Residential Noise Assessment

Site Address: Former Barclays Bank, 1 King Street, South Shields, NE33 1DA

Client Name: Adsen Moore Financial Consulting

Project Reference No: NP-012419

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Delivering sustainable development by promoting good health and well-being through effective management of noise.

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the proposed development') at Former Barclays Bank, 1 King Street, South Shields, NE33 1DA ('the site'). The proposed development is for conversion of former retail unit & offices to self-contained studio flats (retaining ground floor retail unit).

The applicant has submitted planning application no. ST\2024\ENQ\00316 ('the application') to South Tyneside Metropolitan Borough Council. This report has been prepared to accompany the planning application submitted to the Local Planning Authority ('LPA').

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have been subsequently used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (2024)
- Noise Policy Statement for England (2010)
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- 'ProPG Planning and Noise' (May 2017)
- Approved Document F: Volume 1 Dwellings (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the conversion of the existing building from a former bank to a mixed-use development. This will consist of commercial towards the front elevation on the ground floor and residential dwellings across the upper floors. The figure below shows the proposed development layout from the basement to 2nd floor level, however, four floors are proposed and can be found in Appendix C.

Drawing Ref No. 24.044/CA/XX/XX/DR/A/20_004/P1 from 'Create Architecture'

Figure 1 – Proposed Development Plans (Basement to Level 2)

2. Environmental Noise Survey

2.1 Measurement Methodology

The following table outlines the measurement dates and particulars. In all instances the microphones were fitted with a proprietary outdoor kit complete with a 130mm diameter windshield. All equipment was field calibrated before and after each set of measurements; negligible drift was noted. The equipment registers and survey weather conditions can be found in Appendix D.

Location	Survey Dates	Measurement Particulars
MP1	14 – 17/03/2025	Equipment mounted protruding from a third-floor window at approximately 1m distance from the building façade at the front of site, overlooking Fowler Street (façade correction applied).
MP2	14 – 17/03/2025	Equipment mounted protruding from a first-floor window at approximately 1m distance from the southern façade at the rear of site, overlooking King Street (façade correction applied).

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations.

Imagery ©2025 Google, Imagery ©2025 Airbus, Infoterra Ltd & Bluesky, Maxar Technologies, Map data ©2025

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site is located on the corner of King Street and Keppel Street, in South Shields. The area surrounding the site consists primarily of commercial premises and residential dwellings that are located on the floors above.

The commercial properties are generally composed of retail units and are considered low risk. However, the development site is also in direct line of sight of 3no. public houses, which advertise entertainment including amplified music.

It is difficult to find any information on 'The Scotia' pub, which is situated approximately 15m to the north of the development site. The signs on the external facades advertise live entertainment, however the pub looks as though it may be permanently closed. Opposite 'The Scotia' is the 'Ship & Royal' pub, approximately 27m from site. This pub offers live bands, DJs and shows regular sporting events and is operational between 11:00 – 19:00, Monday to Thursday and 11:00 – 22:00, Friday to Saturday. 'Riddick's Sports Bar' to the south-southeast is newly operational and held its first opening weekend during the measurement period; operational hours are 10:00 – 22:30, Sunday to Thursday and 10:00 – 23:30, Friday to Saturday. As such, the measurements are believed to have captured a busy event and are considered 'robust'.

During the site visit it was observed that noise from non-anthropogenic sources, such as seagulls, was highly audible. Plant units servicing neighbouring premises were noticed to the rear of the development, however, any associated noise emissions were inaudible over the residual noise climate (primarily road traffic including heavy buss traffic). As such, no further assessment is deemed necessary.

A large bus station is also located to the southwest of site. It was noted that vehicles arrive regularly, park and remain with engines in an idle state until leaving the station. Additionally, further to the west, there is metro station with audible trains arriving and departing regularly.

In summary, the acoustic environment is deemed to be moderate to high in level and the noise profile was dominated by road traffic noise emissions, with any commercial and pedestrian noise second in nature at the front façade. Noise from the bus station is significantly dominant to the rear.

2.3 Environmental Noise Survey Results

The following section outlines the measured sound levels during the survey. The time history results can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							$L_{Aeq,T}$ (dB)	'Typical' $L_{AFmax,1min}$ (dB)
		63	125	250	500	1k	2k	4k		
MP1	Average $L_{eq,16hr}$ (Day)	59	57	54	54	55	51	45	58	--
	Average $L_{eq,8hr}$ (Night)	59	58	54	56	55	53	49	60	80
	Highest $L_{eq,1hr}$ (Day)	63	62	62	60	58	56	50	63	--
	Highest $L_{eq,1hr}$ (Night)	64	64	59	59	59	62	59	67	80
MP2	Average $L_{eq,16hr}$ (Day)	60	56	53	52	53	50	48	57	--
	Average $L_{eq,8hr}$ (Night)	57	54	51	53	53	51	50	58	82
	Highest $L_{eq,1hr}$ (Day)	57	56	52	56	60	55	49	62	--
	Highest $L_{eq,1hr}$ (Night)	64	61	58	62	60	56	57	65	82

Table 2 – Sound Level Results Summary

2.4 Entertainment Noise Level Analysis

The following graphs show the $L_{eq,15min}$ sound levels measured in the 63Hz and 125Hz 1/1 octave bands throughout the entire survey. These values are used to assess if entertainment noise is likely to have been comparatively audible in the environment.

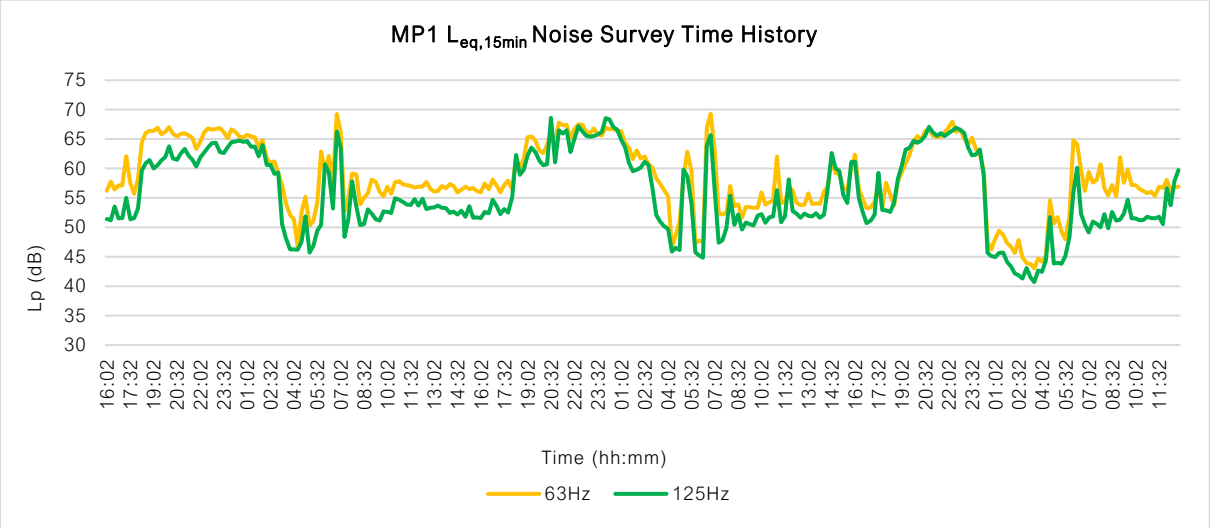

Figure 3 – MP1 Low Frequency Noise Analysis

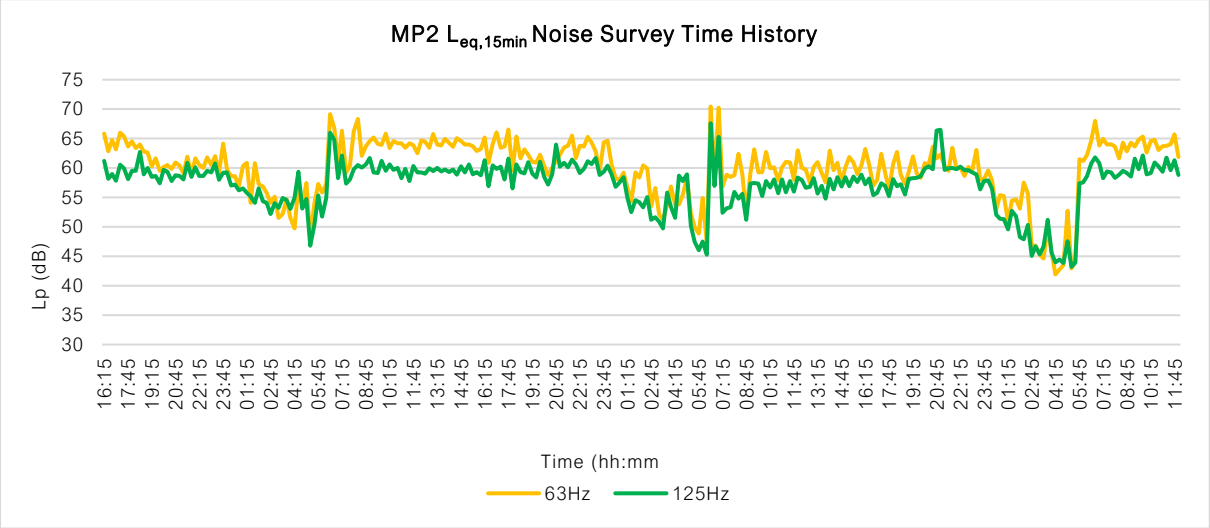

Figure 4 – MP2 Low Frequency Noise Analysis

As can be seen in the time history graph for MP1, a significant low frequency ramp up in noise level was recorded until not far after the closing times of the surrounding pubs and bars. These entertainment noise emissions would be clearly perceptible within the acoustic climate.

At MP2 low frequency noise emissions drop at approximately 11pm. The bus timetables from the South Shields Interchange show that the majority of the regular bus services conclude at approximately 11pm, which suggests that this is primarily caused by noise from busses. Noise levels at both positions also elevate at approximately the same time each morning. This is believed to be caused by regular vehicle movements, possibly supplying deliveries to the surrounding commercial premises.

3. The Agent of Change Principle

As noise from the existing entertainment noise associated with nearby commercial properties is likely to be audible and impactful at the proposed development, the agent of change principle must be considered.

Regarding this, the following is stated in paragraph 200 of the NPPF:

"Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Given the above, it is thought that good acoustic design principles must be implemented at the site to protect the amenity of future residents and avoid placing undue restrictions on the adjacent establishments.

The 'ProPG Planning and Noise' (May 2017) guidance, was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. ProPG aims to encourage better acoustic design of new residential developments by promoting good health and wellbeing through the effective management of noise. It outlines four key elements which should be considered in the assessment of noise:

- Element 1 – demonstrating a "Good Acoustic Design Process".
- Element 2 – observing internal "Noise Level Guidelines".
- Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
- Element 4 – consideration of "Other Relevant Issues".

The ProPG supplementary document 2 provides the following 'Good Acoustic Design' hierarchy of noise management measures which are considered to be relevant to this development:

1. Reduction of noise at the source.

It should first be investigated whether noise emissions can be reduced at the source. As the neighbouring businesses are not owned or operated by the client, it is advised that the client contacts the operators of the establishments to discuss the possibility of noise mitigation (such as the installation of upgraded glazing and doorset). However, it is understood that this may be met with opposition from the neighbouring premises.

2. Reorientation of the development

Considering the nature of the development and the location of the existing windows, it is thought that it would not be feasible to locate the sensitive rooms away from the northern elevations.

3. Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.

Acoustic shielding is deemed unsuitable given the urbanised location of the proposed development site, and the fact residential units will span the upper floors.

4. Enhanced façade sound insulation treatment.

Finally, it is recommended that an enhanced façade sound insulation treatment is implemented in order to reduce internal noise levels as much as possible. This is proposed as follows:

- The level of façade sound insulation required should be calculated considering both the Moorhouse low-frequency curve and the measurements from the loudest operational periods at the northern and eastern elevations when entertainment noise is dominant.
- A mechanical ventilation system should be installed for all sensitive rooms along the affected façades so that windows are not required to be opened in order to mitigate overheating and provide ventilation.

The LPA will need to be satisfied that achieving the lowest practicable noise levels appropriately considers the 'Agent of Change' principle and will not affect the viability of existing businesses.

4. Noise Break-in Assessment and Sound Insulation Scheme

4.1 Internal Noise Level Criteria

As the noise environment is affected by low-frequency noise, the sound insulation scheme is specified using the Moorhouse Curve. The Moorhouse Curve and BS8233 criteria are presented in the tables below.

Moorhouse Curve Design Criteria	
Location	**Day & Night**
All Rooms	63Hz limit of 47dB 125Hz limit of 41dB

Table 3 – Low Frequency Acoustic Design Criteria (Moorhouse)

The following table outlines the internal acoustic design criteria used in the following assessment.

BS8233:2014 Acoustic Design Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 07:00)**
Resting	Living Room	35 dB $L_{Aeq,16hr}$ / NR30	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$ / NR35	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$ / NR30	30 dB $L_{Aeq,8hr}$ / NR25 45 dB L_{AFmax}*

**NOTE 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.*

**NOTE 2: ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".*

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) 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 with 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 recommended in Table 4.

Note 5; BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 4 – Internal Acoustic Design Criteria

As previously stated, more stringent criteria are used for the assessment of the development. This is thought to be in line with Note 4 of the table above. Please note that a 1dB exceedance of the Moorhouse criteria at 125Hz has been predicted in some instances, this is deemed marginal and would not be perceived.

Façade Allocation

In order to correctly specify the required sound reduction, the façades have been divided into colour groups. Appropriate models of glazing and ventilation for each façade colour are shown in Table 5.

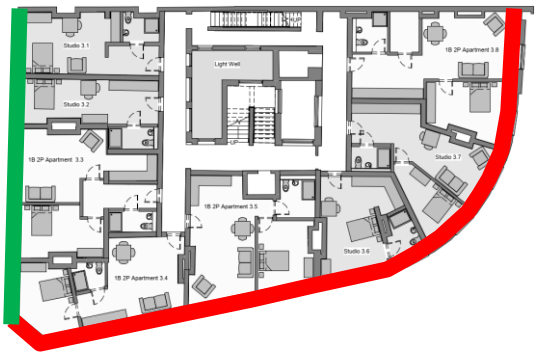

Figure 5 – Façade Allocation – All Floors

4.2 Glazing and Whole Dwelling (Background) Ventilation Specification

The following section provides a glazing and background ventilation specification that achieves the relevant internal noise criteria. The calculations considering the following sound insulation scheme can be found in Appendix E.

Please note that any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

Sound Insulation Scheme – Double Glazing Options								
Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Red Façades – Living Rooms								
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)	21	21	28	37	48	48	54	39 R_W (-6 C_{tr})
Red Façades – Bedrooms and Studio Apartments								
10mm Glass / 16mm Air Cavity / 8.8mm Optiphon Glass (SRI)	25	28	31	42	45	50	58	44 R_W (-6 C_{tr})
Green Façades – Living Rooms								
6mm Glass / 16mm Argon Cavity / 4mm Glass (SRI)	20	21	20	26	38	37	39	32 R_W (-4 C_{tr})
Green Façades – Bedrooms and Studio Apartments								
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)	21	21	28	37	48	48	54	39 R_W (-6 C_{tr})
All Façades – Whole Dwelling Background Ventilation								
Greenwoods MA3051 (2no. through wall vents, D_{ne})	31	41	40	37	47	43	46	42 $D_{ne,W}$ (-2 C_{tr})

Table 5 – Double Glazing Specification

Sound Insulation Scheme – Secondary Glazing Options								
Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Red Façade – Living Rooms								
Existing 4mm Glass / 75mm Air Cavity / 8.8mm Secondary Optiphon Glass (SRI)	21	21	34	43	51	55	57	43 R_W (-9 C_{tr})
Red Façades – Bedrooms and Studio Apartments								
Existing 4mm Glass / 50mm Air Cavity / 10.8mm Secondary Optiphon Glass (SRI)	24	22	34	43	50	56	58	44 R_W (-9 C_{tr})
Green Façades – Living Rooms								
Existing 4mm Glass / 100mm Air Cavity / 4mm Secondary Glass (SRI)	21	21	34	43	51	55	57	43 R_W (-9 C_{tr})
Green Façades – Bedrooms and Studio Apartments								
Existing 4mm Glass / 75mm Air Cavity / 8.8mm Secondary Optiphon Glass (SRI)	21	21	34	43	51	55	57	43 R_W (-9 C_{tr})
All Façades – Whole Dwelling Background Ventilation								
Greenwoods MA3051 (2no. through wall vents, D_{ne})	30	46	45	50	55	65	67	55 $D_{ne,W}$ (-3 C_{tr})

Table 6 – Secondary Glazing Specification

4.3 Remainder of External Envelope

In order to not downgrade the performance of the external fabric as a whole, the remainder of the façade and roofing must provide sound insulation at least 10dB greater than glazing specification above.

The façades are at least 200mm thick brick and will provide ample sound insulation. However, the dormer and room in roof constructions must be considered. The following roofing specification should be installed to ensure compliance:

- 8mm roofing slates,
- 9mm plywood deck,
- Min. 150mm timber joists lined with 100mm mineral wool slab insulation (min density 45kg/m^3),
- Isolation clip and furring channels (e.g., iKoustic MuteClip system),
- 2no. 15mm Gyproc SoundBloc plasterboards (min. surface mass 12.6kg/m^2 per board).

5. Overheating Screening Assessment

5.1 Red Façades

As stated previously, if open windows were to be used as the primary source of ventilation along the red façades (that overlook the public houses to the north), internal noise levels are expected to exceed the required criteria and there is high likelihood of adverse impact from adjacent plant noise sources. For this reason, it is recommended that a secondary ventilation strategy is employed in all living rooms and bedrooms so that adequate internal conditions can be achieved without relying on windows to be opened.

Alternative forms of ventilation include passive systems (such as acoustic louvres) and mechanical systems (such as 'centralised mechanical extract ventilation' and 'mechanical ventilation with heat recovery'). The installation of passive systems is generally preferable; however, the precise requirements must be confirmed with a ventilation specialist. The systems should provide background and purge ventilation and also adequate overheating mitigation.

Further to this, it must also be ensured that the ventilation strategy is compliant with the requirements of Approved Document F. Special consideration should be given to 1.5 to 1.7 of Approved Document F to ensure the self-generated noise levels from the ventilation systems does not exceed the specified criteria.

5.2 Green Façades Overheating Screening Assessment

In order to avoid excessively high temperatures and provide adequate levels of thermal comfort within dwellings, an overheating mitigation strategy must be developed. In low noise areas, this strategy can often rely upon opening windows as the primary source of ventilation, however, in areas with higher levels of noise, this would present a risk of adverse effects on health and quality of life.

Considering that the development is a change of use and not new build, it is not a requirement to achieve the criteria defined in Approved Document O ('ADO'). However, to allow for a reasonable living environment, it is recommended that the less onerous criteria given in the 'Acoustics Ventilation and Overheating Design Guide' ('AVO') should be applied.

Considering that a partially open window provides approximately 13 dB of attenuation (as stated in 'AVO') the proposed internal and external noise criteria are present below and assessed in relation to the measured external noise levels.

Period	Proposed Criteria (dB)		External Level (dB)	
	Internal	External	Measured	Exceedance
Daytime ($L_{Aeq,16hr}$)	50 [1]	63	57	-6
Night-time ($L_{Aeq,8hr}$)	42 [1]	55	54	-1
Night-time ($L_{AFmax,T}$) [2]	65 [1]	78	82	+4

Notes:
[1] Criterion taken from the AVO guide. Above this level, it is stated: "Noise causes a material change in behaviour, e.g., having to keep windows closed most of the time."
[2] L_{AFmax} exceeded fewer than 10 times per night.

Table 7 – Overheating Screening Assessment – Green Façades

The noise levels measured at the green façades exceed the external L_{AFmax} noise criterion shown in the table above. As such, an assessment of whether the development is at risk of overheating would need to be undertaken by a suitably qualified person. Should the outcome indicate the site is at low risk of overheating, then a secondary ventilation strategy may not be required. If the outcome is that the site is at moderate to high risk, then it is recommended that openable windows are not used as the primary source of ventilation.

Alternative forms of ventilation include passive systems (such as acoustic louvres) and mechanical systems (such as 'centralised mechanical extract ventilation' and 'mechanical ventilation with heat recovery'). The installation of passive systems is generally preferable; however, the precise requirements must be confirmed with a ventilation specialist. Further to this, it must also be ensured that all ventilation strategies are compliant with the requirements of Approved Document F.

It should be noted that this assessment relates exclusively to overheating mitigation, and as such, open windows may be used for purge ventilation without acoustic constraint. Further advice can be provided by NOVA Acoustics if required.

6. Noise Breakthrough Assessment and Sound Insulation Scheme

6.1 Noise Breakthrough Criteria

The proposed development structurally adjoins a commercial property via a separating wall and floor. BS8233:2014 states that the internal noise criteria includes 'overall noise' which is the sum of structure borne and airborne noise sources. Noise breaking through from structurally adjoining commercial property will be considered to ensure the total noise from both structurally adjoining commercial properties and external noise ingress, does not exceed the proposed acoustic design criteria. Guidance on sound insulation between adjoining domestic and non-domestic dwellings is discussed in Approved Document E (ADE) of the Building Regulations. The following is stated in section 0.8 of ADE:

"The performance standards set out in Tables 1a and 1b are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations, the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level."

The higher standard of sound insulation required is dependent on the level of noise generated within the commercial property. Noise from structurally adjoining commercial sources can lead to elevated impact and as such further consideration is given to the level of audibility, dominance, attention grabbing features, spectral distribution, regularity, change in level, duration, and time of day the sound is occurring. The commercial properties 'Use Classes' can assist in defining a suitable higher standard of sound insulation.

6.2 Noise Breakthrough Assessment and Specification

The following table outlines the expected level of risk associated with the 'Class Use' of the structurally adjoining commercial property and provides a required sound insulation standard including a discussion to justify the standard.

Planning Class	Level of Risk from Noise	Required Sound Insulation Standard (dB)
E(a) Display or retail sale of goods, other than hot food	Medium	≥60 $D_{nT,w}$
Discussion: The noise emissions produced by retail units may include both amplified music, air handling units, general equipment noise and noise from staff/patrons. Amplified music and noise from general equipment or internal plant associated with these types of facilities is normally of a background level to facilitate conversation and as such is not a primary concern. The noise from staff/patrons can vary significantly and is highly dependent on the nature of the establishment. The required level of sound insulation should consider raised and elevated vocal efforts occurring regularly. The permitted opening hours are not believed to extend into the night-time period (23:00 – 07:00) and as such the sensitivity of the adjoining residential will consider only the daytime period.		

Table 8 – Noise Breakthrough Assessment

Floor Specification

Due to site conditions, identification of the existing floor detail was not possible. However, assumptions have been made based on 'typical' builds of this type. The existing floor detail is assumed to be in line with the following:

- Existing floorboard (assumed min. 18mm)
- Existing 200mm timber joists
- Existing lath and plaster (assumed min. 20mm)

Proposed Upgrade:

- 12mm overlay plywood
- 4mm MuteBarrier® mass loaded vinyl (min. surface mass 10kg/m²)
- Existing 18mm flooring chipboard
- 200mm timber joists with 150mm acoustic mineral wool insulation (min. density 60kg/m³) tightly and evenly fitted.
- Isolation clips (iKoustic MuteClip® or equivalent) and furring channel system affixed to the underside of the joist (in accordance with the manufacturers guidelines)
- 2no. 15mm SoundBloc plasterboards (min. surface mass 12.6kg/m² per board) with overlapping joints and sealed with flexible mastic at the perimeter.

Should the proposed sound insulation upgrades be adhered to, the adopted criteria can be achieved and thus the residential amenity of future occupants can be protected.

It should be noted that this report provides an indicative specification that can achieve the required acoustic performance and considers that all flanking routes for sound have been appropriately suppressed. As with any construction project, the ability to meet the specification will rely upon the quality of the built structure. As such the works should be carried out to a high standard of workmanship to ensure that any sound insulation measures are not breached, for example by installing a rigid connection across an isolated connection.

The development cannot achieve compliance until sound insulation testing is carried out by a UKAS accredited sound insulation testing company upon completion and assessed against the required sound insulation standard.

7. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in Section 4.2.
2. To mitigate against entertainment noise emissions, it is recommended that a secondary ventilation strategy is employed in all living rooms and bedrooms so that adequate internal conditions can be achieved without relying on windows to be opened. Further information is included in Section 5.
3. The remainder of the external envelope including the roofing should be constructed as per Section 3.3.
4. To assist in the design of the alternative ventilation strategy for habitable spaces along the green façade, a TM59 overheating assessment should be undertaken to assess whether the development is at risk of overheating. Should the outcome indicate the site is at low risk of overheating, then a secondary ventilation strategy may not be required. If the outcome is that the site is at moderate to high risk, then it is recommended that openable windows are not used as the primary source of ventilation along the front façade. Alternative ventilation forms are discussed in Section 5 it must also be ensured that all ventilation strategies are compliant with the requirements of Approved Document F.
5. The separating floors between the structurally adjoining commercial property and the proposed development should be designed to achieve the required sound insulation. An indicative specification has been provided in Section 6. Further design assistance can be provided by NOVA Acoustics if required.

The findings of this report will require written approval from the Local Authority prior to work commencing.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Background Sound	Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for N% of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10\log_{10}(p/p_0)^{2.}$ Where: p is the root-mean-square sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy, and guidance.

B.1 – National Planning Policy Framework (2024)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2024. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 187e, it states:

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.

Paragraph 198 states:

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 impact 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; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 198 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life:
- Mitigate and minimise adverse impacts on health and quality of life:
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This 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. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

This is further expanded using the updated "Noise Exposure Hierarchy Table" which includes an additional level of impact referred to as the 'No Observed Adverse Effect Level' ('NOAEL'). It is stated that at this level: *"noise can be heard, but does not cause any change in behaviour, attitude or other physiological response"*. In addition, noise at this level *"can slightly affect the acoustic character of the area but not such that there is a change in the quality of life".*

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, 'WHO Guidelines on Community Noise, 1999'. The Guidelines on Community Noise (1999) document defines community noise to include noise from "industries" and "construction". The desirable criteria levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

BS8233:2014 Internal Ambient Noise Level Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 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_{AFmax}*

Table 9 – BS8233:2014 Internal Ambient Noise Level Criteria

**ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB L_{AFmax} more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

It is noted, however, that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the 'LOAEL' as defined in the NPSE in Appendix B.

B.4 – Approved Document F Volume 1: Dwellings (2021)

Approved Document F states the following in relation to noise:

- Mechanical ventilation systems, including both continuous and intermittent mechanical ventilation, should be designed and installed to minimise noise. This includes doing all of the following.
    - Correctly sizing and jointing ducts.
    - Ensuring that equipment is appropriately and securely fixed, such as using resilient mountings where noise carried by the structure of the building could be a problem.
    - Selecting appropriate equipment, including following paragraph
- For mechanical ventilation systems, fan units should be appropriately sized so that fans operating in normal background ventilation mode are not overly noisy. This might require fans to be sized so that they do not operate near maximum capacity when in normal background ventilation mode.
- Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation.
- If an exposed façade is close to an area of sustained and loud noise (e.g. a main road), then a noise attenuating background ventilator should be fitted.

B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

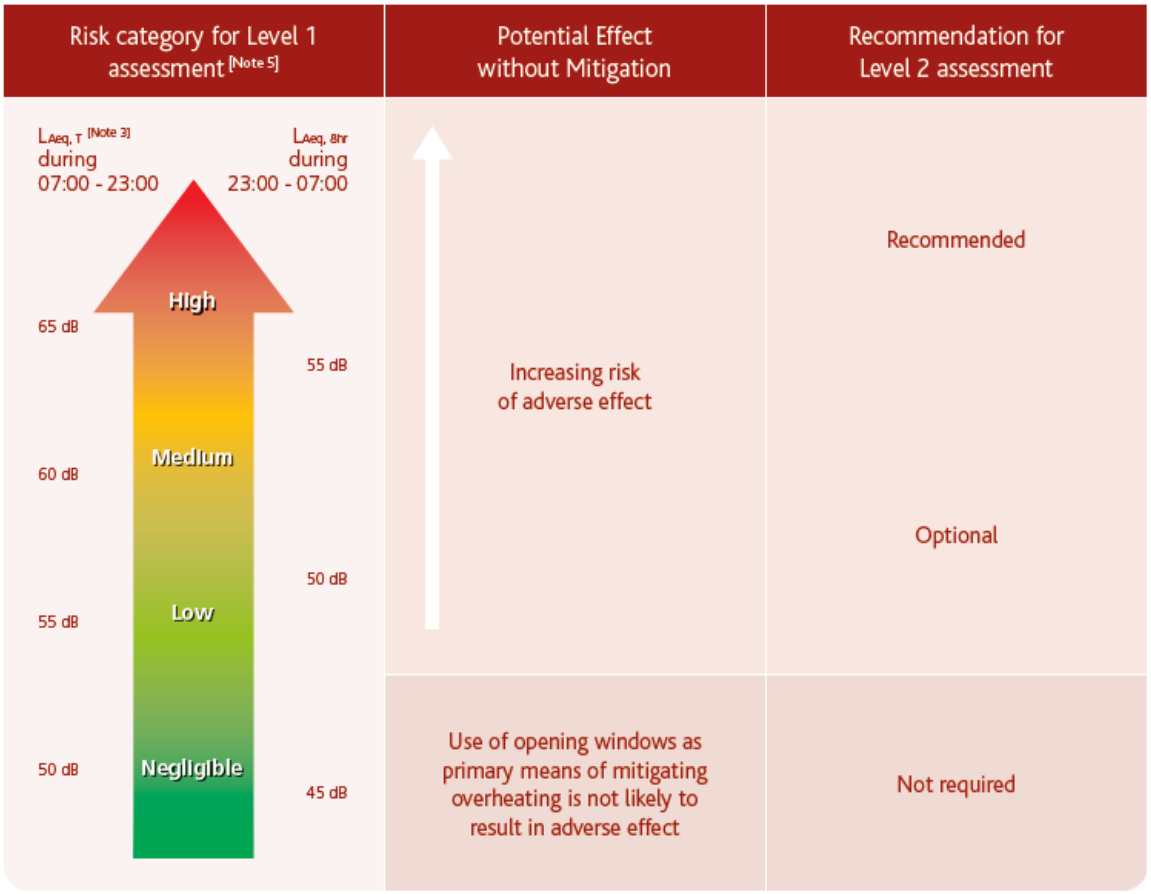

Table 3-2 of AVO Guide (2020)

Figure 6 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

AVO Guide (2020) Level 1 Risk Assessment			
Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Risk Category	Mitigation
≥63 dB $L_{Aeq,16hour}$	≥55 dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤53 dB $L_{Aeq,16hour}$	≤48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 10 – AVO Guide (2020) Level 1 Risk Assessment

Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are >50 dB $L_{Aeq,16hr}$ (day) or >42 dB $L_{Aeq,8hr}$ (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

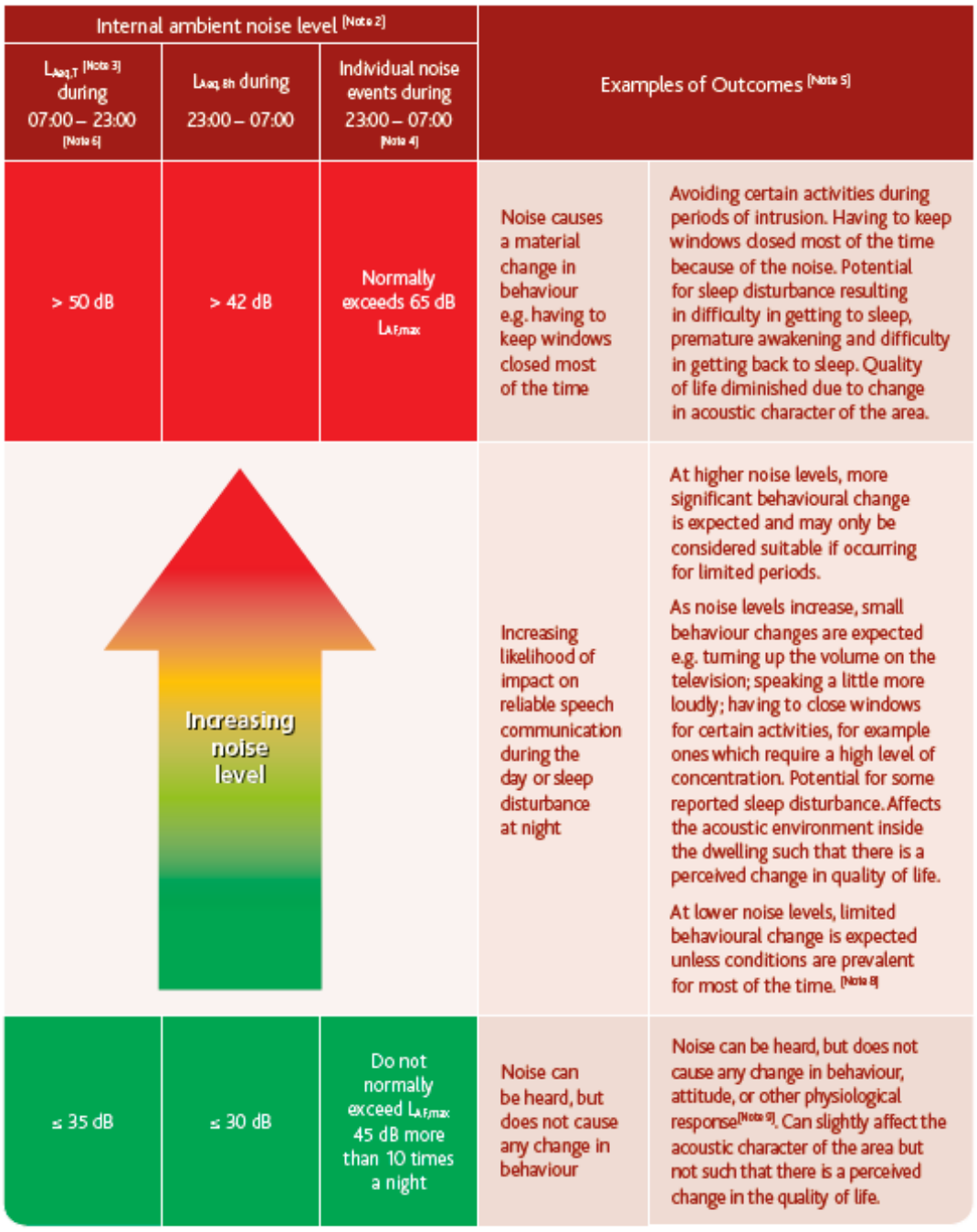

Table 3-3 of AVO Guide (2020)

Figure 7 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans

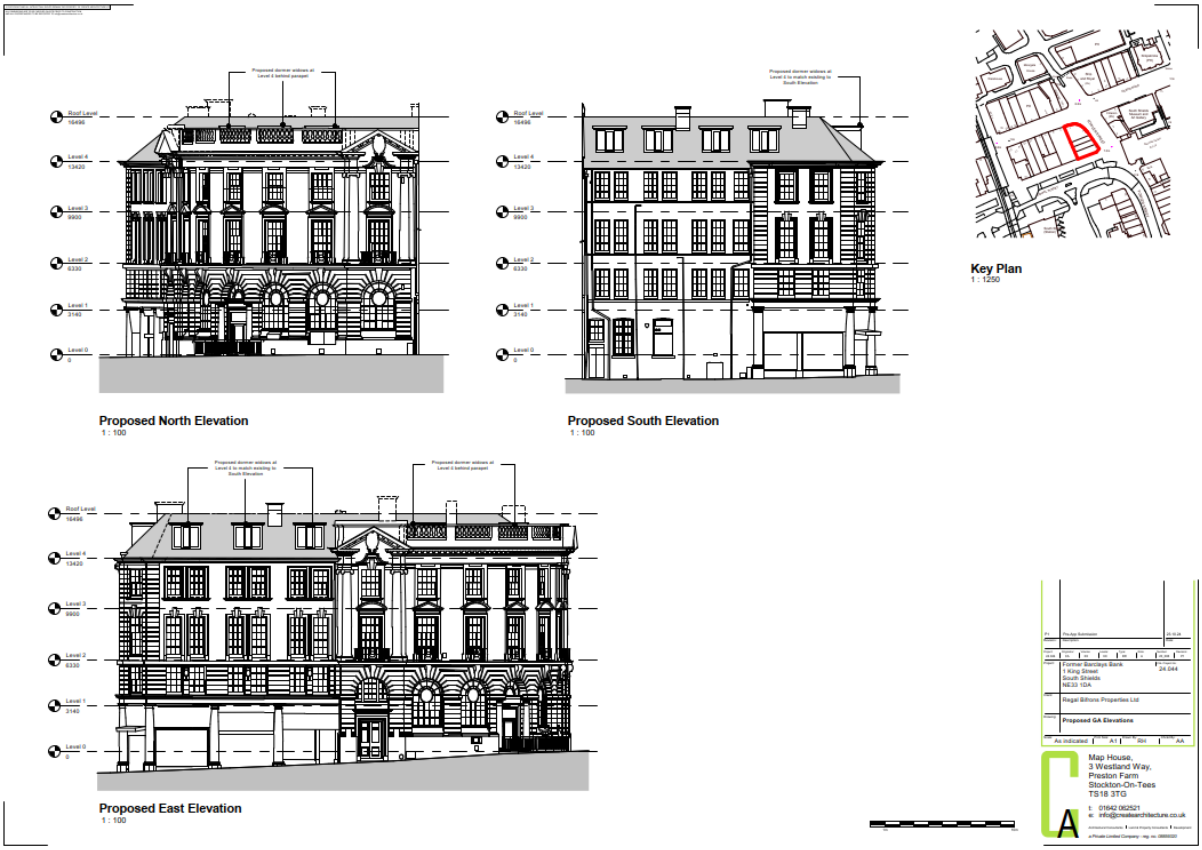

Figure 8 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

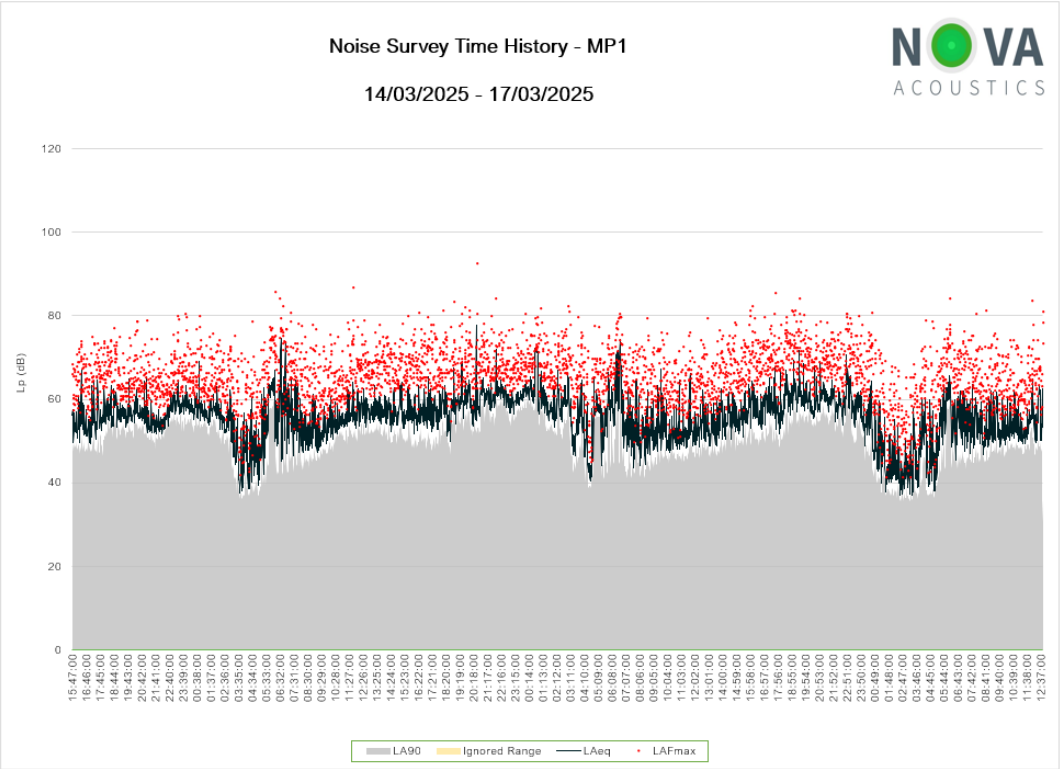

Figure 9 – MP1 Noise Survey Time History

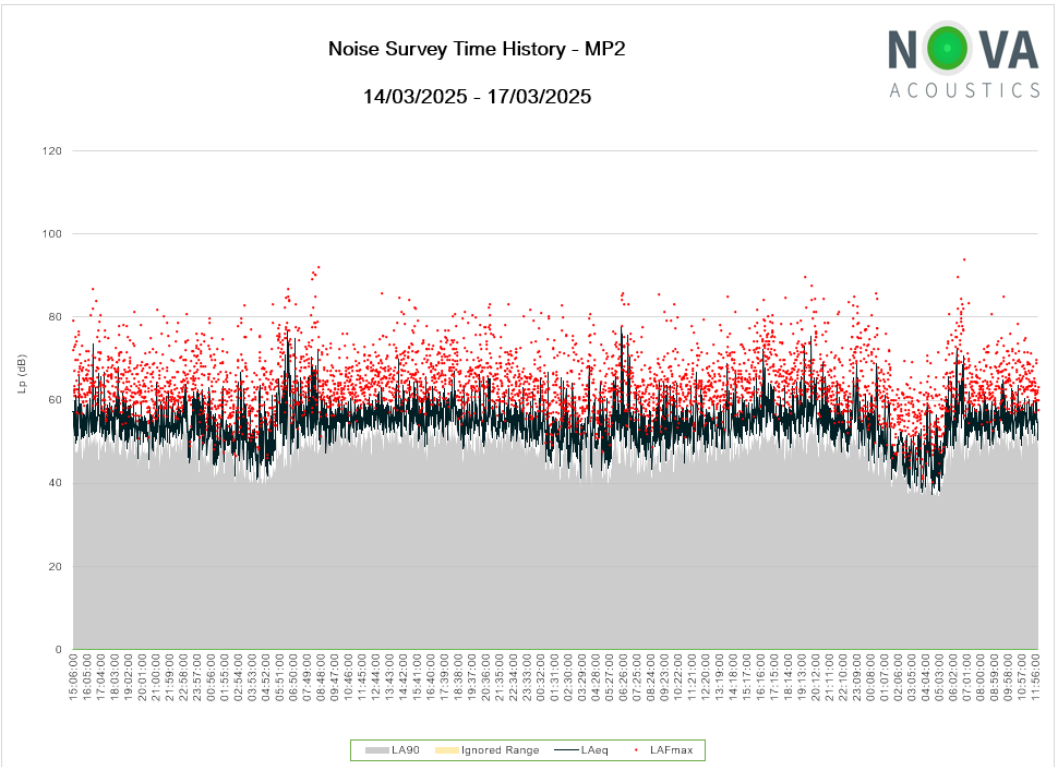

Figure 10 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SV971A Class 1 Sound Level Meter	141346	≤0.2
CESVA CB006 Class 1 Calibrator	901955	
Svatek SV971A Class 1 Sound Level Meter	141359	
CESVA CB006 Class 1 Calibrator	901955	

Table 11 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.2 dB. All sound level meters are calibrated every 24 months, and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted.

The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Cullercoats (Approx. 4.6km N of Site)				
Time Period	Air Temp (°C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
14/03/25: 00:00 – 23:59	1.0 – 9.7	0.0 – 0.3	S	0.6 – 4.7
15/03/25: 00:00 – 23:59	-0.1 – 11.0	0.0	S	0.0 – 2.5
16/03/25: 00:00 – 23:59	1.8 – 9.8	0.0	SE	0.4 – 4.2
17/03/25: 00:00 – 23:59	2.5 – 10.8	0.0	E	1.1 – 4.6

Table 12 – Survey Weather Conditions

Appendix E – Noise Break-in Calculations

E.1 – Façades with Background Ventilation

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. Bedrooms are taken as 0.3s.
- Based on the technical drawings provided to NOVA Acoustics, window areas of 3-6m^2 and room volumes of 21-31m^3 are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 3-8m^2 and room volumes of 45-67m^3 as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturer's technical information, or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000mm^2 per habitable room has been used in the calculations, which equates to 2no. trickle vents (2500mm^2 each).

Living Room (Red Façades - Double) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	27	39	39	31	20	8	6	-7	-16
Ventilation Noise Ingress	14	34	18	18	11	4	-8	-16	-25
Wall Noise Ingress	4	17	12	9	-3	-6	-8	-14	-23
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**29**	**44**	**42**	**34**	**23**	**11**	**8**	**-5**	**-16**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-6	-3	1	-5	-10	-19	-18	-29	-38

Bedroom (Red Façades - Double) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	22	35	32	28	15	10	3	-11	-20
Ventilation Noise Ingress	17	37	21	21	14	7	-5	-13	-22
Wall Noise Ingress	4	18	12	10	-3	-5	-7	-14	-23
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**26**	**42**	**35**	**31**	**19**	**14**	**6**	**-7**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-9	-5	-6	-8	-14	-16	-20	-31	-40

Bedroom (Red Façades - Double) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	67	64	64	59	59	59	62	59	41
Glazing Noise Ingress	21	36	33	25	14	11	9	-1	-20
Ventilation Noise Ingress	16	38	22	18	13	8	1	-3	-22
Wall Noise Ingress	6	18	14	7	-3	-5	-1	-4	-22
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**25**	**43**	**36**	**28**	**19**	**15**	**12**	**2**	**-17**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-5	-4	-5	-7	-9	-10	-9	-17	-34

Bedroom (Red Façades - Double) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	80	70	68	66	75	77	73	64	54
Glazing Noise Ingress	33	42	37	32	30	29	20	4	-7
Ventilation Noise Ingress	30	44	26	25	29	26	12	2	-9
Wall Noise Ingress	17	25	17	14	13	14	10	1	-9
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**37**	**49**	**40**	**36**	**34**	**33**	**22**	**7**	**-4**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-8	-18	-16	-13	-9	-7	-15	-27	-37

Living Room (Red Façades Dormer) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	19	32	32	24	13	0	-2	-14	-23
Ventilation Noise Ingress	11	31	15	15	8	1	-11	-19	-28
Wall Noise Ingress	2	15	10	7	-5	-7	-9	-16	-25
Roof Noise Ingress	9	34	15	5	-4	-10	-10	-22	-32
Room Absorption Correction		4	4	3	3	3	3	2	0
Total Noise Ingress	**27**	**44**	**39**	**31**	**20**	**10**	**5**	**-6**	**-17**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-8	-3	-2	-8	-13	-20	-21	-30	-39

Bedroom (Red Façades Dormer) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	18	31	28	24	11	7	0	-15	-24
Ventilation Noise Ingress	15	35	18	19	11	5	-7	-16	-25
Wall Noise Ingress	0	13	8	5	-7	-10	-12	-18	-27
Roof Noise Ingress	9	34	15	5	-5	-10	-10	-23	-32
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**27**	**45**	**35**	**32**	**20**	**15**	**7**	**-6**	**-17**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-8	-2	-6	-7	-13	-15	-19	-30	-39

Bedroom (Red Façades Dormer) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	67	64	64	59	59	59	62	59	41
Glazing Noise Ingress	18	32	30	21	11	7	6	-5	-23
Ventilation Noise Ingress	14	35	20	15	11	5	-1	-6	-24
Wall Noise Ingress	1	14	9	2	-8	-9	-5	-8	-27
Roof Noise Ingress	9	34	17	1	-5	-10	-4	-13	-31
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**26**	**46**	**37**	**29**	**20**	**15**	**13**	**3**	**-16**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-4	-1	-4	-6	-8	-10	-8	-16	-33

Bedroom (Red Façades Dormer) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	80	70	68	66	75	77	73	64	54
Glazing Noise Ingress	29	38	33	29	26	26	16	0	-10
Ventilation Noise Ingress	27	42	23	23	27	24	9	-1	-11
Wall Noise Ingress	13	20	13	10	8	9	5	-3	-14
Roof Noise Ingress	17	41	20	9	11	9	7	-8	-18
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**38**	**52**	**40**	**36**	**35**	**34**	**23**	**8**	**-3**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-7	-15	-16	-13	-8	-6	-14	-26	-36

Living Room (Red Façades - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	24	39	39	25	14	5	-1	-10	-19
Ventilation Noise Ingress	14	34	18	18	11	4	-8	-16	-25
Wall Noise Ingress	4	17	12	9	-3	-6	-8	-14	-23
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**28**	**44**	**42**	**29**	**18**	**10**	**2**	**-7**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-7	-3	1	-10	-15	-20	-24	-31	-40

Bedroom (Red Façades - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	23	36	38	25	14	5	-3	-11	-20
Ventilation Noise Ingress	17	37	21	21	14	7	-5	-13	-22
Wall Noise Ingress	4	18	12	10	-3	-5	-7	-14	-23
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**27**	**43**	**40**	**29**	**19**	**11**	**2**	**-7**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-8	-4	-1	-10	-14	-19	-24	-31	-40

Bedroom (Red Façades - Secondary) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	67	64	64	59	59	59	62	59	41
Glazing Noise Ingress	24	37	39	22	13	6	3	-1	-20
Ventilation Noise Ingress	16	38	22	18	13	8	1	-3	-22
Wall Noise Ingress	6	18	14	7	-3	-5	-1	-4	-22
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**27**	**43**	**42**	**26**	**18**	**12**	**8**	**2**	**-17**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-3	-4	1	-9	-10	-13	-13	-17	-34

Bedroom (Red Façades - Secondary) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	80	70	68	66	75	77	73	64	54
Glazing Noise Ingress	31	43	43	29	29	24	14	4	-7
Ventilation Noise Ingress	30	44	26	25	29	26	12	2	-9
Wall Noise Ingress	17	25	17	14	13	14	10	1	-9
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**36**	**50**	**45**	**33**	**34**	**30**	**18**	**7**	**-4**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-9	-17	-11	-16	-9	-10	-19	-27	-37

Living Room (Red Façades Dormer - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	17	32	32	18	7	-3	-9	-17	-26
Ventilation Noise Ingress	11	31	15	15	8	1	-11	-19	-28
Wall Noise Ingress	2	15	10	7	-5	-7	-9	-16	-25
Roof Noise Ingress	9	34	15	5	-4	-10	-10	-22	-32
Room Absorption Correction		4	4	3	3	3	3	2	0
Total Noise Ingress	**25**	**44**	**39**	**27**	**17**	**9**	**2**	**-7**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-10	-3	-2	-12	-16	-21	-24	-31	-40

Bedroom (Red Façades Dormer - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	63	63	62	62	60	58	56	50	41
Glazing Noise Ingress	20	32	34	21	10	2	-6	-15	-24
Ventilation Noise Ingress	15	35	18	19	11	5	-7	-16	-25
Wall Noise Ingress	0	13	8	5	-7	-10	-12	-18	-27
Roof Noise Ingress	9	34	15	5	-5	-10	-10	-23	-32
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**28**	**45**	**41**	**30**	**20**	**13**	**3**	**-6**	**-17**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-7	-2	0	-9	-13	-17	-23	-30	-39

Bedroom (Red Façades Dormer - Secondary) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	67	64	64	59	59	59	62	59	41
Glazing Noise Ingress	20	33	36	18	10	2	0	-5	-23
Ventilation Noise Ingress	14	35	20	15	11	5	-1	-6	-24
Wall Noise Ingress	1	14	9	2	-8	-9	-5	-8	-27
Roof Noise Ingress	9	34	17	1	-5	-10	-4	-13	-31
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**28**	**46**	**42**	**27**	**19**	**13**	**9**	**3**	**-16**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-2	-1	1	-8	-9	-12	-12	-16	-33

Bedroom (Red Façades Dormer - Secondary) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	80	70	68	66	75	77	73	64	54
Glazing Noise Ingress	28	39	39	26	25	21	10	0	-10
Ventilation Noise Ingress	27	42	23	23	27	24	9	-1	-11
Wall Noise Ingress	13	20	13	10	8	9	5	-3	-14
Roof Noise Ingress	17	41	20	9	11	9	7	-8	-18
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**37**	**53**	**46**	**34**	**35**	**32**	**20**	**8**	**-3**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-8	-14	-10	-15	-8	-8	-17	-26	-36

Living Room (Green Façades - Double) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	26	33	30	27	26	18	13	5	-4
Ventilation Noise Ingress	11	30	12	9	9	8	-8	-16	-25
Wall Noise Ingress	2	13	7	1	-4	-2	-7	-13	-22
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**28**	**38**	**33**	**30**	**28**	**20**	**15**	**5**	**-5**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-7	-9	-8	-9	-5	-10	-11	-19	-27

Bedroom (Green Façades - Double) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	22	35	34	23	18	11	6	-6	-15
Ventilation Noise Ingress	13	32	14	11	11	10	-6	-14	-23
Wall Noise Ingress	-3	8	2	-4	-10	-7	-12	-18	-27
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**25**	**40**	**37**	**25**	**21**	**16**	**8**	**-5**	**-15**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-10	-7	-4	-14	-12	-14	-18	-29	-37

Bedroom (Green Façades - Double) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	64	61	58	62	60	56	57	56
Glazing Noise Ingress	27	43	39	29	24	11	7	2	1
Ventilation Noise Ingress	18	39	19	17	16	9	-5	-5	-6
Wall Noise Ingress	1	15	7	2	-4	-7	-11	-10	-11
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**30**	**47**	**42**	**32**	**27**	**15**	**9**	**4**	**1**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	0	0	1	-3	-1	-10	-12	-15	-16

Bedroom (Green Façades - Double) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	82	66	64	62	69	74	75	77	73
Glazing Noise Ingress	34	44	42	33	31	25	26	22	18
Ventilation Noise Ingress	26	40	22	21	23	23	15	14	10
Wall Noise Ingress	15	17	10	6	3	7	8	10	6
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**36**	**48**	**45**	**35**	**34**	**29**	**28**	**23**	**17**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-9	-19	-11	-14	-9	-11	-9	-11	-16

Living Room (Green Façades Dormer) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	19	26	23	20	19	11	6	-2	-11
Ventilation Noise Ingress	6	24	6	3	3	2	-14	-22	-31
Wall Noise Ingress	-1	10	4	-2	-8	-5	-10	-17	-25
Roof Noise Ingress	3	28	9	-5	-8	-8	-11	-24	-32
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	**25**	**38**	**30**	**27**	**25**	**18**	**12**	**3**	**-8**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-10	-9	-11	-12	-8	-12	-14	-21	-30

Bedroom (Green Façades Dormer) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	14	28	27	16	11	4	-1	-14	-22
Ventilation Noise Ingress	9	27	10	7	6	5	-10	-18	-27
Wall Noise Ingress	-2	9	3	-3	-9	-6	-11	-18	-26
Roof Noise Ingress	3	28	9	-5	-8	-8	-11	-24	-32
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**22**	**40**	**34**	**23**	**19**	**14**	**5**	**-7**	**-17**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-13	-7	-7	-16	-14	-16	-21	-31	-39

Bedroom (Green Façades Dormer) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	64	61	58	62	60	56	57	56
Glazing Noise Ingress	20	35	32	22	17	4	0	-5	-6
Ventilation Noise Ingress	13	35	15	13	12	5	-9	-10	-11
Wall Noise Ingress	1	16	8	3	-3	-6	-10	-9	-10
Roof Noise Ingress	10	35	14	1	-2	-8	-10	-15	-16
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**27**	**47**	**39**	**29**	**24**	**14**	**7**	**2**	**0**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-3	0	-2	-6	-4	-11	-14	-17	-17

Bedroom (Green Façades Dormer) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	82	66	64	62	69	74	75	77	73
Glazing Noise Ingress	27	37	35	25	24	17	19	15	10
Ventilation Noise Ingress	22	36	18	17	19	19	11	10	6
Wall Noise Ingress	16	18	11	6	4	7	9	11	6
Roof Noise Ingress	15	37	17	4	5	6	9	5	0
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**34**	**48**	**42**	**32**	**31**	**27**	**26**	**22**	**16**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-11	-19	-14	-17	-12	-13	-11	-12	-17

Living Room (Green Façades - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	23	40	37	18	14	11	1	2	-7
Ventilation Noise Ingress	11	30	12	9	9	8	-8	-16	-25
Wall Noise Ingress	2	13	7	1	-4	-2	-7	-13	-22
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**26**	**43**	**40**	**21**	**17**	**15**	**4**	**3**	**-8**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-9	-4	-1	-18	-16	-15	-22	-21	-30

Bedroom (Green Façades - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	20	35	34	17	12	8	-1	-9	-18
Ventilation Noise Ingress	13	32	14	11	11	10	-6	-14	-23
Wall Noise Ingress	-3	8	2	-4	-10	-7	-12	-18	-27
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**23**	**40**	**37**	**20**	**17**	**14**	**2**	**-7**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-12	-7	-4	-19	-16	-16	-24	-31	-40

Bedroom (Green Façades - Secondary) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	64	61	58	62	60	56	57	56
Glazing Noise Ingress	25	43	39	23	18	8	0	-1	-2
Ventilation Noise Ingress	18	39	19	17	16	9	-5	-5	-6
Wall Noise Ingress	1	15	7	2	-4	-7	-11	-10	-11
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**28**	**47**	**42**	**26**	**22**	**14**	**3**	**1**	**-1**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-2	0	1	-9	-6	-11	-18	-18	-18

Bedroom (Green Façades - Secondary) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	82	66	64	62	69	74	75	77	73
Glazing Noise Ingress	30	44	42	27	25	22	19	19	15
Ventilation Noise Ingress	26	40	22	21	23	23	15	14	10
Wall Noise Ingress	15	17	10	6	3	7	8	10	6
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	**34**	**48**	**45**	**30**	**29**	**27**	**22**	**21**	**15**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-11	-19	-11	-19	-14	-13	-15	-13	-18

Living Room (Green Façades Dormer - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	16	33	30	11	7	4	-6	-5	-14
Ventilation Noise Ingress	6	24	6	3	3	2	-14	-22	-31
Wall Noise Ingress	-1	10	4	-2	-8	-5	-10	-17	-25
Roof Noise Ingress	3	28	9	-5	-8	-8	-11	-24	-32
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	**23**	**42**	**37**	**18**	**15**	**13**	**2**	**0**	**-10**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-12	-5	-4	-21	-18	-17	-24	-24	-32

Bedroom (Green Façades Dormer - Secondary) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	62	57	56	52	56	60	55	49	40
Glazing Noise Ingress	12	28	27	10	5	1	-8	-17	-25
Ventilation Noise Ingress	9	27	10	7	6	5	-10	-18	-27
Wall Noise Ingress	-2	9	3	-3	-9	-6	-11	-18	-26
Roof Noise Ingress	3	28	9	-5	-8	-8	-11	-24	-32
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**21**	**40**	**34**	**18**	**15**	**13**	**1**	**-8**	**-18**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-14	-7	-7	-21	-18	-17	-25	-32	-40

Bedroom (Green Façades Dormer - Secondary) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	64	61	58	62	60	56	57	56
Glazing Noise Ingress	18	35	32	16	11	1	-7	-8	-9
Ventilation Noise Ingress	13	35	15	13	12	5	-9	-10	-11
Wall Noise Ingress	1	16	8	3	-3	-6	-10	-9	-10
Roof Noise Ingress	10	35	14	1	-2	-8	-10	-15	-16
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**26**	**47**	**39**	**24**	**21**	**13**	**3**	**1**	**-2**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-4	0	-2	-11	-7	-12	-18	-18	-19

Bedroom (Green Façades Dormer - Secondary) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	82	66	64	62	69	74	75	77	73
Glazing Noise Ingress	23	37	35	19	18	14	12	12	7
Ventilation Noise Ingress	22	36	18	17	19	19	11	10	6
Wall Noise Ingress	16	18	11	6	4	7	9	11	6
Roof Noise Ingress	15	37	17	4	5	6	9	5	0
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**32**	**48**	**42**	**28**	**28**	**26**	**22**	**20**	**15**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-13	-19	-14	-21	-15	-14	-15	-14	-18


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