	77.2	57.1
11/06/2024 23:30	62.0	75.8	44.0	12/06/2024 11:45	65.9	74.5	56.9
11/06/2024 23:45	62.6	76.9	46.7	12/06/2024 12:00	65.6	79.5	58.2
12/06/2024 00:00	62.5	75.3	44.3	12/06/2024 12:15	65.1	80.1	51.5

Building envelope calculations, Flat 4 – Front of building, Daytime

Building Envelope Sound Insulation Calculation According to EN 12354-3

	A2162	**Date**	05/07/2024	
	Day	**Room**	Bedroom 4	

	Term	**Label**	**Octave band centre frequency (Hz)**							**dB(A)**
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
$L_{eq,ff}$	Measured L_{eq}	GF Lounge 1 - South	1.1	-4.1	-4.6	-6.2	-3.0	-6.9	-14.6	64.6
	Measured spectrum	L: GF Lounge 1 - South: Adj Spectrum	65.7	60.5	60.0	58.4	61.6	57.7	50.0	64.6
		K	3	3	3	3	3	3	3	

Room Details

	Term	**Derivation**	**Value**	**Term**	**Derivation**	**Value**
	V	Volume (m^3)	29.5	Sew	Sf - Swi - Sr	5.6
	RT	RT (secs)	0.5	Srr	Area of ceiling (m^2)	10.5
	Sf	Facade area (inc. window) (m^2)	7.5	S	Sf + Srr	7.5
	Sr	Panel Area	0.0	Ao	Ref Area for Dnew	10.0
	Swi	Window area (m^2)	1.8	Attenuation to roof		0.0

Sound Insulation Calculation elements

	Term	**Label/element**	**Octave band centre frequency (Hz)**							**Rw**
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
vent openings	$D_{n,e}$	Passivent ALdB450	35	44.2	42.2	36.2	39.9	42.3	52	40
	$A_0/S \times 10^{-Dn/10}$	B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	33.9	19.5	21.0	25.4	24.9	18.6	1.2	31
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
window	R_{wi}	4/12/8 double glazing	23	26	22	28	38	41	42	33
	$S_{wi}/S \times 10^{-Rwi/10}$	C	0.001	0.001	0.002	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	41.6	33.4	36.9	29.3	22.5	15.6	6.9	31.5
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Primary wall	R_{ew}	Example Wall from BS8233 (Brick and Block)	36	40	44	45	51	56	58	51
	$S_{ew}/S \times 10^{-Rew/10}$	D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	33.5	24.3	19.8	17.2	14.4	5.5	-4.2	19.1
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spandrel Panel	R_{rr}	Example Roof from BS8233	22	28	34	40	45	49	52	44
	$S_r/S \times 10^{-Rrr/10}$	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Internal Noise Levels

	10 Log (B+C+D+E)	F	-27.3	-31.3	-27.8	-31.3	-37.4	-40.0	-46.0	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	
L_{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{eq,2}$	L+F+G+K+T	43.3	34.2	37.2	32.0	29.2	22.7	9.0	34.3
L_{max}	Calc Tolerance	T								
	Internal $L_{max,2}$	M+F+G+K+T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Building envelope calculations, Flat 7 – Front of building, Night Time

Building Envelope Sound Insulation Calculation According to EN 12354-3

	A2162	**Date**	05/07/2024	
	Night	**Room**	Bedroom 7	

	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
$L_{eq,ff}$	Measured L_{eq}	GF Lounge 1 - South	-0.1	-5.6	-4.7	-5.1	-2.5	-9.3	-14.0	58.0
	Measured spectrum	L: GF Lounge 1 - South: Adj Spectrum	57.9	52.4	53.3	52.9	55.5	48.7	44.0	57.9
		K	3	3	3	3	3	3	3	
$L_{max,ff}$	Measured L_{max}	GF Lounge 1 - South	-5.5	-8.1	-7.8	-3.9	-3.7	-8.6	-11.4	74.4
		M: GF Lounge 1 - South: Adj Spectrum	68.9	66.3	66.6	70.5	70.7	65.8	63.0	74.0
		K	6	6	6	6	6	6	6	

Room Details

	Term	Derivation	Value	Term	Derivation	Value
	V	Volume (m^3)	40.4	Sew	Sf - Swi - Sr	5.7
	RT	RT (secs)	0.5	Srr	Area of ceiling (m^2)	14.4
	Sf	Facade area (inc. window) (m^2)	7.3	S	Sf + Srr	7.3
	Sr	Panel Area	0.0	Ao	Ref Area for Dnew	10.0
	Swi	Window area (m^2)	1.5	Attenuation to roof		0.0

Sound Insulation Calculation elements

	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
vent openings	$D_{n,e}$	38 Dne,w: Trickle: Acoustic: Typical	29	30	33	38	37	36	40	38
	$A_0/S \times 10^{-Dn/10}$	B	0.002	0.001	0.001	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	30.8	24.3	22.2	16.8	20.4	14.6	5.9	26
		L_{max} Internal SPL	38.8	35.2	32.5	31.4	32.6	28.7	21.9	42
window	R_{wi}	4/12/8 double glazing	23	26	22	28	38	41	42	33
	$S_{wi}/S \times 10^{-Rwi/10}$	C	0.001	0.001	0.001	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	31.6	23.1	28.0	21.6	14.2	4.4	-1.3	22.9
		L_{max} Internal SPL	42.6	37.0	41.3	39.2	29.4	21.5	17.7	38.5
Primary wall	R_{ew}	Example Wall from BS8233 (Brick and Block)	36	40	44	45	51	56	58	51
	$S_{ew}/S \times 10^{-Rew/10}$	D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	24.4	14.9	11.8	10.4	7.0	-4.8	-11.5	11.5
		L_{max} Internal SPL	35.4	28.8	25.1	28.0	22.2	12.3	7.5	27.5
Spandrel Panel	R_{rr}	Example Roof from BS8233	22	28	34	40	45	49	52	44
	$S_r/S \times 10^{-Rrr/10}$	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Internal Noise Levels

	10 Log (B+C+D+E)	F	-25.3	-27.0	-26.9	-32.4	-35.0	-34.4	-38.2	
	A (furnished)	Room Absorption	13	13	13	13	13	13	13	
	10 log (S/A)	G	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	
L_{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{eq,2}$	L+F+G+K+T	36.1	28.9	29.9	24.0	24.0	17.8	9.3	27.9
L_{max}	Calc Tolerance	T								
	Internal $L_{max,2}$	M+F+G+K+T	47.1	42.8	43.2	41.6	39.2	34.9	28.3	43.7

Building envelope calculations, Flat 7 – Rear of building, Daytime

Building Envelope Sound Insulation Calculation According to EN 12354-3

	A2162	**Date**	05/07/2024	
	Day	**Room**	Bedroom 6	

	Term	**Label**	**Octave band centre frequency (Hz)**							**dB(A)**
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
$L_{eq,ff}$	Measured L_{eq}	GF Lounge 1 - South	1.1	-4.1	-4.6	-6.2	-3.0	-6.9	-14.6	51.3
	Measured spectrum	L: GF Lounge 1 - South: Adj Spectrum	52.4	47.2	46.7	45.1	48.3	44.4	36.7	51.2
		K	3	3	3	3	3	3	3	

Room Details

	Term	**Derivation**	**Value**	**Term**	**Derivation**	**Value**
	V	Volume (m^3)	27.6	Sew	Sf - Swi - Sr	5.1
	RT	RT (secs)	0.5	Srr	Area of ceiling (m^2)	9.9
	Sf	Facade area (inc. window) (m^2)	6.7	S	Sf + Srr	6.7
	Sr	Panel Area	0.0	Ao	Ref Area for Dnew	10.0
	Swi	Window area (m^2)	1.6	Attenuation to roof		0.0

Sound Insulation Calculation elements

	Term	**Label/element**	**Octave band centre frequency (Hz)**							**Rw**
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
vent openings	$D_{n,e}$	23 Dne,w: Trickle: Lowest Performer	28	29	21.7	31.9	29.8	29.3	23.4	30
	$A_0/S \times 10^{-Dn/10}$	B	0.002	0.002	0.010	0.001	0.002	0.002	0.007	
		L_{eq} Internal SPL	27.9	21.7	28.5	16.7	22.0	18.6	16.8	29
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
window	R_{wi}	5/6/5 double glazing	28	27	26	25	34	35	38	32
	$S_{wi}/S \times 10^{-Rwi/10}$	C	0.000	0.000	0.001	0.001	0.000	0.000	0.000	
		L_{eq} Internal SPL	22.9	18.7	19.2	18.6	12.8	7.9	-2.8	18.8
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Primary wall	R_{ew}	Example Wall from BS8233 (Brick and Block)	36	40	44	45	51	56	58	51
	$S_{ew}/S \times 10^{-Rew/10}$	D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	20.0	10.8	6.3	3.7	0.9	-8.0	-17.7	5.7
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spandrel Panel	R_{rr}	Example Roof from BS8233	22	28	34	40	45	49	52	44
	$S_r/S \times 10^{-Rrr/10}$	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Internal Noise Levels

	10 Log (B+C+D+E)	F	-25.3	-26.2	-19.7	-27.6	-27.8	-27.4	-21.6	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	
L_{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{eq,2}$	L+F+G+K+T	31.8	25.8	31.7	22.2	25.3	21.8	19.8	29.8
L_{max}	Calc Tolerance	T								
	Internal $L_{max,2}$	M+F+G+K+T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Building envelope calculations, Flat 5 – Rear of building, Night Time

Building Envelope Sound Insulation Calculation According to EN 12354-3

	A2162	**Date**	05/07/2024	
	Night	**Room**	Bedroom 5	

	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
$L_{eq,ff}$	Measured L_{eq}	GF Lounge 1 - South	-0.1	-5.6	-4.7	-5.1	-2.5	-9.3	-14.0	44.6
	Measured spectrum	L: GF Lounge 1 - South: Adj Spectrum	44.5	39.0	39.9	39.5	42.1	35.3	30.6	44.6
		K	3	3	3	3	3	3	3	
$L_{max,ff}$	Measured L_{max}	GF Lounge 1 - South	-5.5	-8.1	-7.8	-3.9	-3.7	-8.6	-11.4	60.7
		M: GF Lounge 1 - South: Adj Spectrum	55.2	52.6	52.9	56.8	57.0	52.1	49.3	60.3
		K	6	6	6	6	6	6	6	

Room Details

	Term	Derivation	Value	Term	Derivation	Value
	V	Volume (m^3)	26.8	Sew	Sf - Swi - Sr	5.3
	RT	RT (secs)	0.5	Srr	Area of ceiling (m^2)	9.6
	Sf	Facade area (inc. window) (m^2)	6.7	S	Sf + Srr	6.7
	Sr	Panel Area	0.0	Ao	Ref Area for Dnew	10.0
	Swi	Window area (m^2)	1.4	Attenuation to roof		0.0

Sound Insulation Calculation elements

	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	**125**	**250**	**500**	**1 k**	**2 k**	**4 k**	
vent openings	$D_{n,e}$	23 Dne,w: Trickle: Lowest Performer	28	29	21.7	31.9	29.8	29.3	23.4	30
	$A_0/S \times 10^{-Dn/10}$	B	0.002	0.002	0.010	0.001	0.002	0.002	0.007	
		L_{eq} Internal SPL	20.1	13.6	21.8	11.2	15.9	9.6	10.8	23
		L_{max} Internal SPL	30.8	27.2	34.8	28.5	30.8	26.4	29.5	42
window	R_{wi}	5/6/5 double glazing	28	27	26	25	34	35	38	32
	$S_{wi}/S \times 10^{-Rwi/10}$	C	0.000	0.000	0.001	0.001	0.000	0.000	0.000	
		L_{eq} Internal SPL	14.6	10.1	12.0	12.6	6.2	-1.6	-9.3	12.1
		L_{max} Internal SPL	28.3	26.7	28.0	32.9	24.1	18.2	12.4	31.4
Primary wall	R_{ew}	Example Wall from BS8233 (Brick and Block)	36	40	44	45	51	56	58	51
	$S_{ew}/S \times 10^{-Rew/10}$	D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	12.4	2.9	-0.2	-1.6	-5.0	-16.8	-23.5	-0.5
		L_{max} Internal SPL	26.1	19.5	15.8	18.7	12.9	3.0	-1.8	18.2
Spandrel Panel	R_{rr}	Example Roof from BS8233	22	28	34	40	45	49	52	44
	$S_r/S \times 10^{-Rrr/10}$	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Internal Noise Levels

	10 Log (B+C+D+E)	F	-25.4	-26.3	-19.7	-27.8	-27.8	-27.4	-21.7	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	
L_{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{eq,2}$	L+F+G+K+T	24.0	17.6	25.0	16.6	19.2	12.8	13.8	23.1
L_{max}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{max,2}$	M+F+G+K+T	37.7	34.2	41.0	36.9	37.1	32.6	35.5	42.1