# Residential Noise Assessment

Site Address: 9 High Street, Birstall, WF17 9ES

Client Name: Graham and Helen Sykes

Project Reference No: NP-011179

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

# Contents

1. INTRODUCTION ..... 4
1.1 Standards, Legislation, Policy & Guidance ..... 4
1.2 Proposal Brief ..... 4
1.3 Local Planning Authority & Background ..... 5
2. ENVIRONMENTAL NOISE SURVEY ..... 6
2.1 Measurement Methodology ..... 6
2.2 Context & Subjective Impression ..... 6
2.3 Environmental Noise Survey Results ..... 7
2.4 Commercial Noise Emissions ..... 7
2.5 Entertainment Noise Assessment ..... 8
3. ACOUSTIC DESIGN CONSIDERATIONS & THE PROPOSAL ..... 9
4. NOISE BREAK-IN ASSESSMENT AND SOUND INSULATION SCHEME ..... 11
4.1 Internal Noise Level Criteria ..... 11
4.2 Glazing and Whole Dwelling (Background) Ventilation Specification ..... 12
5. OVERHEATING ASSESSMENT ..... 13
5.1 Criteria ..... 13
5.2 Assessment ..... 13
6. EXTERNAL NOISE LEVEL ASSESSMENT ..... 15
6.1 External Noise Level Criteria ..... 15
6.2 External Noise Level Assessment ..... 15
7. CONCLUSION AND ACTION PLAN ..... 16
APPENDIX A – ACOUSTIC TERMINOLOGY ..... 17
APPENDIX B – STANDARDS, LEGISLATION, POLICY, AND GUIDANCE ..... 18
B.1 – National Planning Policy Framework (2023) ..... 18
B.2 – Noise Policy Statement for England (2010) ..... 18
B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings' ..... 20
B.4 – Approved Document 0: Overheating (2021) ..... 21
B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020 ..... 21
APPENDIX C – SITE LOCATION ..... 25
APPENDIX D – ENVIRONMENTAL SURVEY ..... 26
D.1 – Time History Noise Data ..... 26
D.2 – Surveying Equipment ..... 27
D.3 – Meteorological Conditions ..... 27
APPENDIX E – NOISE BREAK-IN CALCULATIONS ..... 28
E.1 – Façades with Background Ventilation ..... 28

## List of Figures

*Figure 1 – Proposed Development* ..... 5
*Figure 2 – Measurement Locations and Site Surroundings* ..... 6
*Figure 3 – AVO Guide Level 1 Risk Category* ..... 22
*Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels* ..... 24
*Figure 5 – Site Location Drawing Supplied by Client* ..... 25
*Figure 6 – MP1 Noise Survey Time History* ..... 26
*Figure 7 – MP2 Noise Survey Time History* ..... 26
*Figure 8 – MP1 Glazing and Ventilation Calculations* ..... 29
*Figure 9 – MP2 Glazing and Ventilation Calculations* ..... 30

## List of Tables

*Table 1 – Measurement Methodology* ..... 6
*Table 2 – Sound Level Results Summary* ..... 7
*Table 3 – MP2 Low-Frequency Sound Level Time History* ..... 8
*Table 4 – Internal Acoustic Design Criteria* ..... 11
*Table 5 – Glazing & Background Ventilation Specification* ..... 12
*Table 6 – External Noise Level Limits for Overheating Criteria* ..... 13
*Table 7 – External Acoustic Design Criteria* ..... 15
*Table 8 – BS8233 External Amenity Area Noise Level Assessment* ..... 15
*Table 9 – BS8233:2014 Internal Ambient Noise Level Criteria* ..... 20
*Table 10 – AVO Guide (2020) Level 1 Risk Assessment* ..... 23
*Table 11 – Surveying Equipment* ..... 27
*Table 12 – Weather Conditions* ..... 27

# 1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a new build residential development ('the Proposed Development') at 9 High Street, Birstall, WF17 9ES ('the Site'). The site is primarily subject to noise from the surrounding road network, and nearby commercial activity.

The applicant has received conditional approval for planning application No. 2023/62/90918/E ('the Application') from Kirklees Council. This report has been prepared to discharge Condition 9 imposed by the Local Planning Authority ('LPA').

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have subsequently been 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:

- The LPA's Kirklees Local Plan.
- National Planning Policy Framework (2023).
- Noise Policy Statement for England (2010).
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'.
- Approved Document O: Overheating (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 proposed development is for the erection of a single storey 3-bed dwelling within a conservation area. The figure below shows the layout of the proposed development.


*Drawing Ref No. (PL) 002) Provided by the Client*

*Figure 1 – Proposed Development*

## 1.3 Local Planning Authority & Background

The following condition of the approved planning application No. 2023/62/90918/E requires discharging:

*"9. Before construction work commences, a report specifying the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development including road traffic/commercial/licensed premises shall be submitted to and approved in writing by the Local Planning Authority. The report shall: a) Determine the existing noise climate b) Predict the noise climate in living rooms and gardens (daytime), bedrooms (nighttime) and other habitable rooms of the development c) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required). The development shall not be occupied until all works specified in the approved report have been carried out in full and such works shall be thereafter retained. Reason: To protect the amenity of occupiers of the proposed development from noise or disturbance from nearby noise generating premises to accord with the aims of Policies LP24 and LP52 of the Kirklees Local Plan and Chapters 12 and 15 of the National Planning Policy Framework. This is a pre-commencement condition to ensure that any risk from land contamination is identified at the outset and that appropriate mitigation, should any be necessary, is implemented at the appropriate stage of the development."*

# 2. Environmental Noise Survey

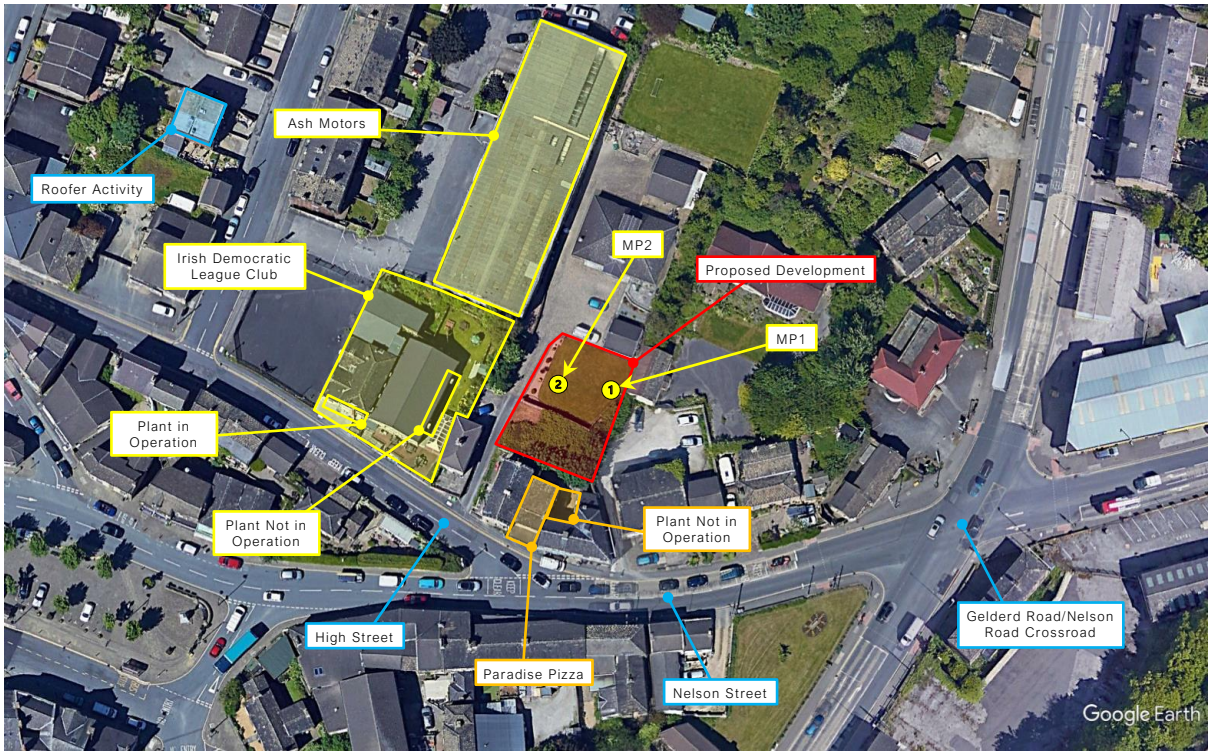
## 2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

| Location | Survey Dates | Measurement Particulars |
|---|---|---|
| MP1 | 24/05/2024 – 26/05/2024 | Equipment tripod mounted in an open area 1.8m above the ground. |
| MP2 | 24/05/2024 – 27/05/2024 | Equipment tripod mounted in an open area 1.8m above the ground. |

*Table 1 – Measurement Methodology*

The figure below outlines the site surroundings and measurement locations:




*Imagery ©2024 Maxar Technologies, Map data ©2024*

*Figure 2 – Measurement Locations and Site Surroundings*

## 2.2 Context & Subjective Impression

The development site is located on land to the rear of 9 High Street, Birstall, WF17 9ES. The area surrounding the site consists of commercial establishments in residential style buildings such as shops a takeaway, and commercial units.

A public house named the 'Irish Democratic League Club' is located adjacent to the west of the site, which closes at 23:30 on Fri-Sat, and 23:00 on all other nights. There is associated plant at the front façade of the club (facing High Street), but it was observed by the site engineer to be inaudible at the proposed development site when in operation. Additionally, the club hosts live music which shall be considered in

the time history analysis and there is an external patron area to the rear. A used car dealership 'Ash Motors' is located to the northwest of the site which operates 10:00 to 18:00 hours, Monday to Sunday. It does not appear to operate any MOT/Repair services.

There is a nearby takeaway, 'Paradise Pizza's', to the south of the site which has associated plant facing the proposed development. This operates from 17:00 to 00:00 hours, Sunday to Thursday and stays open until 01:00 hours on Friday and Saturday nights.

Additional plant was also observed in this location which was understood to be associated with businesses in the area that front onto Nelson Street that were not in operation.

During site visits, the acoustic environment was noted to be low in level and the noise profile was found to be dominated by road traffic noise emissions from the Gelderd Road/Nelson Road Crossroad. There was little to no noise observed by the site engineer emanating from the commercial units.

## 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 | $L_{eq,16hr}$ (Day) | 59 | 52 | 48 | 45 | 45 | 43 | 36 | 50 | -- |
| | $L_{eq,8hr}$ (Night) | 52 | 47 | 42 | 41 | 43 | 42 | 35 | 47 | 66 |
| | Highest $L_{eq,1hr}$ (Day) | 61 | 54 | 51 | 48 | 46 | 47 | 41 | 53 | -- |
| | Highest $L_{eq,1hr}$ (Night) | 57 | 52 | 47 | 44 | 45 | 46 | 38 | 51 | -- |
| MP2 | $L_{eq,16hr}$ (Day) | 60 | 51 | 47 | 45 | 45 | 44 | 40 | 50 | -- |
| | $L_{eq,8hr}$ (Night) | 53 | 44 | 42 | 39 | 42 | 43 | 36 | 47 | 67 |
| | Highest $L_{eq,1hr}$ (Day) | 61 | 54 | 51 | 47 | 47 | 50 | 45 | 55 | -- |
| | Highest $L_{eq,1hr}$ (Night) | 59 | 50 | 47 | 43 | 44 | 48 | 42 | 52 | -- |

*Table 2 – Sound Level Results Summary*

## 2.4 Commercial Noise Emissions

As can be seen in the time history graphs in Appendix D, the background noise level is consistent and low in level throughout the monitoring period. This is generally the case when distant traffic and commercial noise is present but not significantly dominant in an environment.

At MP1, the typical background sound level between 00:00 and 01:00 hours on the Friday night (when the plant associated with Paradise Pizza's' is in operation) was approximately 42dB $L_{A90,15min}$. In the one hour after when the takeaway is understood to be closed, the background sound level marginally reduced to 41dB $L_{A90,15min}$. Background sound levels were identical on the Saturday night. Based on this, it is anticipated that plant associated with the takeaway was not the dominant source in the area and did not impact the overall noise climate.

This was also the case with any plant items associated with the 'Irish Democratic League Club', as background sound levels only reduced by approximately 1dB when the establishment had closed, indicating that associated plant was not dominant.

In line with guidance from ProPG, Section 2.14, as the commercial sources are not considered dominant in the area (i.e. the impact would be rated as lower than adverse) any contributions shall be included as part of the background noise level and a full BS4142 assessment shall not be carried out.

As such, it is expected that the noise from the surrounding commercial establishments is unlikely to cause adverse impact at the development site.

## 2.5 Entertainment Noise Assessment

Considering the proximity to the adjacent public house, an entertainment noise assessment has been undertaken.

In order to predict whether entertainment noise could cause adverse impact at the development site, an analysis of the measured low frequency noise emissions at MP2 has been undertaken. It is understood that there was live music on the Saturday night (25th May). The low frequency noise has been selected for assessment as emissions at these frequencies are unlikely to be effectively attenuated by the building envelope of the pub. Time history graphs showing periods where low-frequency noise emissions may have been audible in the environment are shown below.

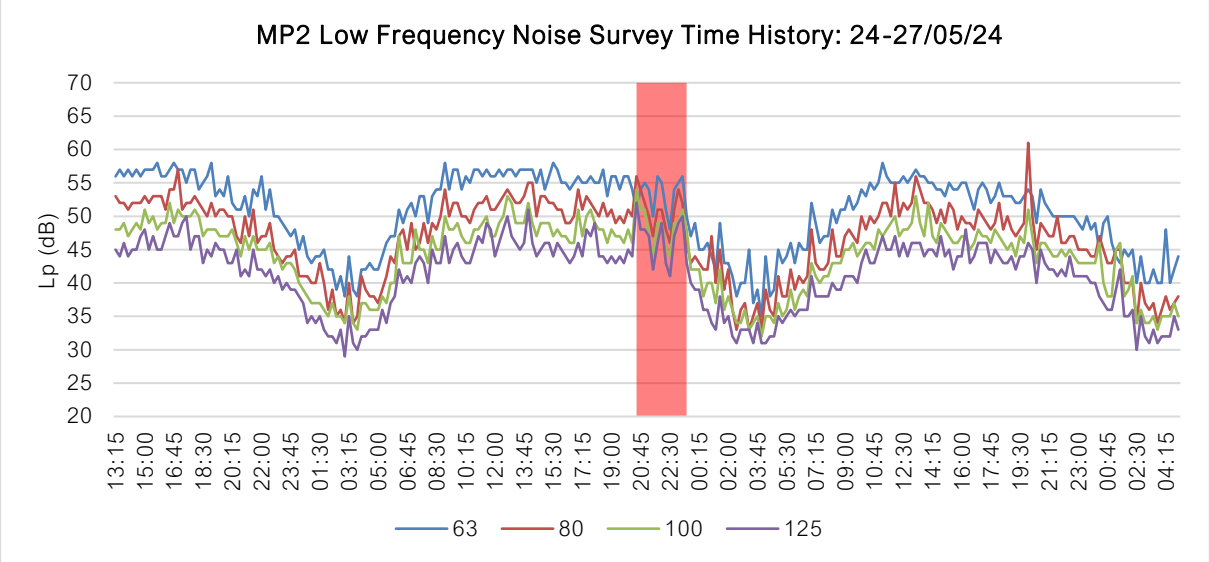



*Table 3 – MP2 Low-Frequency Sound Level Time History*

From the above figure, noise levels at lower-frequency bands appear to extend slightly further into the night-time during an event (as highlighted in red). However, the measured levels at the lower frequency bands are fairly consistent with those during the following morning (i.e. when live music is not present in the area).

This indicates that noise associated with live music may be slightly audible at the development site however, considering that low frequency noise emissions generally did not exceed 55dB, it is thought that this can be adequately controlled by the façade sound insulation of the proposed development, providing a robust assessment is undertaken. This is explained further in subsequent sections.

## 3. Acoustic Design Considerations & The Proposal

As noise from live music associated with the adjacent pub may be audible at the proposed development during events, the agent of change principle should be considered.

Regarding this, the following is stated in paragraph 193 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 reduce the risk of adverse impact on the amenity of future residents and avoid placing undue restriction on the adjacent pub.

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. <u>Reduction of noise at the source</u>

In order to reduce the possibility of adverse impact, it should first be investigated whether noise emissions can be reduced at the source.

It should be highlighted that the noise survey was caried out over a bank holiday (i.e. when activities within the beer garden or any internal events are likely at higher capacity). Based on the measured noise levels, it is anticipated that noise emissions may be 'slightly' audible at the development site, at worst. Therefore, imposing additional mitigation on the neighbouring club (i.e. inclusion of a noise limiter for live acts) is considered onerous and is likely not even required to achieve 'low impact' based on absolute sound levels measured at the development site (less than 55dB in lower frequency bands). It should also be highlighted that there are existing dwellings in close proximity to the club, indicating that some level of control is currently required by the venue to avoid complaints from the residents.

Therefore, in this instance, it is considered more appropriate to include good acoustic design as part of the proposed development rather than reducing the noise at the source.

2. Reorientation of the development

Considering the nature of the development, it is thought that it would not be feasible to locate all sensitive rooms away from the nearby pub.

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 presently in place and as such only marginal gains may be made through modifying the existing fencing other than to ensure it is maintained or made good.

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.

- The level of façade sound insulation required will be calculated considering more onerous criteria (see Section 4).
- Windows should remain openable at the occupants' choice.

It should be noted that anyone moving into area will be highly aware of the adjacent commercial noise, which is likely to reduce adverse impact, but this should not be relied upon. 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.

Additionally, given there are presently residential dwellings in close proximity the club, it is highly likely that action is being taken to limit noise complaints in the local area.

# 4. Noise Break-in Assessment and Sound Insulation Scheme

## 4.1 Internal Noise Level Criteria

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

| Activity | Location | Daytime (07:00 – 23:00) | Night-time (23:00 – 07:00) |
|---|---|---|---|
| Resting | Living Room | 35 dB $L_{Aeq,16hr}$ | -- |
| Dining | Dining Room/Area | 40 dB $L_{Aeq,16hr}$ | -- |
| Sleeping (Daytime resting) | Bedroom | 35 dB $L_{Aeq,16hr}$ | 30 dB $L_{Aeq,8hr}$<br>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 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved".*

*Note 4: BS8233 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 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*

In order to protect against fluctuations in entertainment and commercial noise from the nearby pub and nearby plant respectively, the façade sound reduction is specified considering the loudest 1-hour measurements from the daytime and night-time periods. This is more stringent than the typical BS8233 criteria (average 16-hour and 8-hour daytime and night-time measurements respectively) and is thought to be in accordance with Note 4 shown in the table above. This would also aid in controlling noise break-in via the potential for any low frequency noise associated with the entertainment sources in the area.

## 4.2 Glazing and Whole Dwelling (Background) Ventilation Specification

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

| Sound Insulation Scheme – All Living Rooms & Bedrooms | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Description | Octave Frequency Band (Hz, dB) | | | | | | | Overall (dB) |
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | |
| 6mm Glass / 16mm Air Cavity / 6mm Glass | 20 | 21 | 20 | 26 | 38 | 37 | 39 | 31 $R_w$ (-4; $C_{tr}$) |
| Titon Standard Vent + C25 (2 No. Trickle, Open Position) | 25 | 36 | 38 | 36 | 32 | 37 | 39 | 35 $D_{n,e,w}$ (-2; $C_{tr}$) |

*Table 5 – Glazing & Background Ventilation Specification*

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.

### *External Envelope*

In order to not downgrade the performance of the façade, the other elements within the external envelope (roof, walls etc.) would need to have a sound insulation performance that is 10dB greater than the glazing shown above. This would equate to a performance of 41dB $R'_w$.

This would be achievable with standard construction methods; however, care should be undertaken to limit low frequency noise transfer via the roof particularly. As a result, we would advise that the ceiling within the rooms is double boarded (assumed to be two layers of standard plasterboard).

# 5. Overheating 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.

## 5.1 Criteria

The threshold levels at which adverse effects may occur are defined in Approved Document O ('ADO') and the 'Acoustics Ventilation and Overheating Design Guide' ('AVO'). Considering that a partially open window provides approximately 9dB of attenuation in areas of moderate risk (as stated in the ADO supporting documentation), the proposed internal and external noise criteria are summarised as follows:

| Period | Proposed Criteria (dB) | | Measured Levels at Development Site |
|---|---|---|---|
| | Internal | External | |
| Daytime ($L_{Aeq,16hr}$) | 50 [1] | 59 | 50 |
| Night-time ($L_{Aeq,8hr}$) | 40 [2] | 49 | 47 |
| Night-time ($L_{AFmax}$) [3] | 55 [2] | 64 | 67 |

***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] Criteria taken from Approved Document O. Above this level, it is stated: "Windows are likely to be closed during sleeping hours."*

*[3] $L_{AFmax}$ exceeded fewer than 10 times per night.*

*Table 6 – External Noise Level Limits for Overheating Criteria*

## 5.2 Assessment

The noise levels measured on site **exceed** the external noise criteria shown in the table above but only during the night-time period by 3dB (in relation to the maximum events). Whilst this only a marginal exceedance, an assessment of whether the development is at risk of overheating should be undertaken by a suitably qualified person. Should the outcome indicate the site is at low risk of overheating during the night-time, 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.

However, during the daytime the external noise levels measured on site are below the threshold criteria shown in the table above. Given this, it is thought that opening windows can be used as the primary means of mitigating overheating areas other than bedrooms. However, it must also be ensured that all ventilation is compliant with the requirements of Approved Document F.

# 6. External Noise Level Assessment

## 6.1 External Noise Level Criteria

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

| Activity | Location | Daytime (07:00 – 23:00) | Night-time (23:00 – 07:00) |
|---|---|---|---|
| Relaxation | External Amenity Spaces | 50 – 55 dB $L_{Aeq,16hr}$ | -- |

*Table 7 – External Acoustic Design Criteria*

## 6.2 External Noise Level Assessment

The primary garden area for the development is located to the front (south of the site). The external amenity area sound levels are compared with the BS8233 criteria in the table below.

| Area | $L_{Aeq,16hr}$ Noise Level (dB) | BS8233:2014 Criteria (dB) | Exceedance (dB) |
|---|---|---|---|
| Front Garden | 50 | 50 – 55 dB $L_{Aeq,16hr}$ | 0 |

*Table 8 – BS8233 External Amenity Area Noise Level Assessment*

As can be seen, the noise level in the garden is below the criteria and no further mitigation is thought to be required.

# 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 systems, or suitable alternatives, should be installed as shown in Section 4.2.
2. To assist in the design of the alternative ventilation strategy, an overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. Further details can be found in Section 5.2.

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: $L_p = 10\log_{10}(p/p_0)^{2.}$ Wherehere: $p$ 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 (2023)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2023. 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 180e, 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 191 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 191 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.

| 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 $L_{Aeq,8hour}$<br>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 0: Overheating (2021)

Approved Document O states the following in relation to noise:

1. In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).
2. Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.
    a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
    b. 55dB $L_{AFmax}$, more than 10 times a night (between 11pm and 7am).
3. Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.

    NOTE: Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).B.6 - Acoustics Ventilation and Overheating – Residential Design Guide 2020

## 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.

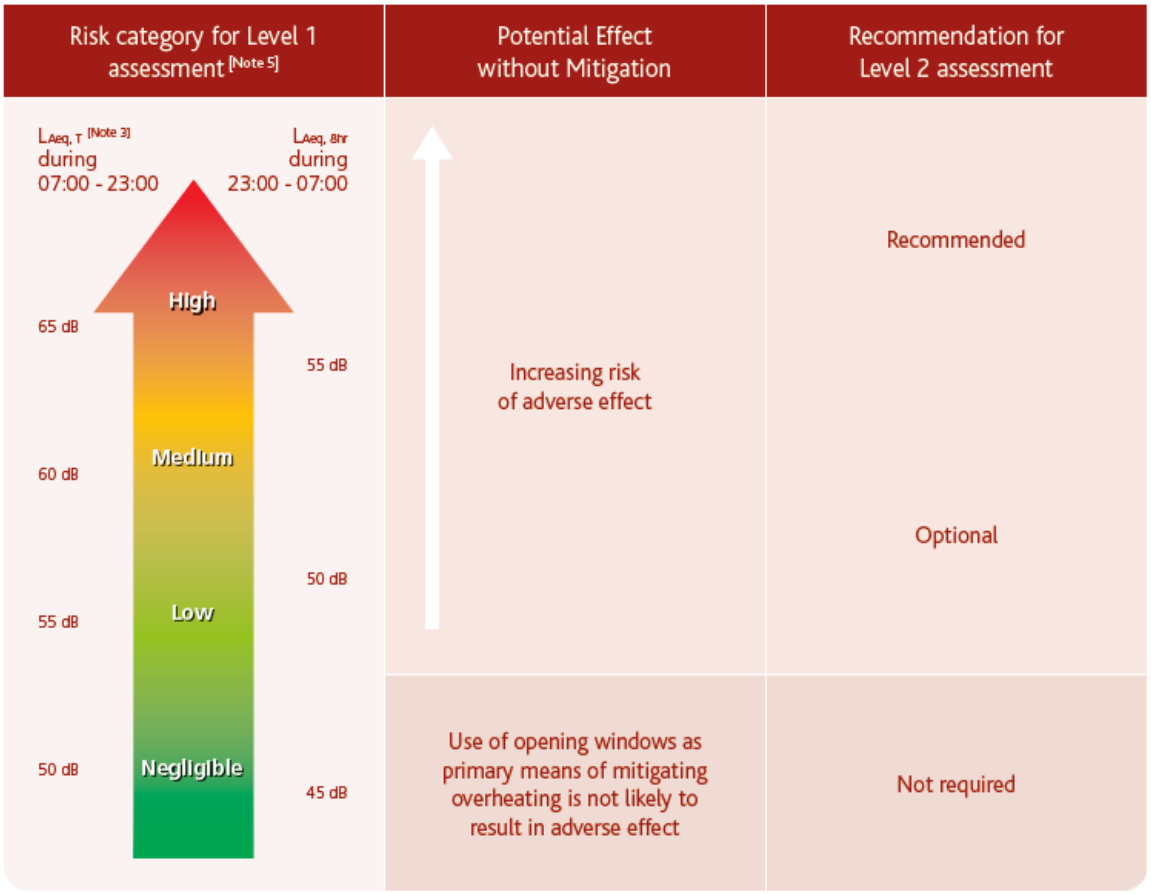



*Table 3-2 of AVO Guide (2020)*

*Figure 3 – 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.

| 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.

| Internal ambient noise level [Note 2] | | | Examples of Outcomes [Note 5] | |
|---|---|---|---|---|
| $L_{Aeq,T}$ [Note 3] during 07:00 – 23:00 [Note 6] | $L_{Aeq,8h}$ during 23:00 – 07:00 | Individual noise events during 23:00 – 07:00 [Note 4] | | |
| > 50 dB | > 42 dB | Normally exceeds 65 dB $L_{AF,max}$ | Noise causes a material change in behaviour e.g. having to keep windows closed most of the time | Avoiding certain activities during periods of intrusion. 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 difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area. |
|  | | | Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night | At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods.<br>As noise levels increase, small behaviour changes are expected e.g. turning up the volume on the television; speaking a little more loudly; having to close windows for certain activities, for example ones which require a high level of concentration. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in quality of life.<br>At lower noise levels, limited behavioural change is expected unless conditions are prevalent for most of the time. [Note 8] |
| ≤ 35 dB | ≤ 30 dB | Do not normally exceed $L_{AF,max}$ 45 dB more than 10 times a night | Noise can be heard, but does not cause any change in behaviour | Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response[Note 9]. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life. |

Note 1 The noise levels suggested in Tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

*Table 3-3 of AVO Guide (2020)*

*Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels*

# Appendix C – Site Location

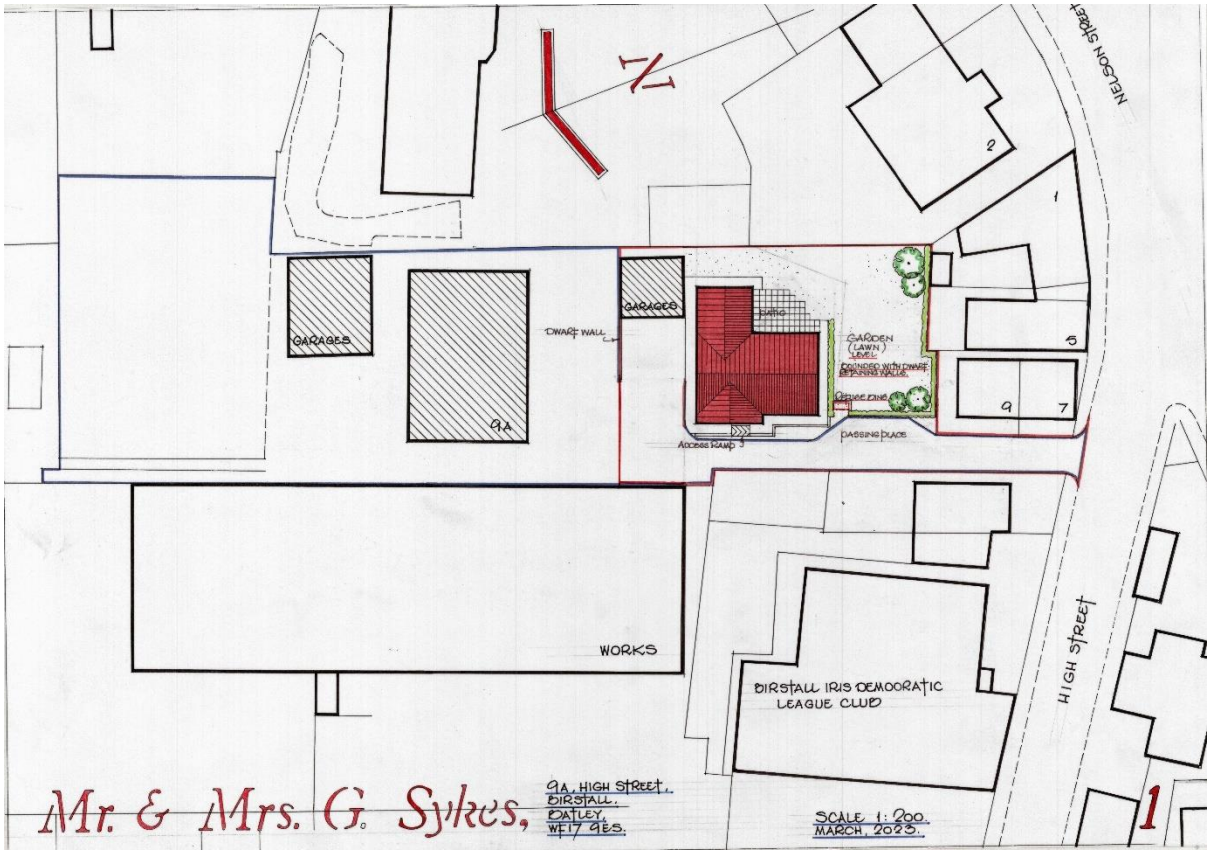



*Figure 5 – Site Location Drawing Supplied by Client*

# Appendix D – Environmental Survey

## D.1 – Time History Noise Data

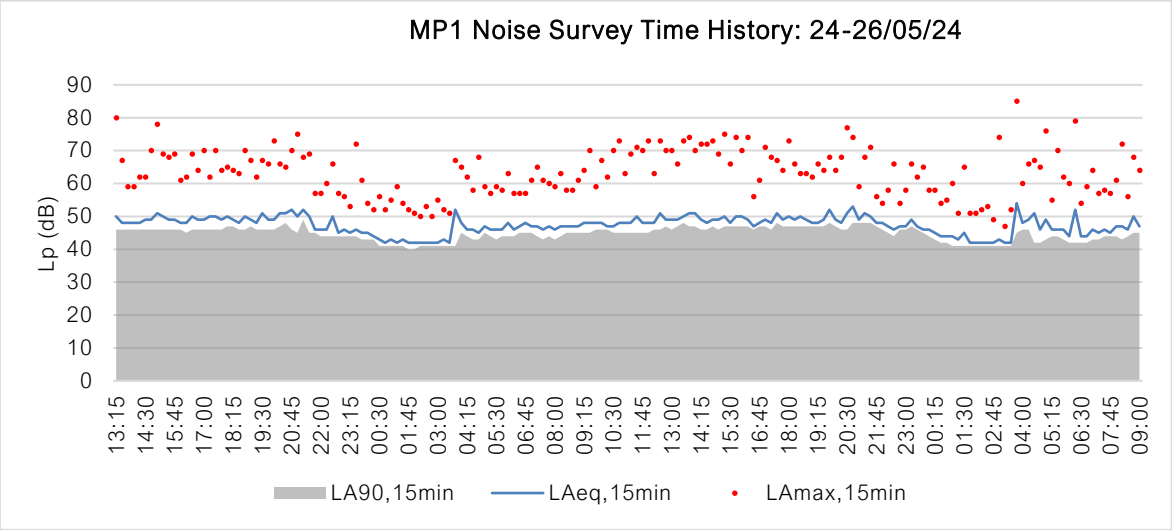



*Figure 6 – MP1 Noise Survey Time History*

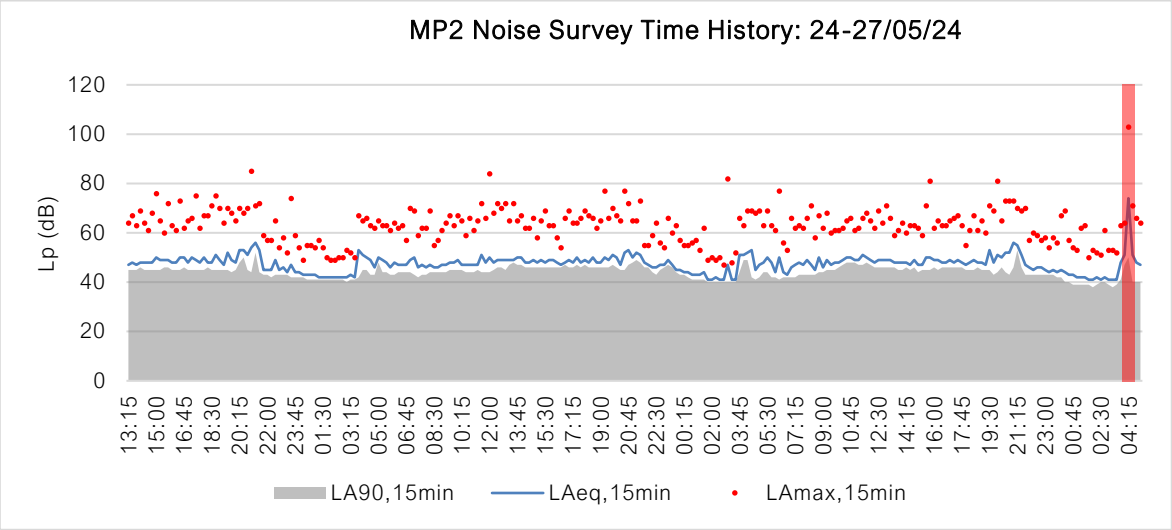



*Figure 7 – MP2 Noise Survey Time History*

*Note – The data points marked in red above have been removed for analysis as this reading has been considered anomalous.*

## D.2 – Surveying Equipment

| Piece of Equipment | Serial No. | Calibration Deviation |
|---|---|---|
| Cesva SC420 Class 1 Sound Level Meter | T246471 | ≤0.1 |
| Cesva CB006 Class 1 Calibrator | 901955 | |
| Cesva SC250 Class 1 Sound Level Meter | T252860 | ≤0.1 |
| Svantek CB011 Class 1 Calibrator | T251945 | |

*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 ≤0.1dB. 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 – Hanging Heaton, Batley(Approx. 4.78km SE of Site) | | | | |
|---|---|---|---|---|
| Time Period | Air Temp ($^0$C) | Rainfall (mm/h) | Prevailing Wind Direction | Wind Speed (m/s) |
| 24/05/24 – 00:00 – 23:59 | 11.0 – 15.4 | 0.0 | SSE | 0.0 – 1.3 |
| 25/05/24 – 00:00 – 23:59 | 7.5 – 19.3 | 0.0 – 0.8 | ENE | 0.0 – 0.0 |
| 26/05/24 – 00:00 – 23:59 | 10.7 – 17.8 | 0.0 – 2.5 | NNE | 0.0 – 1.3 |
| 27/05/24 – 00:00 – 23:59 | 9.3 – 15.7 | 0.0 – 3.3 | SSE | 0.0 – 2.7 |

*Table 12 – 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. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided to NOVA Acoustics, the window areas and room volumes below were used as a worst-case scenario for calculations:

| Room / Building Element | Glazing Area ($m^2$) | Room Volume ($m^3$) |
|---|---|---|
| MP1 Living Rooms (eastern) | 3.4 | 30.5 |
| MP1 Bedrooms (eastern) | 4.2 | 50.1 |
| MP2 Living Rooms (western) | 2.3 | 97.9 |
| MP2 Bedrooms (western) | 1.8 | 32.3 |

- The acoustic performance of the façade elements are taken from the relevant manufacturers technical information or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000$mm^2$ per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500$mm^2$ each).

Living Room (MP1) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 53 | 61 | 54 | 51 | 48 | 46 | 47 | 41 | 41 |
| Glazing Noise Ingress | 18 | 33 | 25 | 23 | 14 | 0 | 2 | -6 | -6 |
| Ventilation Noise Ingress | 17 | | 18 | 13 | 12 | 14 | 10 | 2 | 2 |
| Wall Noise Ingress | -8 | 12 | 0 | -5 | -18 | -21 | -20 | -26 | -26 |
| Roof Noise Ingress | 9 | 35 | 14 | 3 | -7 | -14 | -15 | -23 | -23 |
| Room Absorption Correction | | 4 | 4 | 3 | 3 | 3 | 3 | 1 | 0 |
| **Total Noise Ingress** | **27** | **44** | **33** | **30** | **22** | **20** | **16** | **7** | **6** |
| NR30 & Moorhouse | 35 | 47 | 41 | 39 | 33 | 30 | 26 | 24 | 22 |
| Exceedance of Criteria | -8 | -3 | -8 | -9 | -11 | -10 | -10 | -17 | -16 |

Bedroom (MP1) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 53 | 61 | 54 | 51 | 48 | 46 | 47 | 41 | 41 |
| Glazing Noise Ingress | 15 | 31 | 23 | 21 | 12 | -2 | 0 | -8 | -8 |
| Ventilation Noise Ingress | 14 | | 15 | 10 | 9 | 11 | 7 | -1 | -1 |
| Wall Noise Ingress | -5 | 15 | 3 | -2 | -15 | -18 | -17 | -23 | -23 |
| Roof Noise Ingress | 8 | 34 | 13 | 2 | -8 | -15 | -16 | -24 | -24 |
| Room Absorption Correction | | 3 | 3 | 2 | 2 | 2 | 1 | 0 | -1 |
| **Total Noise Ingress** | **24** | **42** | **30** | **27** | **19** | **16** | **12** | **3** | **2** |
| NR30 & Moorhouse | 35 | 47 | 41 | 39 | 33 | 30 | 26 | 24 | 22 |
| Exceedance of Criteria | -11 | -5 | -11 | -12 | -14 | -14 | -14 | -21 | -20 |

Bedroom (MP1) Night Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 51 | 57 | 52 | 47 | 44 | 45 | 46 | 38 | 38 |
| Glazing Noise Ingress | 12 | 27 | 21 | 17 | 8 | -3 | -1 | -11 | -11 |
| Ventilation Noise Ingress | 12 | | 13 | 6 | 5 | 10 | 6 | -4 | -4 |
| Wall Noise Ingress | -8 | 11 | 1 | -6 | -19 | -19 | -18 | -26 | -26 |
| Roof Noise Ingress | 4 | 30 | 11 | -2 | -12 | -16 | -17 | -27 | -27 |
| Room Absorption Correction | | 3 | 3 | 2 | 2 | 2 | 1 | 0 | -1 |
| **Total Noise Ingress** | **21** | **38** | **28** | **23** | **15** | **15** | **11** | **0** | **-1** |
| NR25 & Moorhouse | 30 | 47 | 41 | 35 | 28 | 25 | 21 | 19 | 17 |
| Exceedance of Criteria | -9 | -9 | -13 | -12 | -13 | -10 | -10 | -19 | -18 |

Bedroom (MP1) Night Time Max

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Corrected Lmax Spectrum | 66 | 72 | 67 | 62 | 59 | 60 | 61 | 53 | 53 |
| Glazing Noise Ingress | 27 | 42 | 36 | 32 | 23 | 12 | 14 | 4 | 4 |
| Ventilation Noise Ingress | 28 | | 28 | 21 | 20 | 25 | 21 | 11 | 11 |
| Wall Noise Ingress | 7 | 27 | 17 | 10 | -3 | -3 | -2 | -10 | -10 |
| Roof Noise Ingress | 19 | 45 | 26 | 13 | 3 | -1 | -2 | -12 | -12 |
| Room Absorption Correction | | 3 | 3 | 2 | 2 | 2 | 1 | 0 | -1 |
| **Total Noise Ingress** | **36** | **53** | **43** | **38** | **30** | **30** | **26** | **15** | **14** |
| NR40 | 45 | 67 | 56 | 49 | 43 | 40 | 37 | 34 | 33 |
| Exceedance of Criteria | -9 | -14 | -13 | -11 | -13 | -10 | -11 | -19 | -19 |

*Figure 8 – MP1 Glazing and Ventilation Calculations*

*Note: A check against Moorhouse criteria has been undertaken to ensure robustness within the assessment.*

Living Room (MP2) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 55 | 61 | 54 | 51 | 47 | 47 | 50 | 45 | 45 |
| Glazing Noise Ingress | 11 | 26 | 18 | 16 | 6 | -6 | -2 | -9 | -9 |
| Ventilation Noise Ingress | 13 | | 13 | 8 | 6 | 10 | 8 | 1 | 1 |
| Wall Noise Ingress | -5 | 15 | 3 | -2 | -16 | -17 | -14 | -19 | -19 |
| Roof Noise Ingress | 9 | 34 | 13 | 2 | -9 | -14 | -13 | -20 | -20 |
| Room Absorption Correction | | 5 | 4 | 4 | 4 | 4 | 3 | 2 | 1 |
| **Total Noise Ingress** | **23** | **43** | **28** | **24** | **15** | **16** | **14** | **6** | **5** |
| NR30 & Moorhouse | 35 | 47 | 41 | 39 | 33 | 30 | 26 | 24 | 22 |
| Exceednce of Criteria | -12 | -4 | -13 | -15 | -18 | -14 | -12 | -18 | -17 |

Bedroom (MP2) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 55 | 61 | 54 | 51 | 47 | 47 | 50 | 45 | 45 |
| Glazing Noise Ingress | 13 | 29 | 21 | 19 | 9 | -3 | 1 | -6 | -6 |
| Ventilation Noise Ingress | 17 | | 16 | 11 | 9 | 13 | 11 | 4 | 4 |
| Wall Noise Ingress | -4 | 16 | 4 | -1 | -15 | -16 | -13 | -18 | -18 |
| Roof Noise Ingress | 7 | 33 | 12 | 1 | -10 | -15 | -14 | -21 | -21 |
| Room Absorption Correction | | 4 | 3 | 3 | 2 | 2 | 2 | 1 | -1 |
| **Total Noise Ingress** | **24** | **41** | **29** | **25** | **17** | **19** | **17** | **9** | **7** |
| NR30 & Moorhouse | 35 | 47 | 41 | 39 | 33 | 30 | 26 | 24 | 22 |
| Exceednce of Criteria | -11 | -6 | -12 | -14 | -16 | -11 | -9 | -15 | -15 |

Bedroom (MP2) Night Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 52 | 59 | 50 | 47 | 43 | 44 | 48 | 42 | 42 |
| Glazing Noise Ingress | 10 | 27 | 17 | 15 | 5 | -6 | -1 | -9 | -9 |
| Ventilation Noise Ingress | 14 | | 12 | 7 | 5 | 10 | 9 | 1 | 1 |
| Wall Noise Ingress | -7 | 14 | 0 | -5 | -19 | -19 | -15 | -21 | -21 |
| Roof Noise Ingress | 5 | 31 | 8 | -3 | -14 | -18 | -16 | -24 | -24 |
| Room Absorption Correction | | 4 | 3 | 3 | 2 | 2 | 2 | 1 | -1 |
| **Total Noise Ingress** | **21** | **39** | **25** | **21** | **13** | **16** | **15** | **6** | **4** |
| NR25 & Moorhouse | 30 | 47 | 41 | 35 | 28 | 25 | 21 | 19 | 17 |
| Exceednce of Criteria | -9 | -8 | -16 | -14 | -15 | -9 | -6 | -13 | -13 |

Bedroom (MP2) Night Time Max

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| Corrected Lmax Spectrum | 67 | 74 | 65 | 62 | 58 | 59 | 63 | 57 | 57 |
| Glazing Noise Ingress | 25 | 42 | 32 | 30 | 20 | 9 | 14 | 6 | 6 |
| Ventilation Noise Ingress | 29 | | 27 | 22 | 20 | 25 | 24 | 16 | 16 |
| Wall Noise Ingress | 8 | 29 | 15 | 10 | -4 | -4 | 0 | -6 | -6 |
| Roof Noise Ingress | 20 | 46 | 23 | 12 | 1 | -3 | -1 | -9 | -9 |
| Room Absorption Correction | | 4 | 3 | 3 | 2 | 2 | 2 | 1 | -1 |
| **Total Noise Ingress** | **36** | **54** | **40** | **36** | **28** | **31** | **30** | **20** | **19** |
| NR40 | 45 | 67 | 56 | 49 | 43 | 40 | 37 | 34 | 33 |
| Exceednce of Criteria | -9 | -13 | -16 | -13 | -15 | -9 | -7 | -14 | -14 |

*Figure 9 – MP2 Glazing and Ventilation Calculations*

*Note: A check against Moorhouse criteria has been undertaken to ensure robustness within the assessment.*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