



Residential Noise Assessment

Site Address: Knowles Quarry, Barnsley Road, Cudworth, Barnsley, S72 8UU

Client Name: Consult Construct Ltd.

Project Reference No: NP-009933



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01	--

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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 new build residential development ('the Proposed Development') at Knowles Quarry, Barnsley Road, Cudworth, Barnsley, S72 8UU ('the Site'). The site is primarily subject to noise from the adjacent road network.

A noise survey has been undertaken to establish the prevailing sound levels at the Proposed Development Site. 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:

- National Planning Policy Framework (2023)
- Noise Policy Statement for England (2010)
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- ProPG: 'Planning and Noise 2017' (including supplementary documents 1 & 2).
- 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 proposal is for the '*Creation of 9 independent supported living flats and associated communal space and car parking*' (application ref: 2023/0453).

The following relevant planning condition has been recommended by Barnsley Metropolitan Borough Council:

"Prior to any work commencing a noise impact assessment shall be submitted and agreed by the local planning authority which shall have been used to inform the layout and design of the scheme such that mitigation is implemented to achieve the following sound levels within all dwellings;

- *Bedrooms: LAeq (8 hours) – 30dB (2300 to 0700 hours);*
- *Living Rooms & Bedrooms: LAeq (16 hour) – 35dB (0700 to 2300 hours);*
- *Bedrooms: LAFmax – 45dB (2300 to 0700 hours). 10 events*
- *Rear Gardens: LAeq (16 hours) – 50dB – 55dB (0700 to 2300 hours)*

Where the above noise criteria cannot be achieved with windows partially open, the scheme shall include a system of alternative acoustically treated ventilation to all habitable rooms if appropriate. The assessment shall be accompanied by a plan which clearly identifies the different types of mitigation measures proposed, where each type of mitigation is proposed and a programme of implementation. Thereafter the development shall be carried out in accordance with the approved measures.

Reason: To reduce or remove adverse impacts on health and the quality of life, especially for people living and/or working nearby, in accordance with Local Plan Policy POLL1"

The figure below shows the Proposed Development layout.



Drawing Ref No. 22.2668 from 'Consult Construct'

Figure 1 – Proposed Development Layout

2. Environmental Noise Survey

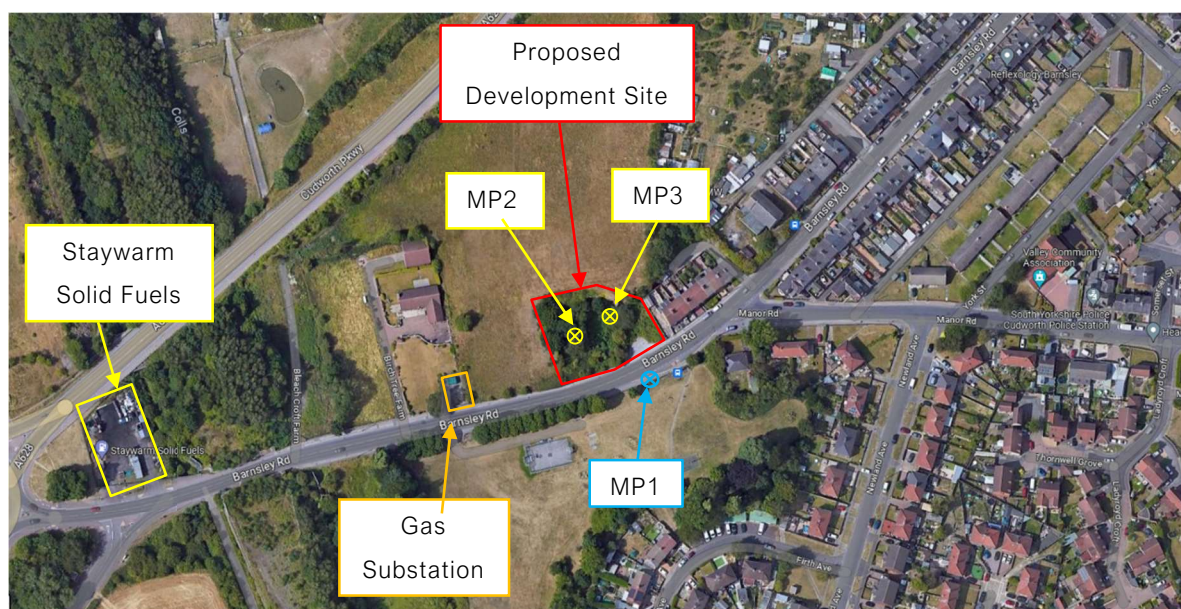
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	05/09/2023 – 06/09/2023	Equipment mounted to lamppost 3.5m above the ground on the opposite side of the road, approximately 15m from the proposed development boundary.
Spot Measurements (MP2 & MP3)	05/09/2023	Placed on a tripod at a height of 2m and not near any other large reflective surfaces.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



Imagery ©2023 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The Proposed Development Site is located on vacant land off Barnsley Road Barnsley. The area surrounding the Site consists primarily of residential dwellings to the east and south with open fields to the east and north. Situated 40m from the western boundary is a gas substation, and at 190m is “Staywarm Solid Fuels” which distributes coal.

During the site visits, the acoustic environment was deemed to be low to moderate in level and the noise profile was dominated by road traffic noise emissions from Barnsley Road. Noise emissions from ‘Staywarm Solid Fuels’ and the nearby gas substation were not audible at the western most boundary of the Site.

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)	$L_{AFmax,1min}$ (dB)*
		63	125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	70	67	67	67	68	64	54	71	--
	$L_{eq,8hr}$ (Night)	62	58	58	59	61	57	47	64	82
MP2	05/09/23: 12:40 – 13:30	64	57	51	52	54	48	37	56	--
MP3	05/09/23: 13:30 – 14:00	65	57	54	55	58	52	39	60	--

Table 2 – Sound Level Results Summary

*Exceeded fewer than ten times.

3. Noise Break-in Assessment and Sound Insulation Scheme

3.1 Internal Noise Level Criteria

The noise profile of the area is predominantly “anonymous” steady state noise sources e.g., transport. The following table outlines the internal and external 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 $L_{Aeq,16hr}$ / 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 3 – Acoustic Design Criteria

The measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

3.2 Glazing and 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.

Sound Insulation Scheme – All Living Rooms & Bedrooms Facing Barnsley Road									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
6mm Optiphon Glass / 16mm Argon Cavity / 8.8mm Optiphon Glass (SRI)*	24	25	27	38	48	47	55	41 (R _w)	34 (R _w + C _{tr})
Greenwoods 2500EA.AC1 (D _{ne})*	31	41	40	37	47	43	46	42 (D _{n,e})	40 (D _{n,e,w} + C _{tr})
Communal Spaces at Rear of Development									
6mm Glass / 16mm Air Cavity / 4mm Glass (SRI)*	20	21	20	26	38	37	39	31 (R _w)	27 (R _w + C _{tr})
Titon Standard Vent + C25 (D _{ne})*	--	36	38	36	32	37	39	35 (D _{n,e})	33 (D _{n,e,w} + C _{tr})

Table 4 – Glazing 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.

4. Open Window Noise Break-In Assessment

4.1 Internal Noise Levels with Open Windows Criteria

The AVO Guide advises that if windows are open regularly to provide higher rates of ventilation to mitigate overheating, this will lead to elevated internal noise levels which could lead to undesirable living conditions. If windows are opened rarely the occupants may be able to tolerate elevated noise levels due to the inherent benefits of natural ventilation. This assessment will firstly assess whether the internal noise level criteria can be achieved with open windows. The AVO Guide provides criteria for both daytime and night-time periods which shown below.

Windows	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	AVO Guide Table 3-3 Example Outcomes	AVO Guide Table 3 – 2 Recommendation for Level 2 Assessment
Rarely Open	50 dB $L_{Aeq,16hour}$	42 dB $L_{Aeq,8hour}$ Normally Exceeds 65 dB L_{AFmax}	Noise causes a material change in behaviour e.g., having to keep windows closed most of the time	Recommended
Increasing Noise Level			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	Optional
Often Open	40 dB $L_{Aeq,16hour}$	35 dB $L_{Aeq,8hour}$ Normally Exceeds 45 dB L_{AFmax}	Noise can be heard, but does not cause any change in behaviour	Not Required

Table 5 – AVO Guide Open Window Criteria

To advise if openable windows can be used as the ventilation strategy (whilst maintaining reasonable internal noise levels), an open window assessment will be provided. The suitability of the internal noise levels will be based upon the internal noise criteria above and an open window providing 13dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

4.2 Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria from Table 3 – 3 of the AVO Guide can be achieved with open windows.

AVO Open Window Assessment – Front Façade				
External Noise Levels	AVO Guide Windows Open Often	Exceedance	AVO Guide Windows Rarely Open	Exceedance
71 $L_{Aeq,16hr}$ (Day)	53	+18	63	+8
64 $L_{Aeq,8hr}$ (Night)	48	+16	55	+9
82 $L_{AF,max}$ (Night)	58	+24	78	+4
AVO Open Window Assessment – Rear Façade				
56 $L_{Aeq,16hr}$ (Day)	53	3	63	-7

Table 6 – Open Window Assessment

The external noise levels at the front of the façade exceed the AVO Guides 'Rarely Open' criteria. This means that windows cannot be used for the primary means of ventilation and an alternate ventilation strategy is required that is capable of a higher rate of ventilation. A mechanical extract ventilation system should be installed to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F. It is understood that continuous MEV extract fans installed in accordance with the specified trickle ventilators to allow the ingress of fresh air will be adequate. The ventilation system should be designed by an appropriately qualified person to ascertain compliance with the relevant Building Regulations. Special consideration should be given to 1.5 to 1.7 of Approved Document F to assist in the design of the ventilation system and to ensure the self-generated noise levels from the MEV extract fans to not exceed the specified criteria.

The external noise levels at the rear façades exceed the AVO Guides 'Windows Open Often' criteria. This means that windows being used for the primary means of ventilation (whilst maintaining reasonable internal noise levels) could vary dependent on the outcome of a TM59 overheating assessment. To assist in the design of the alternative ventilation strategy a TM59 overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. The TM59 assessor should be provided with this report to base their study.

If a TM59 assessment is not undertaken, again, an appropriate model of alternative mechanical ventilation should be installed to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F.

To provide further context, sound typically falls into two categories: the first being 'anonymous' sources, such as road, rail, and aircraft and the second being 'non-anonymous', which includes noise from pubs and clubs, industry, etc. Transport noise sources are generally termed 'environmental noise', which affects everybody in society to varying degrees, however, there is a recognised benefit of transportation sources for mobility and movement of goods. Humans tend to habituate to transportation noise over time as it does not threaten safety or trigger a flight or fight psychological stress response. It is a noise that is

consistent within society, benign in terms of threat, acceptable as a societal norm and characterless to the point that it does not normally draw attention.

Considering the nature of the acoustic environment at the Site, it is thought that installing windows that can be opened and closed at the occupants' discretion is unlikely to have a negative impact on residential amenity. It is not recommended that any windows are 'forced closed' or 'sealed' units, regardless of whether mechanical ventilation is required.

5. External Noise Level Assessment

The proposed location for the external amenity area is shown in the figure below. Typically, the external areas adjacent to the road at the front of the development would not be used for resting and relaxation, and as such, they are not included in the assessment.



Figure 3 – External Amenity Area Location

The external amenity area will be significantly shielded from the road noise emissions (including by the main building and a half wall/half fence barrier at the western and southern façades). In order to predict the noise levels, a correction will be applied to the noise level recorded at Measurement Position 3 (MP3). This is shown in the table below.

External Amenity Area Noise Level Assessment				
MP3 Noise Level (dB)	Correction for Shielding (dB)	Expected Noise Level (dBA)	BS8233:2014 Criteria (dB)	Exceedance of Criteria (dB)
60	15 – 20	40 – 45	50 – 55 $L_{Aeq,16hr}$	0

Table 7 – BS8233:2014 External Amenity Area Noise Level Assessment

As can be seen in the table above, the noise levels in the external amenity area are predicted to be within the BS8233 criteria. As such, no further mitigation is required.

6. 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. To assist in the design of the alternative ventilation strategy a TM59 overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. The TM59 assessor should be provided with this report to base their study. It is highlighted that this report also presents an alternative ventilation strategy in Section 4 should a TM59 assessment not be undertaken.

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 p_0 is the reference sound pressure (20 μ Pa)
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 p_0 is the reference sound pressure (20 μ Pa)
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 2021. 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 174e, 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 185 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 185 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.”

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 8 – 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 – ProPG: Planning and Noise (2017)

ProPG Planning and Noise published May 2017 by the Association of Noise Consultants (ANC) 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 promoting good health and wellbeing through the effective management of noise. It therefore 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 LPAs should encourage. These are shown below, In descending order of preference:

Order of Preference	Noise Management Measure
1	Reduction of the noise generated at source by redesign, relocation, or containment. *
2	Maximising the spatial separation of noise source(s) and receptor(s).
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.
4	Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.
5	Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
6	Using the layout of the scheme to reduce noise propagation across the site.
7	Using the orientation of buildings to reduce the noise exposure of noise sensitive rooms.
8	Using the building envelope to mitigate noise to acceptable levels.

Table 9 – Hierarchy of Noise Management Measures

*Not from ProPG

B.5 – Approved Document O: 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.6 – 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.

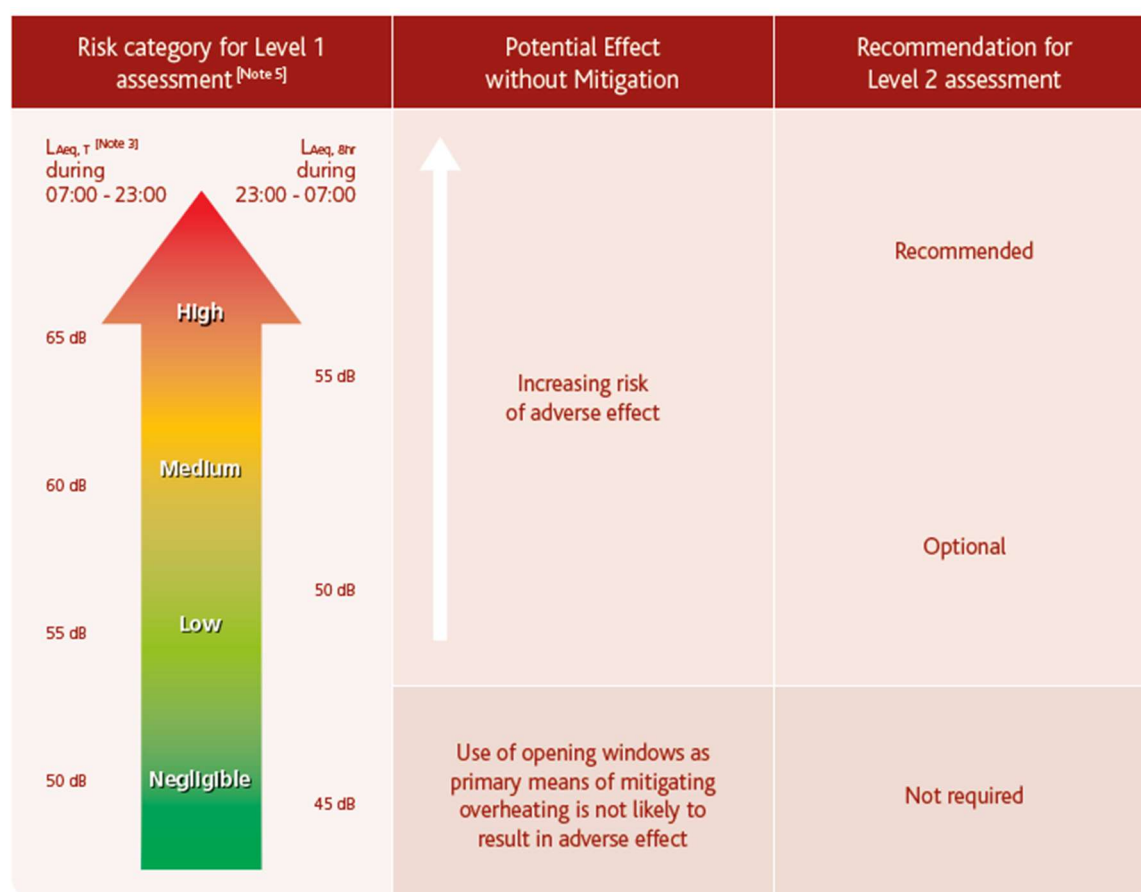


Table 3-2 of AVO Guide (2020)

Figure 4 – 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.

Internal ambient noise level ^[Note 2]			Examples of Outcomes ^[Note 5]	
$L_{Aeq,T}$ ^[Note 3] during 07:00 – 23:00 ^[Note 6]	$L_{Aeq,th}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 ^[Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{A,Imax}$	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. 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. 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 $L_{A,Imax}$ 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 5 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix D – Environmental Survey

D.1 – Time History Noise Data

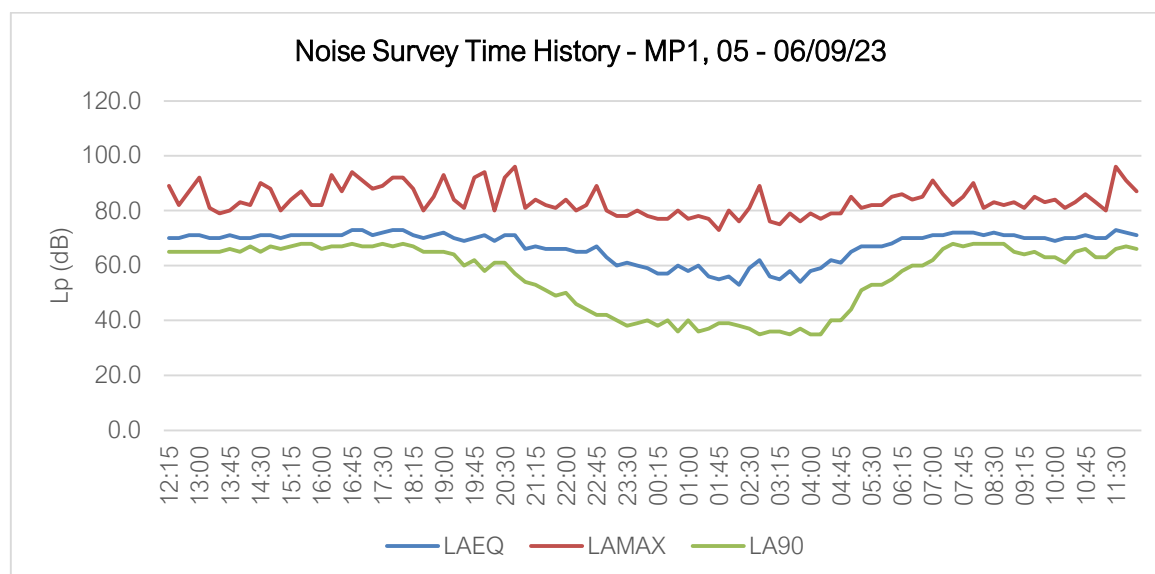


Figure 7 – MP1 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SV307 Class 1 Sound Level Meter	70884	≤0.1
Svantek SV36 Class 1 Calibrator	106876	
CESVA SC250 Class 1 Sound Level Meter	T252915	≤0.1
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 ≤0.1dB. 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 – Brierly (Approx. 3.5km NW of Site)				
Time Period	Air Temp (°C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
05/09/23 – 00:00 – 23:59	12.8 – 26.3	0.0	SE	0.0 – 3.2
06/09/23 – 00:00 – 23:59	14.4 – 29.1	0.0	S	0.0 – 1.6

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 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.
- All room and window dimensions are based on plans provided to NOVA Acoustics by the client.

Living Room (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	71	70	67	67	67	68	64	54	54
Glazing Noise Ingress	28	40	36	34	23	14	11	-7	-7
Ventilation Noise Ingress	32	41	28	29	32	23	23	10	10
Wall Noise Ingress	13	27	19	17	7	7	3	-7	-7
Roof Noise Ingress									
Room Absorption Correction		0	0	-1	-1	-1	-2	-3	-4
Total Noise Ingress	33	44	37	35	33	24	24	11	11
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-2	-15	-11	-4	0	-6	-2	-13	-11

Bedroom (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	71	70	67	67	67	68	64	54	54
Glazing Noise Ingress	29	41	37	35	24	15	12	-6	-6
Ventilation Noise Ingress	33	43	30	31	34	25	25	12	12
Wall Noise Ingress	12	26	18	16	6	6	2	-8	-8
Roof Noise Ingress									
Room Absorption Correction		-1	-2	-2	-3	-3	-3	-4	-6
Total Noise Ingress	34	45	38	36	34	25	25	12	12
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-1	-14	-10	-3	1	-5	-1	-12	-10

Bedroom (MP1) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	64	62	58	58	59	61	57	47	47
Glazing Noise Ingress	20	33	28	26	16	8	5	-13	-13
Ventilation Noise Ingress	25	35	21	22	26	18	18	5	5
Wall Noise Ingress	5	18	9	7	-2	-1	-5	-15	-15
Roof Noise Ingress									
Room Absorption Correction		-1	-2	-2	-3	-3	-3	-4	-6
Total Noise Ingress	27	37	29	27	26	18	18	5	5
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-3	-18	-14	-8	-2	-7	-3	-14	-12

Bedroom (MP1) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	82	80	76	76	77	79	75	65	65
Glazing Noise Ingress	38	51	46	44	34	26	23	5	5
Ventilation Noise Ingress	43	53	39	40	44	36	36	23	23
Wall Noise Ingress	23	36	27	25	16	17	13	3	3
Roof Noise Ingress									
Room Absorption Correction		-1	-2	-2	-3	-3	-3	-4	-6
Total Noise Ingress	44	55	47	45	44	36	36	23	23
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-1	-12	-9	-4	1	-4	-1	-11	-10

Figure 8 – Noise Break-In Calculation Front Façade

Living Room (Rear Communal Area) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	60	65	57	54	55	58	52	39	39
Glazing Noise Ingress	28	43	34	32	27	18	13	-2	-2
Ventilation Noise Ingress	28	23	18	21	28	17	2	2	
Wall Noise Ingress	-1	18	5	0	-9	-7	-13	-26	-26
Roof Noise Ingress									
Room Absorption Correction		-1	-1	-2	-2	-2	-2	-4	-5
Total Noise Ingress	31	43	35	32	28	28	18	4	4
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-4	-16	-13	-7	-5	-2	-8	-20	-18

Figure 9 – Noise Break-In Calculation Rear Façade



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