Residential Noise Assessment

Site Address: 100-102 Northgate, Huddersfield HD1 6AR

Client Name: Fixby Properties Ltd

Project Reference No: NP-009787

Authorisation and Version Control			
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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 residential development ('the Proposed Development') at 100-102 Northgate, Huddersfield HD1 6AR ('the Site'). The proposed development is a conversion of commercial first and attic floor spaces into residential dwellings. The site is subject to noise from the surrounding road network, nearby garages and car dealerships, and rail network to the West.

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.

Standards, Legislation, Policy & Guidance

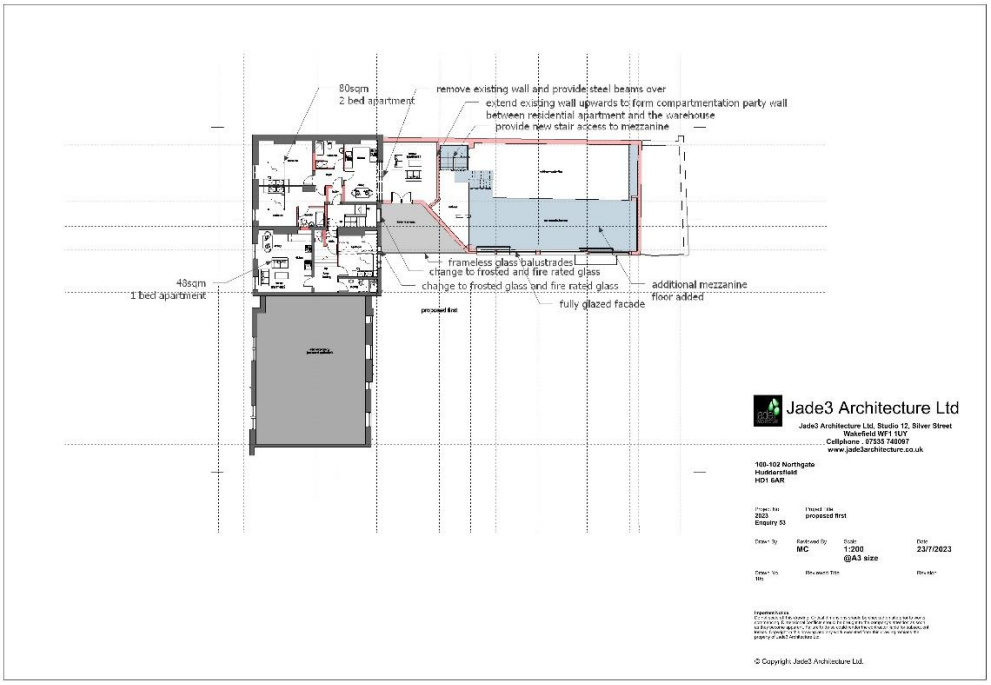
The following performance standards, legislation, policy and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (2021)
- 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 F: Volume 1 Dwellings (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)

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

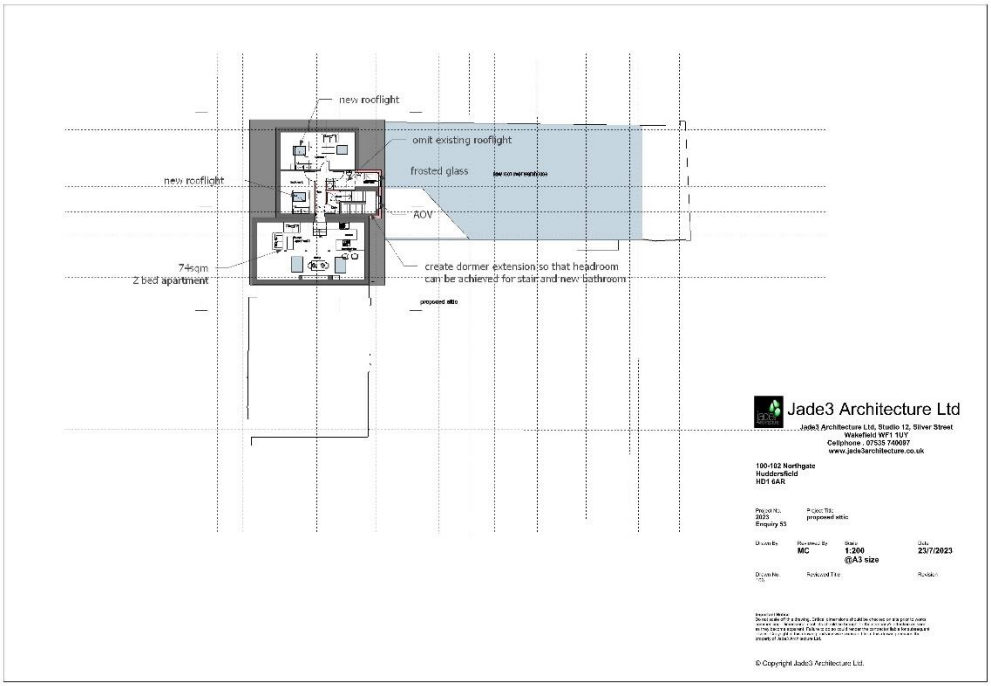
Proposal Brief

The proposal is for the change of use of a commercial first and attic floor spaces into residential dwellings. The site adjoins an existing commercial premises at ground floor level. As part of the development, it is proposed to extend the first floor directly above the warehouse area of the commercial usage. The figure below shows the proposed development.



Drawing Ref No.105 from 'Jade3 Architecture Ltd'

Figure 1 – Proposed Development 1st Floor



Drawing Ref No.105 from 'Jade3 Architecture Ltd'

Figure 2 – Proposed Development Attic Floor

2. Environmental Noise Survey

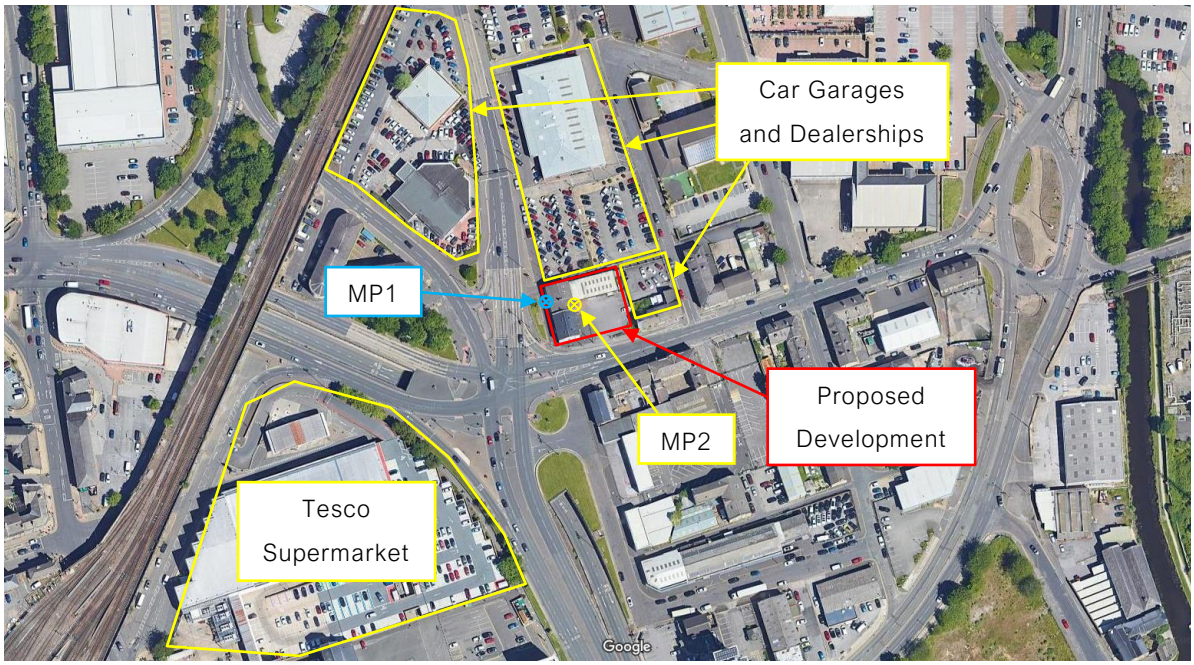
Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	10/08/2023 – 13/08/2023	Equipment mounted to a tripod protruding 1.5m from the window overlooking the A641 leading to the large intersection.
MP2	10/08/2023 – 14/08/2023	Equipment mounted to a tripod protruding 1.5m from the window overlooking the carpark to the business on the ground floor.

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 3 – Measurement Locations and Site Surroundings

Context & Subjective Impression

The development site is located at 100-102 Northgate, above an existing business. The area surrounding the site consists primarily of commercial buildings, garages and car dealerships with some residential dwellings to the east. There is a large road intersection to the southwest and railway lines 120m to the west.

The acoustic environment is deemed to be moderate to high in level and the noise profile is dominated by road traffic noise emissions from the adjacent intersection and frequent vehicle pass-bys along Lower Fitzwilliam Street. Noise from the surrounding businesses was considered to be infrequent and secondary to road traffic noise.

It was however noted during both site visits that there were deliveries occurring outside the warehouse area of the adjoining commercial premises. Goods were being loaded out of a large box-van into the warehouse through the electric shutter doors. From further analysis of the measured results at MP2, this type of activity is anticipated to be infrequent and short in duration.

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)	69	64	64	60	61	58	49	65	--
	Highest $L_{eq,1hr}$ (Day)	70	66	67	67	64	65	57	70	--
	$L_{eq,8hr}$ (Night)	61	55	56	53	55	54	42	59	76
	Highest $L_{eq,1hr}$ (Night)	65	59	62	59	61	61	46	66	--
MP2	$L_{eq,16hr}$ (Day)	65	58	56	54	57	55	50	65	--
	Highest $L_{eq,1hr}$ (Day)	68	63	62	56	61	58	50	68	--
	$L_{eq,8hr}$ (Night)	57	49	49	49	50	45	40	57	70
	Highest $L_{eq,1hr}$ (Night)	63	55	56	55	55	51	47	63	--

Table 2 – Sound Level Results Summary

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3. Noise Break-in Assessment and Sound Insulation Scheme

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 $L_{Aeq,8hr}$ 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 – Internal Acoustic Design Criteria

The noise profile of the area is predominantly "anonymous" steady state noise sources e.g., transport. Therefore, the measured $L_{eq,16hr}$, $L_{eq,8hr}$ and typical $L_{AFmax,1min}$ at the front of the development (MP1) are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

Due to potential for commercial activity to the rear of the development (MP2), the assessment considers the loudest $L_{eq,1hr}$ during daytime hours (i.e. when the nearby commercial premises is in operation).

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									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	
	63	125	250	500	1k	2k	4k		
8mm Glass / 16mm Air Cavity / 4mm Glass	21	22	21	28	38	40	47	33 (R_w)	28 (R_w + C_{tr})
Greenwoods 2500EA.AC1 (2 No. Trickle)	19	21	17	25	35	37	31	29 (D_{new})	25 (D_{new} + C_{tr})

Table 4 – Glazing and 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.

It should be noted that the predicted levels are significantly below the adopted criteria within rear bedrooms (i.e. those overlooking the adjoining commercial premises). Therefore, any uncertainties with regards to attention catching features associated with the commercial premises are considered to be protected against.

Roof Buildup Specification

Based on the measured levels at the site, it is considered that the roof system will require additional sound insulation to achieve appropriate internal noise levels. An indicative roofing construction is provided below:

- 8mm roofing slates.
- 4mm membrane.
- 200mm joists with resilient bar, filled with 100mm insulation (RWA45).
- 2no. layers of 15mm SoundBloc plasterboard.

4. Open Window Noise Break-in Assessment

Internal Noise Levels with Open Windows Criteria

BS8233 states that when relying on closed windows to achieve the internal acoustic design criteria, appropriate alternative ventilation should be provided. Approved Document F states: "*Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation"*. 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. 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 a 5dB relaxation of the internal noise criteria and an open window providing 13dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria can be achieved with open windows. The criteria from Table 3 – 3 of the AVO Guide 'Windows Rarely Open'* is shown in the table below for reference.

AVO Open Window Assessment – MP1				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
65 $L_{Aeq,16hr}$ (Day)	53	+12	63	+2
59 $L_{Aeq,8hr}$ (Night)	48	+11	55	+4
76 $L_{AF,max}$ (Night)	63	+18	78	-2
AVO Open Window Assessment – MP2				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
65 $L_{Aeq,16hr}$ (Day)	53	+12	63	+2
57 $L_{Aeq,8hr}$ (Night)	48	+9	55	+2
70 $L_{AF,max}$ (Night)	63	+12	78	-8

Table 5 – Open Window Assessment

**This criterion is taken from the Acoustics Ventilation and Overheating (AVO) Guide, which is relevant to the planning, design, and commissioning of new dwellings. Whilst the current project relates to dwellings formed by material change of use, the alternative 'new dwelling' criteria supports the principle of "Good Acoustic Design".*

The external noise levels exceed the AVO Guides ‘Rarely Open’ criteria which 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. It is noted that the windows will remain openable at the occupant’s choice.

5. Noise Breakthrough Assessment and Sound Insulation Scheme

Noise Breakthrough Criteria

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

Noise Breakthrough Assessment and Specification

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

Planning Class	Level of Risk from Noise	Required Sound Insulation Standard (dB)
E(a) Display or retail sale of goods, other than hot food	Medium	≥53 $D_{nT,w}$ + C_{tr}
Discussion: The noise emissions produced by a display or retail sale of goods premises may include some low level music, patrons to the business and employees working in the office space which currently occupies the ground floor area. This business presently operates between 9:30 and 18:00. The proposed development is a material change of use, as such a target 53 $D_{nT,w}$ + C_{tr} which is 10dB above the building regulation requirement will provide a robust specification target.		

Table 6 – Noise Breakthrough Assessment

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.

The following specifications have been based on the existing buildup of the floor.

Specification with upgrades above and below existing floor:

- 22mm RCM Cemboard.
- 18mm particle board.
- Existing 100mm timber joists with 100mm Rockwool RWA45 (45kg/m^3) tightly and evenly fitted.
- MuteClipTM and furring channel System affixed to the underside of the joist. (In accordance with the manufacturers guidelines).
- 2 No. layers of 15mm SoundBloc plasterboard (with overlapping joints and sealed with flexible mastic at the perimeter).

*Specification with upgrades above existing floor only:

- 4mm 2500kg/m^2 Mass Loaded Vinyl (MLV).
- 2 No. 18mm RCM Cemboard.
- Batton and cradle suspended floor system with 50mm depth studs and 50mm Rockwool RWA45 (45kg/m^3) tightly and evenly fitted.
- 4mm 2500kg/m^2 Mass Loaded Vinyl (MLV).
- 2 No. layers of 18mm particle board.
- Upgraded 200mm additional wooden joist on top of existing joist, structurally tied into the existing walls with 100mm Rockwool RW3 (40kg/m3) tightly and evenly fitted.

**Given the limitations of what can be practically installed this specification achieves 50 $D_{nT,w}$ + C_{tr} but has been provided at the request of the client and must be assessed for suitability buy the local authority.*

During the site visit it was noted that the existing joist was 100mm in depth. This may be structurally insufficient to sustain the additional weight of upgrade systems built on top of the floor only that provide sufficient noise reduction to be considered safe. If the joist is replaced or upgraded, it may be possible to employ a system built up from the existing joist.

The following indicative specification is for the wall that will separate the lounge area of apartment 1 with the proposed upper floor of the warehouse mezzanine area.

Specification of Separating Wall:

- 2 No. layers of 15mm SoundBloc plasterboard (with overlapping joints and sealed with flexible mastic at the perimeter).
- Double 90mm timber-stud with 25mm separating gap and 100mm Rockwool RW3 (40kg/m3) tightly and evenly fitted.
- 2 No. layers of 15mm SoundBloc plasterboards (with overlapping joints and sealed with flexible mastic at the perimeter).

It should be noted that this report provides indicative specifications 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 wall and 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 (2021)

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.

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 7 – 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".

B.5 – Approved Document F Volume 1: Dwellings (2021)

Approved Document F states the following in relation to noise:

- Mechanical ventilation systems, including both continuous and intermittent mechanical ventilation, should be designed and installed to minimise noise. This includes doing all of the following.
    - Correctly sizing and jointing ducts.
    - Ensuring that equipment is appropriately and securely fixed, such as using resilient mountings where noise carried by the structure of the building could be a problem.
    - Selecting appropriate equipment, including following paragraph

- For mechanical ventilation systems, fan units should be appropriately sized so that fans operating in normal background ventilation mode are not overly noisy. This might require fans to be sized so that they do not operate near maximum capacity when in normal background ventilation mode.
- Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation.
- If an exposed façade is close to an area of sustained and loud noise (e.g. a main road), then a noise attenuating background ventilator should be fitted.

B.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.

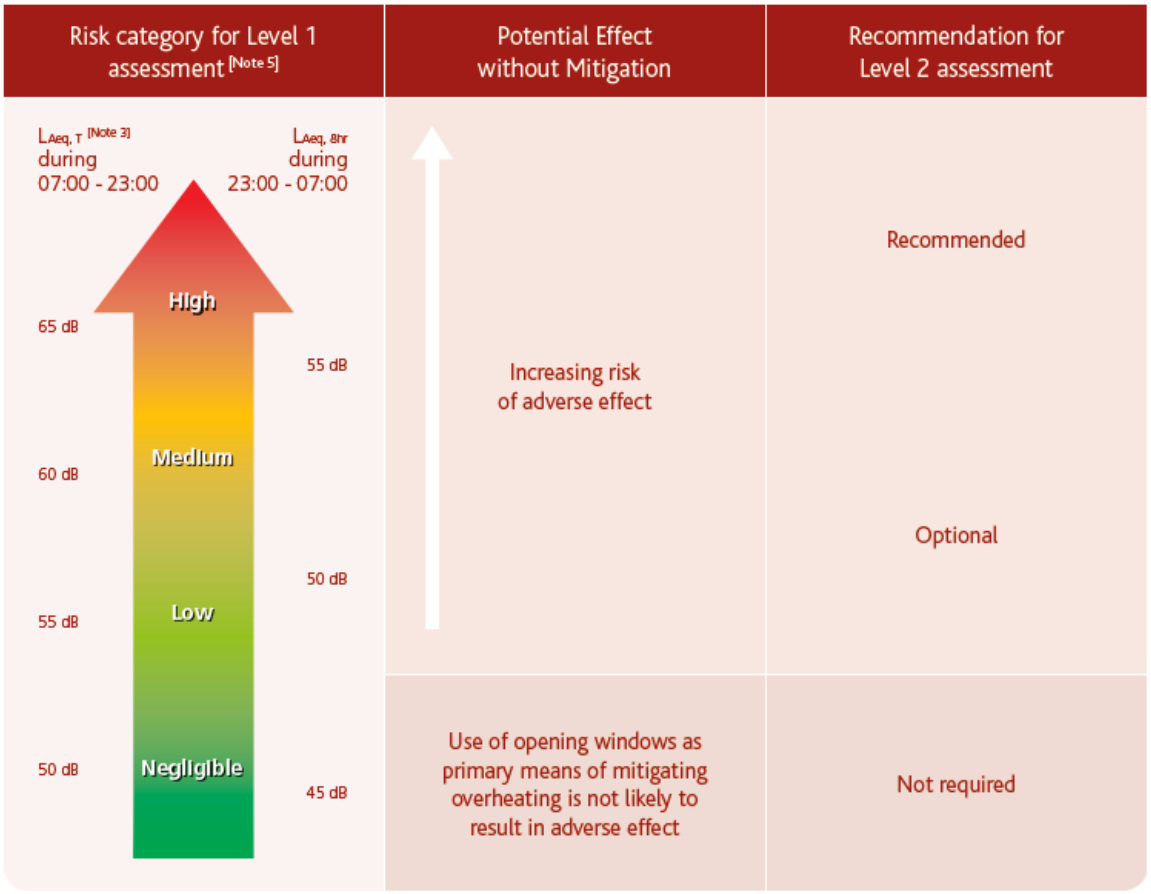

Table 3-2 of AVO Guide (2020)

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.

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 8 – 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. 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 $L_{AF,max}$ 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 5 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans

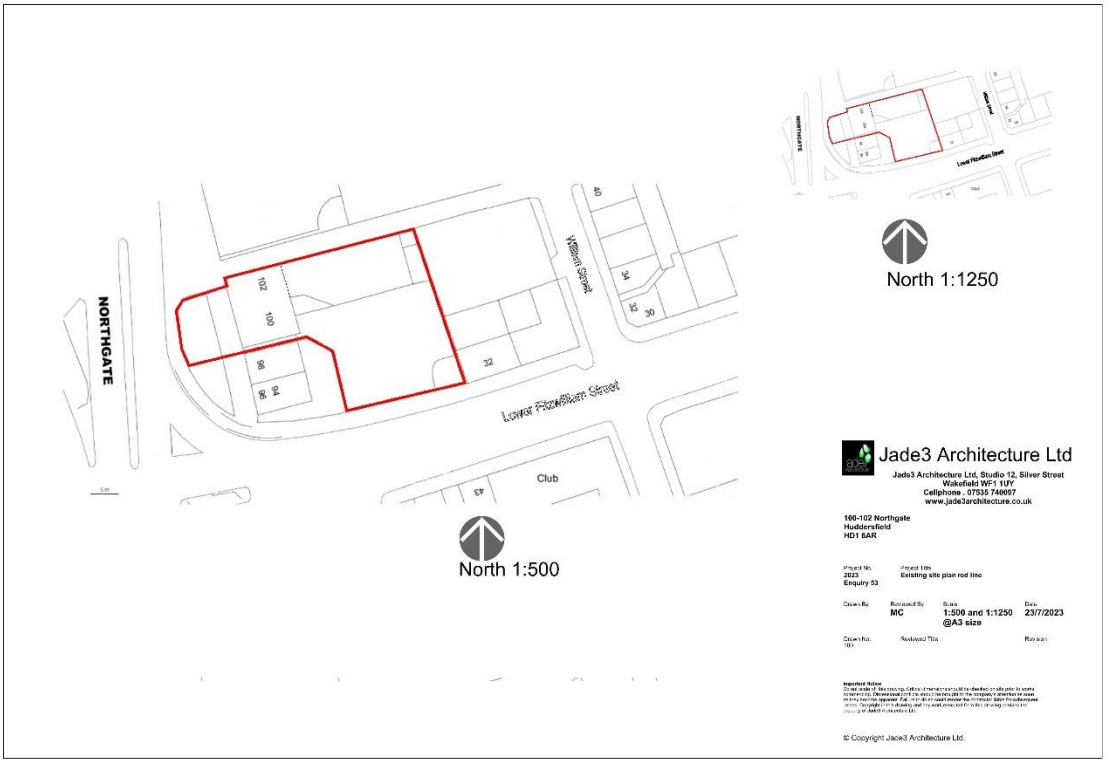

Figure 6 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

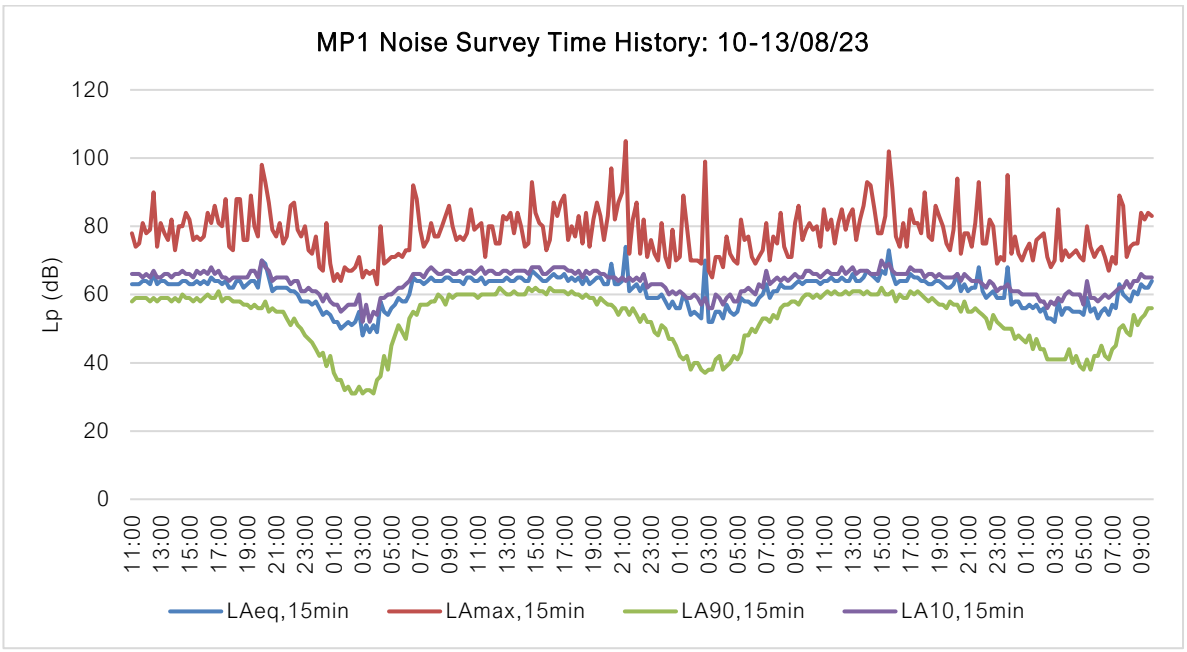

Figure 7 – MP1 Noise Survey Time History

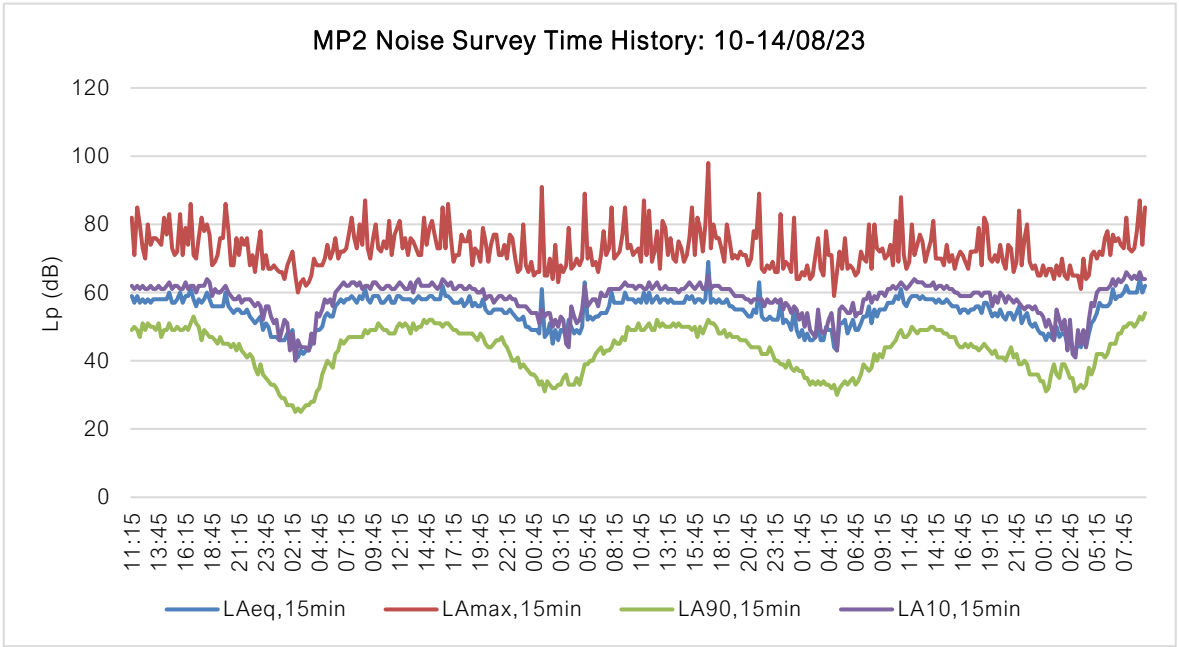

Figure 8 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek 977 Class 1 Sound Level Meter	34826	≤0.1
Svantek SV33B Class 1 Calibrator	116639	
Svantek 971 Class 1 Sound Level Meter	77796	≤0.1
Svantek SV33B Class 1 Calibrator	116639	

Table 9 – 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 ≤0.1 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Almondbury (Approx. 3km SWW of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
10/08/23 – 00:00 – 23:59	14.7 – 27.2	0.0	ESE	0.0 – 7.6
11/08/23 – 00:00 – 23:59	14.7 – 24.4	0.0	SSW	0.0 – 6.3
12/08/23 – 00:00 – 23:59	14.9 – 21.6	5.3	SSW	0.0 – 8.0
13/08/23 – 00:00 – 23:59	15.0 – 20.8	3.3	SSW	0.0 – 6.3
14/08/23 – 00:00 – 23:59	14.3 – 21.2	15.5	SSE	0.0 – 6.3

Table 10 – 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 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, window areas of 2.4m^2 and room volumes of 23.4m^3 are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 2.4m^2 and room volume of 105.9m^3 as a worst-case scenario.
- 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 5000mm^2 per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm^2 each).

It should be noted that the calculations include assessment against the equivalent Noise rating (NR) curve. In some instances there are slight exceedances of the NR criteria however, the global values (as provided in BS8233) are still achieved and are therefore the glazing and ventilation strategy is deemed appropriate.

Living Room (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	69	64	64	60	61	58	49	49
Glazing Noise Ingress	23	35	29	30	19	10	5	-11	-11
Ventilation Noise Ingress	19	34	19	20	19	10	11	-1	-1
Wall Noise Ingress	9	21	18	15	3	-1	-9	-18	-18
Roof Noise Ingress	14	37	18	13	4	5	2	-7	-7
Room Absorption Correction		3	3	2	2	2	1	0	-1
Total Noise Ingress	**30**	**46**	**35**	**36**	**27**	**18**	**17**	**4**	**2**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-5	-13	-13	-3	-6	-12	-9	-20	-20

Bedroom (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	65	69	64	64	60	61	58	49	49
Glazing Noise Ingress	28	39	33	34	23	14	9	-7	-7
Ventilation Noise Ingress	24	39	24	25	24	15	16	4	16
Wall Noise Ingress	12	23	20	17	5	1	-7	-16	-16
Roof Noise Ingress	12	35	16	11	2	3	0	-9	-9
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**34**	**48**	**39**	**40**	**31**	**22**	**21**	**7**	**18**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-1	-11	-9	1	-2	-8	-5	-17	-4

Bedroom (MP1) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	59	61	55	56	53	55	54	42	42
Glazing Noise Ingress	20	31	24	26	16	8	5	-14	-14
Ventilation Noise Ingress	18	31	15	17	17	9	12	-3	-3
Wall Noise Ingress	4	15	11	9	-2	-5	-11	-23	-23
Roof Noise Ingress	5	27	7	3	-5	-3	-4	-16	-16
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**27**	**40**	**30**	**32**	**24**	**16**	**17**	**0**	**-1**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-3	-15	-13	-3	-4	-9	-4	-19	-18

Bedroom (MP1) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	76	78	72	73	70	72	71	59	59
Glazing Noise Ingress	37	48	41	43	33	25	22	3	3
Ventilation Noise Ingress	34	47	31	33	33	25	28	13	13
Wall Noise Ingress	21	32	28	26	15	12	6	-6	-6
Roof Noise Ingress	21	44	24	20	12	14	13	1	1
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**44**	**57**	**47**	**49**	**41**	**33**	**33**	**17**	**15**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-1	-10	-9	0	-2	-7	-4	-17	-18

Living Room (MP2) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	64	68	63	62	56	61	58	50	50
Glazing Noise Ingress	21	34	28	28	15	10	5	-10	-10
Ventilation Noise Ingress	17	33	18	18	15	10	11	0	0
Wall Noise Ingress	7	20	17	13	-1	-1	-9	-17	-17
Roof Noise Ingress	13	36	17	11	0	5	2	-6	-6
Room Absorption Correction		3	3	2	2	2	1	0	-1
Total Noise Ingress	**28**	**45**	**34**	**34**	**23**	**18**	**17**	**5**	**3**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	-7	-14	-14	-5	-10	-12	-9	-19	-19

Bedroom (MP2) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	64	68	63	62	56	61	58	50	50
Glazing Noise Ingress	26	38	32	32	19	14	9	-6	-6
Ventilation Noise Ingress	23	38	23	23	20	15	16	5	17
Wall Noise Ingress	10	22	19	15	1	1	-7	-15	-15
Roof Noise Ingress	11	34	15	9	-2	3	0	-8	-8
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**32**	**47**	**38**	**38**	**27**	**22**	**21**	**8**	**19**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	-3	-12	-10	-1	-6	-8	-5	-16	-3

Bedroom (MP2) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	53	57	49	49	49	50	45	40	40
Glazing Noise Ingress	14	27	18	19	12	3	-4	-16	-16
Ventilation Noise Ingress	12	27	9	10	13	4	3	-5	-5
Wall Noise Ingress	-2	11	5	2	-6	-10	-20	-25	-25
Roof Noise Ingress	0	23	1	-4	-9	-8	-13	-18	-18
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**21**	**36**	**24**	**25**	**20**	**11**	**8**	**-2**	**-3**
NR25	30	55	43	35	28	25	21	19	17
Exceednce of Criteria	-9	-19	-19	-10	-8	-14	-13	-21	-20

Bedroom (MP2) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	70	74	66	66	66	67	62	57	57
Glazing Noise Ingress	31	44	35	36	29	20	13	1	1
Ventilation Noise Ingress	29	43	25	26	29	20	19	11	11
Wall Noise Ingress	15	28	22	19	11	7	-3	-8	-8
Roof Noise Ingress	16	40	18	13	8	9	4	-1	-1
Room Absorption Correction		3	2	2	1	1	1	0	-2
Total Noise Ingress	**38**	**53**	**41**	**41**	**37**	**28**	**24**	**15**	**13**
NR40	45	67	56	49	43	40	37	34	33
Exceednce of Criteria	-7	-14	-15	-8	-6	-12	-13	-19	-20


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