Residential Noise Assessment

Site Address: 209 Queens Road, Watford, WD17 2QH

Client Name: Steve York

Project Reference No: NP-010391

Authorisation and Version Control			
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Amendment History	
Revision	Summary of Amendments
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 209 Queens Road, Watford, WD17 2QH ('the Site'). The proposed development is for a new residential development above a tyre fitting garage. The site is subject to noise from road traffic and railway.

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

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

1.1 Standards, Legislation, Policy & Guidance

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

- National Planning Policy Framework (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)

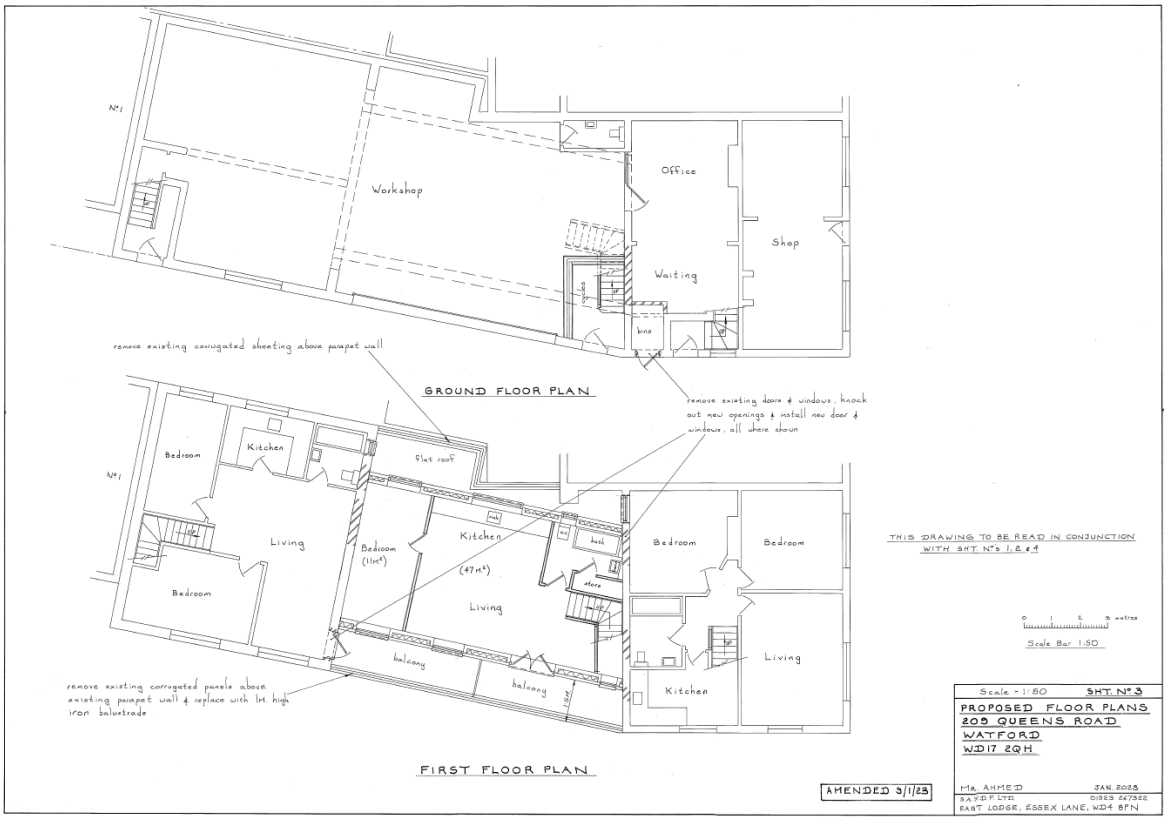
Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for a new residential dwelling above a tyre fitting garage. It is also understood that there will be minor changes to the existing residential dwellings either side of the site.

Although balcony areas are proposed to the front of the development, given the size of these spaces it is anticipated that these are not provided for the purpose of relaxation. Instead, the balcony areas are likely included for uses such as drying washing or growing plants, and noise limits should not be necessary for these uses.

The figure overleaf shows the proposed development.



Drawing Ref No. SHT No. 3 from 'S.A.Y.D.F Ltd'

Figure 1 – Proposed Development

2. Environmental Noise Survey

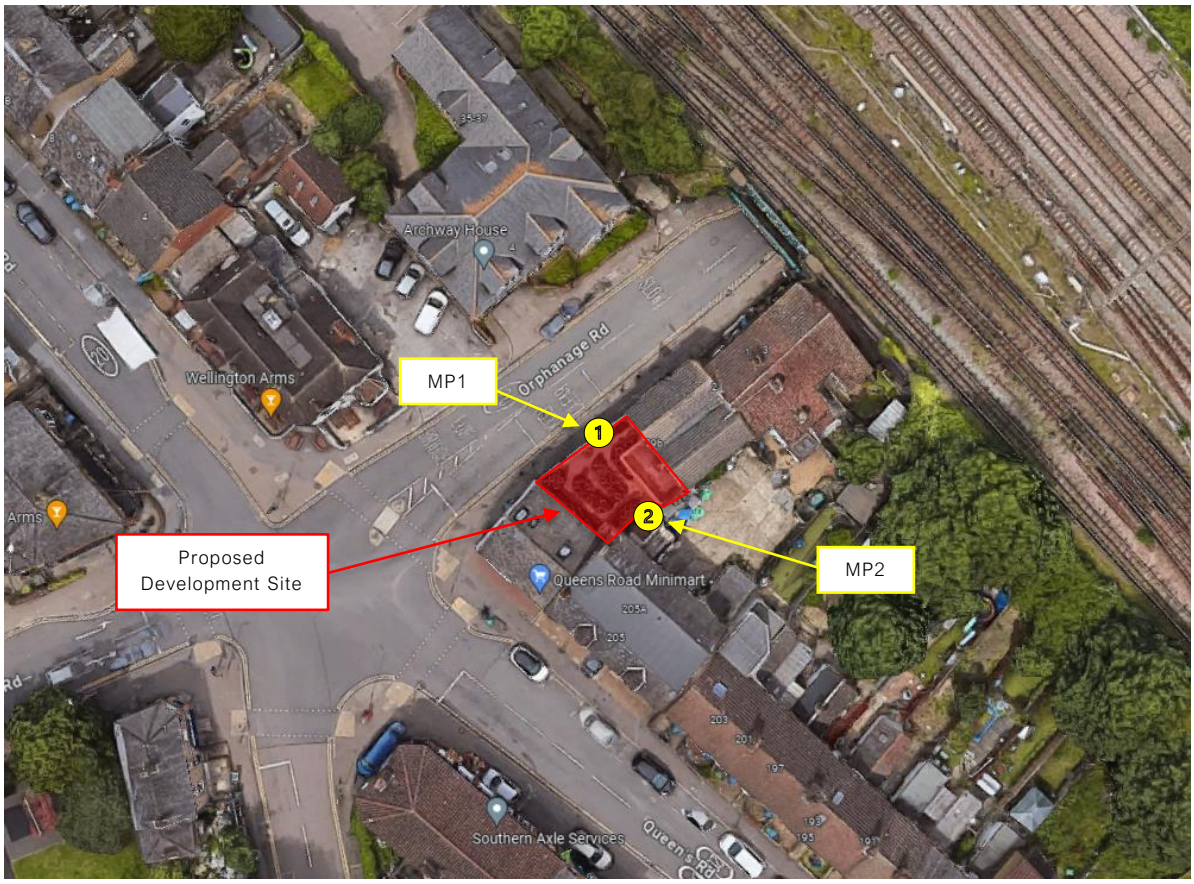
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	16/11/2023 – 20/11/2023	Equipment mounted on the rooftop of the proposed development at 1m distance from the building façade on Orphanage Road.
MP2	16/11/2023 – 20/11/2023	Equipment mounted on the rooftop of the proposed development at 1m distance from the building façade to the rear of the building.

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 area surrounding the site consists primarily of residential dwellings and commercial premises in all directions. The neighbouring property is a fish and chip shop, with opening hours of 12:00 – 21:00, Monday – Sunday. Beneath the proposed development is a tyre fitting garage, with opening hours of 09:00 – 18:00, Monday – Saturday. Directly opposite the site is the "Wellington Arms", a public house that is understood to operate until 00:00 hours on Fridays and Saturdays.

The acoustic environment is deemed to be moderate in level and the noise profile is dominated by road traffic noise emissions from the surround road network, as well as the nearby railway to the west. The garage beneath the development was not deemed to be audible by the on-site engineer on set up and collection of equipment. From review of the data at MP1, there appears to be limited influence from the pub opposite the site, with the measurement time history following a typical diurnal pattern and no addition low frequency noise content during the operational hours of the pub.

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)
		125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	64	62	60	63	59	52	66	--
	Highest $L_{eq,1hr}$ (Day)	65	63	61	65	62	57	68	--
	$L_{eq,8hr}$ (Night)	59	56	55	58	53	45	61	78
	Highest $L_{eq,1hr}$ (Night)	65	61	60	61	55	49	64	--
MP2	$L_{eq,16hr}$ (Day)	57	54	52	52	50	42	56	--
	Highest $L_{eq,1hr}$ (Day)	58	55	57	57	51	45	60	--
	$L_{eq,8hr}$ (Night)	52	49	48	47	44	40	52	72
	Highest $L_{eq,1hr}$ (Night)	57	56	55	51	46	46	57	--

Table 2 – Sound Level Results Summary

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 acoustic design criteria used in the following assessment.

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

Although the noise profile at the site follows a typical diurnal pattern (i.e. that which is generally associated with transportation noise) the assessment considers a shorter reference period (loudest 1 hour) to account for potential impacts associated with the nearby commercial premises (tyre fitting garage, fish and chip shop, public house).

In addition, to account for any uncertainty or attention-catching features directly associated with activities within the tyre fitting garage or mechanical plant from the nearby fish and chip shop, more stringent NR25 criteria has been adopted during the daytime hours (i.e. when these premises are in operation). This approximately equate to a 5dB reduction from the BS8233 criteria and should therefore provide a robust assessment.

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 – North Façade (MP1) – Living Rooms & Bedrooms								
Description	Octave Frequency Band (Hz, dB)						Overall (dB)	
	125	250	500	1k	2k	4k		
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon™ Glass	24	24	32	37	37	44	35 (R_w)	31 ($R_w + C_{tr}$)
Greenwoods 2500EA.AC1 (through-frame)	41	40	37	47	43	46	42 ($D_{ne,w}$)	40 ($D_{ne,w} + C_{tr}$)

Table 4 – Glazing & Ventilation Specification – North Façade (MP1)

Sound Insulation Scheme – South Façade (MP2) – Living Rooms & Bedrooms								
Description	Octave Frequency Band (Hz, dB)						Overall (dB)	
	125	250	500	1k	2k	4k		
6mm Glass / 16mm Air Cavity / 4mm Glass	21	20	26	38	37	39	31 (R_w)	27 ($R_w + C_{tr}$)
Greenwoods 2500EA.AC1 (through-frame)	41	40	37	47	43	46	42 ($D_{ne,w}$)	40 ($D_{ne,w} + C_{tr}$)

Table 5 – Glazing & Ventilation Specification – South Façade (MP2)

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	50dB $L_{Aeq,16hour}$	42dB $L_{Aeq,8hour}$ Normally Exceeds 65dB $L_{AF,max}$	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	40dB $L_{Aeq,16hour}$	35dB $L_{Aeq,8hour}$ Normally Exceeds 45dB $L_{AF,max}$	Noise can be heard, but does not cause any change in behaviour.	Not Required

Table 6 – 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 – North Façade (MP1)				
External Noise Levels	AVO Guide Windows Open Often	Exceedance	AVO Guide Windows Rarely Open	Exceedance
66dB $L_{Aeq,16hr}$ (Day)	53	+13	63	+3
61dB $L_{Aeq,8hr}$ (Night)	48	+13	55	+6
78dB $L_{AF,max}$ (Night)	58	+20	78	+0
AVO Open Window Assessment – South Façade (MP2)				
56dB $L_{Aeq,16hr}$ (Day)	53	+3	63	-7
52dB $L_{Aeq,8hr}$ (Night)	48	+4	55	-3
72dB $L_{AF,max}$ (Night)	58	+14	78	-6

Table 7 – Open Window Assessment

For the south facing façade, external noise levels exceed the AVO Guides 'Windows Open Often' criteria which 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. Should relying on open windows to overcome overheating not be suitable, a mechanical extract ventilation system should be installed.

For the north facing façade, the external noise levels exceed the AVO Guides 'Rarely Open' criteria, 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. Alternatively, an MVHR system could be installed that is capable of providing both background and purge ventilation.

The chosen 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 fans does not exceed the specified criteria. It is noted that the windows will remain openable at the occupant's choice.

5. Noise Breakthrough Assessment and Sound Insulation Scheme

5.1 Noise Breakthrough Criteria

The proposed development structurally adjoins a commercial property via a separating floor. BS8233 states that the internal noise criteria from Table 1.0 includes 'overall noise' which is the sum of structure borne and airborne noise sources. Noise breaking through from structurally adjoining commercial property will be considered to ensure the total noise from both structurally adjoining commercial properties and external noise ingress, does not exceed the proposed acoustic design criteria. Guidance on sound insulation between adjoining domestic and non-domestic dwellings is discussed in Approved Document E (ADE) of the Building Regulations, section 0.8 of Part E states.

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

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

5.2 Noise Breakthrough Assessment and Specification

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

Planning Class	Level of Risk from Noise	Required Sound Insulation Standard (dB)
Sui Generis (i.e. Tyre Fitting Garage)	High	≥55 $D_{nT,w}$ + C_{tr} (detailed assessment also required)
Discussion: The proposed development is above a tyre fitting specialised. As such, hydraulic lifts and other power tools are expected to be used. The unit is currently operating during daytime hours only (Mon to Sat, 09:00 – 18:00). However, due to the inherent nature of the business, a detailed assessment on noise breaking through the partition floor should be also applicable. It is considered that the resulting noise levels from noise breakthrough should not exceed the NR15 curve so not to cumulatively add to external noise breaking through the façade (as detailed in Section 3).		

Table 8 – Noise Breakthrough Assessment Criteria

It is anticipated that the existing roof of the car garage is of concrete construction. An indicative specification that can achieve the required sound insulation standard is outlined below. The airborne sound reduction provided by the proposed system has been modelled in INSUL 9.0.

- 18mm flooring particle board
- Timber joists
- Minimum 150mm cavity between flooring board and existing roof (with no connections) filled with 50mm rockwool insulation (min. density 48kg/m^3)
- Existing 100mm concrete block ceiling (min. density 2000kg/m^3)

The following table presents the noise breakthrough assessment through the partition floor between the site and the ground floor tyre fitting garage.

Internal noise levels are taken from a previous assessment of an MOT centre, undertaken by NOVA Acoustics. Although the ground floor site is for tyre fitting only, it is anticipated that source noise levels from an MOT garage are suitable and will provide a worst-case assessment.

The assessment considers the noise breaking through the partition floor into a living room area within the adjoining dwelling. This again will provide a worst-case based on the partition size and the likely internal reverberation characteristics of this space. For the purposes of the assessment, the following assumptions were made:

- Floor area: 5m x 5.5m (28m^2).
- Reverberation time of 0.5s, this is deemed typical for a furnished living room within the UK.
- A receiver height of 1m from the partition, replicating somebody sitting in a chair.

Description	1/1 Octave Frequency Band (Hz, dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Internal Noise Level of MOT Centre (L_{eq})	60	62	62	64	66	70	69	75
Predicted Performance of Partition Floor (R_w)	35	55	70	73	80	80	80	--
Sound Power of Partition (L_w)	39	21	6	5	0	4	3	--
Direct Sound Pressure Level ($L_{p,dir}$)	25	7	-8	-9	-14	-10	-11	17
Reverberant Sound Pressure Level ($L_{p,rev}$)	33	15	0	-1	-6	-2	-3	3
Total Noise Breakthrough (L_{eq})	33	15	0	-1	-6	-2	-3	11
NR15 Criteria (L_{eq})	47	35	25	18	15	11	9	20
Exceedance of Criteria	**-8**	**-14**	**-19**	**-13**	**-15**	**-7**	**-6**	**-9**

Table 9 – Noise Breakthrough Assessment

It is seen from the above table that the noise breaking through the existing partition is likely to fall below the adopted internal criteria within the residential uses (NR15). This indicates a low likelihood of adverse impact on residential amenity, and it is therefore considered that the installed partition floor will provide suitable performance between the development and the adjoining dwelling.

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

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 system, or a suitable alternative, should be installed as shown in Section 3.
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.
3. The separating floor between the structurally adjoining commercial property and the proposed development should be designed to achieve the required sound insulation. An indicative specification has been provided in Section 5. Further design assistance can be provided by NOVA Acoustics Ltd if required.

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

Appendix A – Acoustic Terminology

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

Appendix B – Standards, Legislation, Policy, and Guidance

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

B.1 – National Planning Policy Framework (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 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.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	--
Sleeping (Daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$ 45dB L_{AFmax}*

Table 10 – 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 11 – Hierarchy of Noise Management Measures

**Not from ProPG*

B.5 – 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.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.

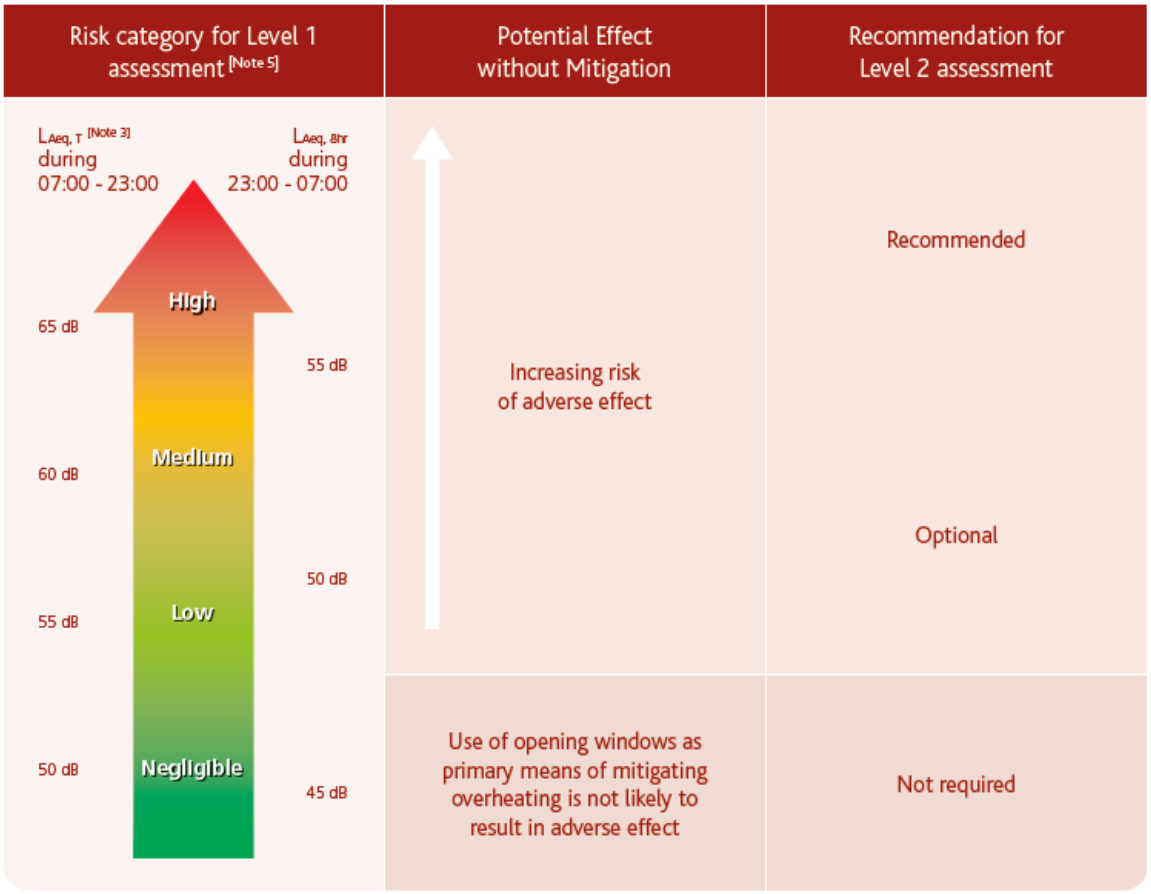


Table 3-2 of AVO Guide (2020)

Figure 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
≥63dB $L_{Aeq,16hour}$	≥55dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62dB $L_{Aeq,16hour}$	52 – 54dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56dB $L_{Aeq,16hour}$	49 – 51dB $L_{Aeq,8hour}$	Low Risk	
≤53dB $L_{Aeq,16hour}$	≤48dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 12 – AVO Guide (2020) Level 1 Risk Assessment

Level 2 Risk Assessment:

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

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

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

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

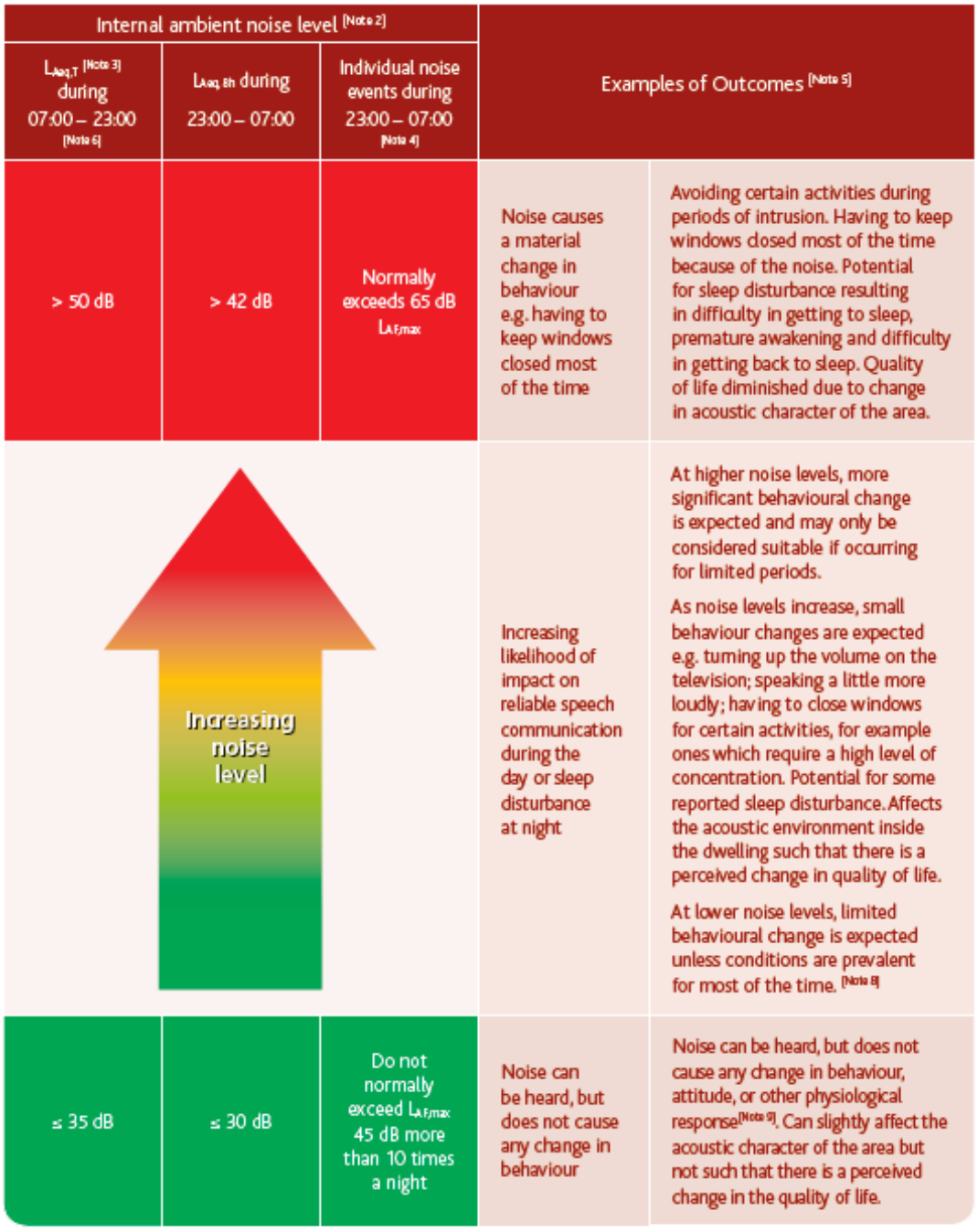


Table 3-3 of AVO Guide (2020)

Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans

Ordnance Survey®

Superplan®

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N

National Grid sheet reference at centre of this Superplan: TQ1197SW

The representation of a road, track or path is no evidence of a right of way.

This Superplan product does not contain all recorded map information.

Scale 1:1250

Centre Coordinates: 511165 197022
Supplied by: Trident Map Services
Serial Number: 01226800

Appendix D – Environmental Survey

D.1 – Time History Noise Data

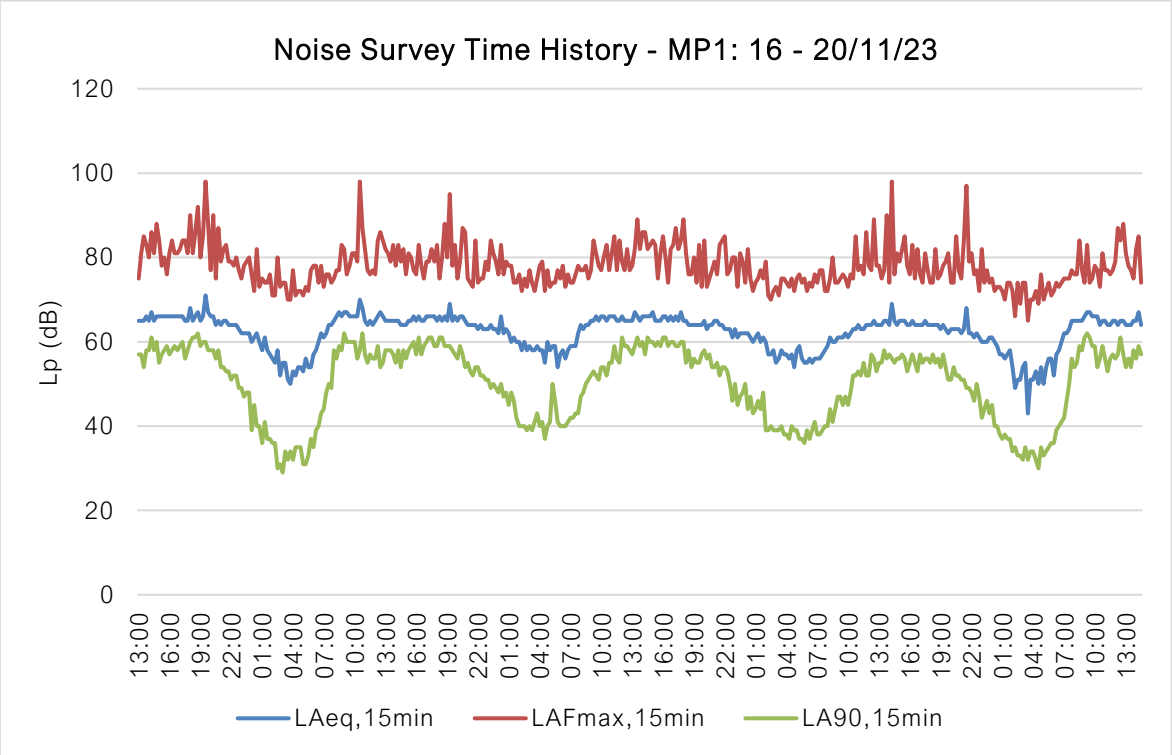

Figure 5 – MP1 Noise Survey Time History

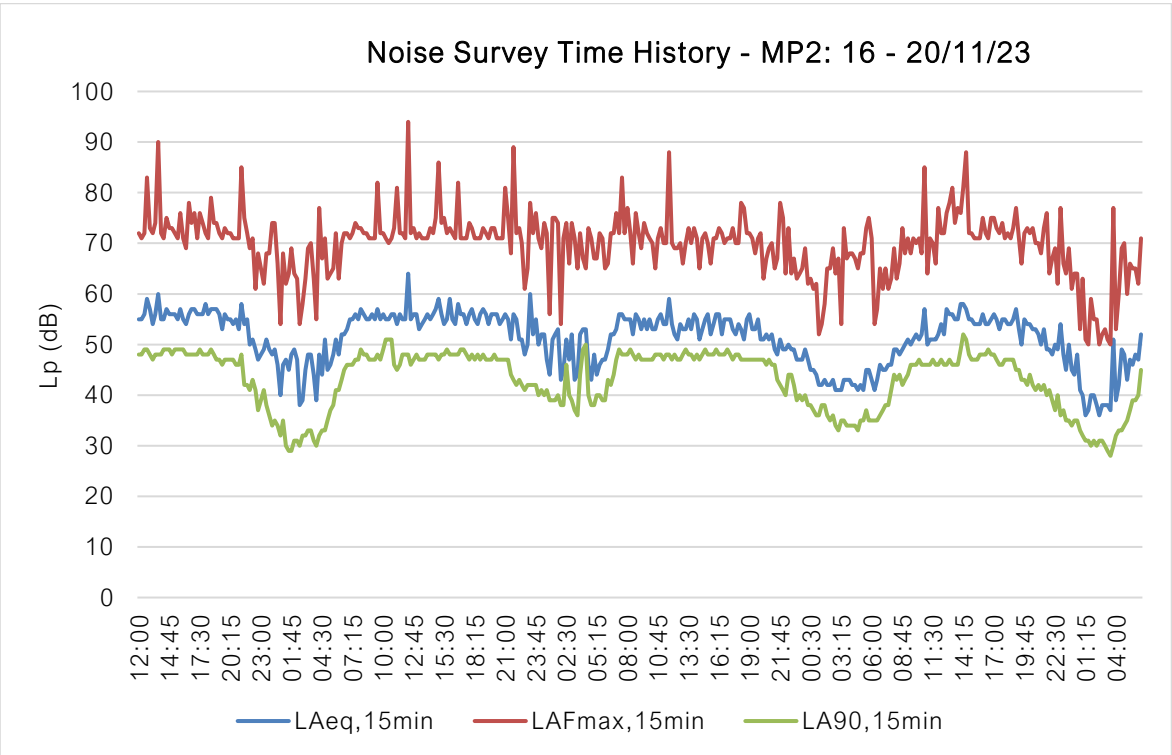

Figure 6 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC420 Class 1 Sound Level Meter	T250680	≤0.3
CESVA CB006 Class 1 Calibrator	902441	
CESVA SC420 Class 1 Sound Level Meter	T238593	≤0.1
CESVA CB006 Class 1 Calibrator	902441	

Table 13 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with negligible deviation noted. 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 – Watford (Approx. 0.3 NW of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
16/11/23 – 00:00 – 23:59	4.0 – 7.6	0.0	SSW	0.0 – 1.2
17/11/23 – 00:00 – 23:59	3.1 – 10.9	0.0	SSW	0.0 – 1.2
18/11/23 – 00:00 – 23:59	8.0 – 14.6	0.0 – 1.8	WNW	0.2 – 2.2
19/11/23 – 00:00 – 23:59	10.4 – 13.7	0.0	SSW	0.4 – 2.9
20/11/23 – 00:00 – 23:59	7.4 – 12.4	0.0	WSW	0.0 – 1.8

Table 14 – Weather Conditions

Appendix E – Noise Break-in Calculations

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 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for an unfurnished living room and 0.3 seconds for a furnished bedroom in the UK. These values are used for calculations.
- Based on the technical drawings provided to NOVA Acoustics, a window area of 1.6m^2 and a room volume of 27.6m^3 are used in the calculations for the bedroom as a worst-case scenario. For the living room, the calculations are based on a window area of 5.3m^2 (2 no. façades) and a room volume of 83.6m^3 as a worst-case scenario.
- The acoustic performance of the façade elements is 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 5000mm^2 per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm^2 each), with 1 No. trickle vent on each façade.

It should be noted that there is a slight exceedance of the proposed NR criteria within the bedroom at 500Hz. From further investigation, this exceedance is approximately 0.5dB within the calculations and is considered negligible, especially when more stringent criteria is being applied to the assessment.

Living Room (North Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	68	72	65	63	61	65	62	57
Glazing Noise Ingress	25	44	37	28	17	10	7	-4
Ventilation Noise Ingress	23	39	22	21	22	16	17	9
Wall Noise Ingress	10	29	17	13	1	4	1	-4
Roof Noise Ingress								
Room Absorption Correction		-1	-1	-1	-2	-2	-2	-3
Total Noise Ingress	**29**	**48**	**39**	**30**	**24**	**18**	**18**	**9**

Bedroom (North Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	68	72	65	63	61	65	62	57
Glazing Noise Ingress	16	35	28	19	8	1	-2	-13
Ventilation Noise Ingress	25	40	23	22	23	17	18	10
Wall Noise Ingress	11	30	18	14	2	5	2	-3
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**28**	**45**	**32**	**27**	**25**	**20**	**20**	**11**

Bedroom (North Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	64	67	65	61	60	61	55	49
Glazing Noise Ingress	14	30	28	17	7	-3	-9	-21
Ventilation Noise Ingress	22	35	23	20	22	13	11	2
Wall Noise Ingress	8	25	18	12	1	1	-5	-11
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**25**	**40**	**32**	**25**	**24**	**16**	**13**	**3**

Bedroom (North Façade) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	78	79	76	73	72	75	70	62
Glazing Noise Ingress	26	42	39	29	19	11	6	-8
Ventilation Noise Ingress	35	48	35	33	35	28	27	16
Wall Noise Ingress	21	37	29	24	13	15	10	2
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**38**	**52**	**44**	**37**	**37**	**30**	**28**	**16**

Figure 7 – Noise Break-In Calculation – North Façade

Living Room (South Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	60	60	58	55	57	57	51	45
Glazing Noise Ingress	21	30	27	25	21	9	4	-4
Ventilation Noise Ingress	16	27	15	13	18	8	6	-3
Wall Noise Ingress	3	18	11	6	-2	-3	-9	-15
Roof Noise Ingress								
Room Absorption Correction		-1	-1	-1	-2	-2	-2	-3
Total Noise Ingress	**24**	**34**	**29**	**27**	**24**	**13**	**9**	**-1**

Bedroom (South Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	60	60	58	55	57	57	51	45
Glazing Noise Ingress	21	30	27	25	21	9	4	-4
Ventilation Noise Ingress	18	28	16	14	19	9	7	-2
Wall Noise Ingress	3	18	11	6	-2	-3	-9	-15
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**25**	**36**	**31**	**28**	**26**	**15**	**11**	**1**

Bedroom (South Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	57	56	57	56	55	51	46	46
Glazing Noise Ingress	21	26	26	26	19	3	-1	-3
Ventilation Noise Ingress	16	24	15	15	17	3	2	-1
Wall Noise Ingress	1	14	10	7	-4	-9	-14	-14
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**24**	**32**	**30**	**29**	**24**	**9**	**6**	**2**

Bedroom (South Façade) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	72	71	72	71	70	66	61	61
Glazing Noise Ingress	36	42	42	42	35	19	15	13
Ventilation Noise Ingress	31	40	31	31	33	19	18	15
Wall Noise Ingress	17	29	25	22	11	6	1	1
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**40**	**47**	**45**	**45**	**39**	**24**	**21**	**18**

Figure 8 – Noise Break-In Calculation – South Façade

Living Room (Cumulative) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Glazing Noise Ingress	27	44	37	30	23	13	9	-1
Ventilation Noise Ingress	24	39	22	21	23	16	17	9
Wall Noise Ingress	11	29	18	14	3	5	1	-4
Roof Noise Ingress	-89							
Room Absorption Correction		-1	-1	-1	-2	-2	-2	-3
Total Noise Ingress	**30**	**48**	**40**	**32**	**27**	**19**	**18**	**9**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	0	-7	-3	-3	-1	-6	-3	-10

Bedroom (Cumulative) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Glazing Noise Ingress	23	36	31	26	22	10	5	-3
Ventilation Noise Ingress	26	40	24	23	25	18	19	10
Wall Noise Ingress	12	30	19	14	3	5	2	-3
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**30**	**45**	**35**	**31**	**29**	**21**	**20**	**11**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	0	-10	-8	-4	1	-4	-1	-8

Bedroom (Cumulative) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Glazing Noise Ingress	22	32	30	27	20	4	0	-3
Ventilation Noise Ingress	23	36	24	21	23	14	12	4
Wall Noise Ingress	9	25	18	13	2	1	-5	-9
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**28**	**41**	**34**	**31**	**27**	**16**	**14**	**6**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	-2	-14	-9	-4	-1	-9	-7	-13

Bedroom (Cumulative) Night Time Lmax

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Glazing Noise Ingress	37	45	44	42	35	20	15	13
Ventilation Noise Ingress	36	48	36	35	37	28	27	18
Wall Noise Ingress	22	38	31	26	15	16	11	5
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**42**	**53**	**48**	**45**	**41**	**31**	**29**	**20**
NR40	45	67	56	49	43	40	37	34
Exceednce of Criteria	-3	-14	-8	-4	-2	-9	-8	-14

Figure 9 – Noise Break-In Calculation – Cumulative Break-in


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