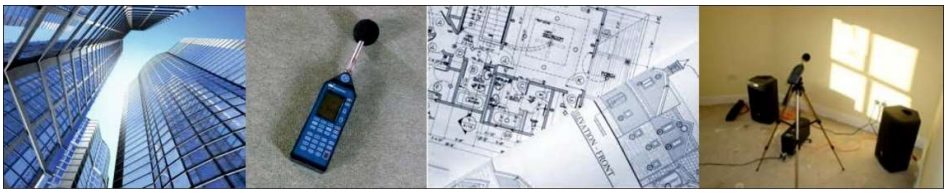
Ian Sharland
LIMITED
Noise & Vibration Control Specialists

Ashfield House
Back Lane
Marlborough
Wiltshire SN8 1JJ
Telephone: (01672) 515761
Facsimile: (01672) 512761
Email: office@iansharland.co.uk



PROPOSED BARN CONVERSION
HUDDS MILL FARM
HUDDS MILL LANE
EDINGTON
BA13 4NT

ENVIRONMENTAL NOISE ASSESSMENT
v.2

Client:
SARAH BLAZIER
Hudds Mill Farm
Hudds Mill Lane
Eddington
BA13 4NT

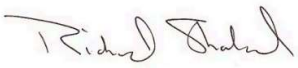
25th October 2023
Ref: M5483

R Sharland MA(Cantab), CEng, MSc, MIOA
P Ashford BSc (Eng), MIOA
SB Sharland MA(Cantab)

Registered in England & Wales No. 1293250
Reg'd Office: 25 St Thomas St. Winchester SO23 9DD

CONTENTS

1. SUMMARY 2
2. INTRODUCTION 3
3. SURVEY OF EXISTING NOISE & VIBRATION LEVELS 4
4. ASSESSMENT OF NOISE LEVELS 7
4.1 National Planning Policy Framework (July 2021) 7
4.2 National Policy Statement for England (March 2010) 8
4.3 Planning Practice Guide 'Noise' (July 2019) 9
4.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings 14
4.5 World Health Organisation Guidelines 15
4.6 Approved Document F Ventilation 16
4.7 Approved Document O – Overheating (2021) 17
4.8 IOA/ANC Acoustics Ventilation and Overheating – Residential Design Guide 19
4.9 BS 6472:2008 Evaluation of Human Exposure to Vibration in Buildings (1 – 80 Hz) 20
5. RECOMMENDATIONS FOR NOISE ATTENUATION MEASURES 22
6. ASSESSMENT OF VIBRATION LEVELS 26
7. CONCLUSION 28
FIGURE 1 – SITE LOCATION 29
FIGURE 2 – PROPOSED SITE PLAN 30
FIGURE 3 – PROPOSED FLOOR PLAN, UNIT 1 31
FIGURE 4 – PROPOSED FLOOR PLAN, UNIT 2 32
..... 32
FIGURE 5 – VARIATION OF MEASURED NOISE LEVELS 33
FIGURE 6 – VARIATION OF MEASURED VIBRATION LEVELS 34
APPENDIX I – OUTSIDE TO INSIDE CALCULATIONS 35
APPENDIX II - TERMINOLOGY RELATING TO NOISE 37

Project Reference	M5483
Issue No.	2
Reviewed	Richard Sharland MA MSc CEng MIOA
Signature	
Author	Eddie Oxborough MSc MIOA
Signature	
Date	25th October 2023

This report has been prepared by Ian Sharland Ltd with all reasonable skill, care and diligence, and taking account of the Services and the Terms agreed between Ian Sharland Ltd and the Client. This report is confidential to the client, and Ian Sharland Ltd accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Ian Sharland Ltd beforehand. Any such party relies upon the report at their own risk. Ian Sharland Ltd disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the Services.

1. SUMMARY

1.1 An assessment of environmental noise has been undertaken at a proposed barn conversion on Hudds Mill Farm, Hudds Mill Lane, Edington.

1.2 It is proposed that two existing agricultural barns be converted to create two new dwellings.

1.3 The existing ambient noise climate affecting the site has been established (Section 3), and the survey has confirmed a typical variation in daytime and night-time levels.

1.4 Section 4 provides a description of the relevant national planning policies and defines the criteria which would commonly be applied to projects of this nature.

1.5 Means of attenuating the external noise levels have been submitted (Section 5), in the form of a specification for the façade glazing and means of acoustically ventilating the houses.

1.6 An assessment of noise in external amenity areas confirms that levels will generally be at or below the threshold values described in the BS and WHO guidelines, across the majority of the space. No additional mitigation is proposed.

1.8 A survey of ground vibration levels (Section 6) has been undertaken and this indicates that the predicted values would well below the category described as a 'Low Probability of Adverse Comment'.

1.9 Overall, it is concluded that, with the recommended measures in place, the occupants of the new properties can be provided with an acceptable acoustic environment.

2. INTRODUCTION

2.1 An assessment of environmental noise has been undertaken at Hudds Mill Farm, Hudds Mill Lane, Edington.

2.2 The development site is situated to the north of the farm, immediately adjacent to the mainline London to Exeter railway (Figure 1, Site Location). It is otherwise very well removed from all other sources of noise.

2.3 It is proposed to convert two single storey barns, either side of a central courtyard, into a pair of residential dwellings (Figures 2 – 4, Proposed Site & Floor Plans). A third barn on the site will be demolished.

2.4 It is noted that the development will remove any ongoing agricultural use from the courtyard. However, it is recognised that the proposed houses will be subject to noise from the railway line. It is therefore necessary to quantify these effects and consider if mitigation is required.

2.5 Formally, the objectives of the current exercise may be summarised as follows:

(i) To determine the existing ambient noise climate in the vicinity of the development site.
(ii) To assess likely noise levels at the facades of any new buildings, and to specify a suitable façade construction to ensure acceptable conditions.
(iii) To consider external noise levels and advise on any requirements for site screening;
(iv) To assess ground vibration levels on the site and make recommendations for any remediation necessary.

2.6 This report details the investigations carried out in respect of each of these objectives and summarises the conclusions which have been reached.

3. SURVEY OF EXISTING NOISE & VIBRATION LEVELS

3.1 The first step in the assessment of potential impact is to measure and describe the existing ambient noise levels affecting the site.

3.2 A noise survey was undertaken from Thursday 19th October 2023 to Monday 23rd October 2023.

3.3 A Rion NL-52 Type 1 sound level meter was set up along the on the southern edge of the courtyard. The equipment was set between the two buildings, at a distance from the railway line equal to the nearest facades (see Figure 1).

3.4 The microphone of the meter was attached to extendable light stand and set up at a height of 2m, in a free field position.

3.5 The equipment was configured to measure 5minute samples of the following acoustic parameters:

L_{Aeq} The A-weighted equivalent continuous sound pressure level which, over the sample period, contains the same acoustic energy as the time-varying signal being recorded.

L_{Amax} The A-weighted maximum sound pressure level recorded during each sample period (as measured on fast response).

L_{A90} A statistical parameter representing the A-Weighted noise level exceeded for 90% of each sample period. This is commonly used to describe the underlying background noise levels.

3.6 Weather conditions throughout the survey period are summarized in the following table;

Date	Average Temperature (°C)	Events	Average Wind Speed m/sec	Wind Direction
Thursday 19/10	16	Rain evening	2.6	SE
Friday 20/10	12	Rain all day	2.6	E
Saturday 21/10	10	Rain o/n	2.2	NE
Sunday 22/10	10	None	1.8	SW
Monday 23/10	10	None	0.9	S

Table 3.1 – Summary of Weather Conditions

3.7 The equipment was calibrated before and after the survey and showed no significant variance.

3.8 Figure 5 shows the variation in noise levels during the survey period, and Table 3.2 confirms the measured levels during each of the standard daytime and night-time periods.

Period		Day Time $L_{Aeq,\ 07.00 - 23.00}$	Night-Time $L_{Aeq,\ 23.00 - 07.00}$	Typical $L_{Amax,\ fast}$ Night
Thursday 19/10	dB(A)	56.5*	41.9	68
Friday 20/10	dB(A)	56.1	53.2	74
Saturday 21/10	dB(A)	50.1	48.8	69
Sunday 22/10	dB(A)	51.0	47.8	71
*Part measurements				

Table 3.2 – Summary of Measured Noise Levels

3.9 The L_{Amax} levels shown in the tables are the peak values based on the 95th percentile and may exclude exceptional 'one-off' events during the night. In this instance, the analysis reflects a small number of raised measurements, inferred to be arising from passing trains, and then a much lower level for the remainder of the night. The values in Table 3.2 reflect the noise arising from the passing trains.

3.10 The second part of the ambient condition survey was to record ground vibration levels on the site. Again, the primary (and perhaps only) source of ground borne vibration was deemed to the passing rail traffic.

3.11 Measurements were taken within the easterly barn (see Figure 1).

3.12 A Rion VM-54 3-axis vibration meter was set up with the accelerometer connected to a heavy plate and placed onto the concrete floor slab of the building. The equipment was set to record the VDV (vibration dose values) over 5 minutes samples.

3.13 The survey was undertaken over a 24 hrs period between Thursday 19th and Friday 20th October 2023.

3.14 Figure 6 shows the variation of the vibration levels over the survey period in the dominant Z-axis, and Table 3.3 confirms the measured levels during each of the standard day time and night-time periods:

Period	X axis VDV $m/s^{1.75}$	Y axis VDV $m/s^{1.75}$	Z axis VDV $m/s^{1.75}$
Day time 0700 – 2300	0.02	0.02	0.04
Night Time 2300 - 0700	0.01	0.01	0.02

Table 3.3 – Summary of Measured Vibration Dose Values

3.15 Sections 5 & 6 of this report will discuss the noise & vibration levels, in respect of their suitability for residential building.

4. ASSESSMENT OF NOISE LEVELS

4.1 National Planning Policy Framework (July 2021)

4.1.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

4.1.2 Planning law requires that applications for planning permission be determined in accordance with the development plan, unless material considerations indicate otherwise. The National Planning Policy Framework must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

4.1.3 The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

4.1.4 Paragraph 185 of the NPPF states:

185. 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 minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[1] ;

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.

[1] Refers here to the NPSE, discussed in Section 3.2 of this report.

4.2 National Policy Statement for England (March 2010)

4.2.1 The document "Noise Policy Statement for England" sets out the following vision for on-going noise policy:

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

4.2.2 This vision should be achieved through the following Noise Policy 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.*
> - *and where possible, contribute to the improvement of health and quality of life".*

4.2.3 To achieve these objectives the Noise Policy Statement sets out three noise levels to be defined by the assessor:

- **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.

- **LOAEL** - Lowest Observed Adverse Effect Level
  This is the level above which adverse effects on health and quality of life can be detected. Where levels lie between the LOAEL and SOAEL, the Statement requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, as set out in the NPPF.
- **SOAEL** - Significant Observed Adverse Effect Level
  This is the level above which significant adverse effects on health and quality of life occur. It notes, however, that "it is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times".

4.2.4 Paragraph 2.7 states that "… the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a policy, development or other activity may not have been given adequate weight when assessing the noise implications".

4.2.5 This provides clear guidance that noise must not be considered in isolation but as part of the overall scheme, taking into account the overall sustainability and associated impacts of the proposed development; there is no benefit in reducing noise to an excessively low level if this creates or increases some other adverse impact. Similarly, it may be appropriate in some cases for noise to have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance to the development.

4.2.6 The Noise Policy Statement considers that noise levels above the SOAEL would be seen to have, by definition, significant adverse effects and would be considered unacceptable. Where the assessed noise levels fall between the LOAEL and the SOAEL noise levels, the Policy Statement 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."*

4.2.7 Where noise levels are below the LOAEL it is considered there will be no adverse effect. Once noise levels are below the NOEL there will be no observable change. An indication of the numerical definition of LOAEL may be derived from the following guidance.

4.3 Planning Practice Guide 'Noise' (July 2019)

4.3.1 The Ministry of Housing Communities and Local Government provided further guidance to support the NPPF. The section, Noise, published in July 2019, provides the following advice:

When is noise relevant to planning?

Noise needs to be considered when development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced). When preparing plans, or taking decisions about new development, there may also be opportunities to make improvements to the acoustic environment. Good acoustic design needs to be considered early in the planning process to ensure that the most appropriate and cost-effective solutions are identified from the outset.

What are the observed effect levels?

- *Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur.*
- *Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected.*
- *No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.*

Although the word 'level' is used here, this does not mean that the effects can only be defined in terms of a single value of noise exposure. In some circumstances adverse effects are defined in terms of a combination of more than one factor such as noise exposure, the number of occurrences of the noise in a given time period, the duration of the noise and the time of day the noise occurs.

How can it be established whether noise is likely to be a concern?

At the lowest extreme, when noise is not perceived to be present, there is by definition no effect. As the noise exposure increases, it will cross the 'no observed effect' level. However, the noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life. If the noise exposure is at this level no specific measures are required to manage the acoustic environment.

As the exposure increases further, it crosses the 'lowest observed adverse effect' level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

Increasing noise exposure will at some point cause the 'significant observed adverse effect' level boundary to be crossed. Above this level the noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. If the exposure is predicted to be above this level the planning process should be used to avoid this effect occurring, for example through the choice of sites at the plan-making stage, or by use of appropriate mitigation such as by altering the design and layout. While such decisions must be made taking account of the economic and social benefit of the activity causing or affected by the noise, it is undesirable for such exposure to be caused.

At the highest extreme, noise exposure would cause extensive and sustained adverse changes in behaviour and / or health without an ability to mitigate the effect of the noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be avoided.

4.3.2 The table below summarises the noise exposure hierarchy, based on the likely average response:

Perception	***Examples of Outcomes***	***Increasing Effect Level***	***Action***
	No Observed Effect Level		
Not Present	*No Effect*	*No Observed Effect*	*No specific measures required*
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	*No Observed Adverse Effect*	*No specific measures required*
	Lowest Observed Adverse Effect Level		
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	*Observed Adverse Effect*	*Mitigate and reduce to a minimum*
	Significant Observed Adverse Effect Level		
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, 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	*Significant Observed Adverse Effect*	*Avoid*
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	*Unacceptable Adverse Effect*	*Prevent*

Table 3.1 – Noise Exposure Hierarchy

4.3.3 The guidance further advises:

> **What factors influence whether noise could be a concern?**
>
> The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.
>
> These factors include:

- the source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.
- for a new noise making source, how the noise from it relates to the existing sound environment.
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- the spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features), and
- the local arrangement of buildings, surfaces and green infrastructure, and the extent to which it reflects or absorbs noise.

More specific factors to consider when relevant include:

- the cumulative impacts of more than one source of noise.
- whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations;
- In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.
- Noise Action Plans (where these exist), and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations should be taken into account. Defra's website has information on Noise Action Plans and Important Areas. Local authority environmental health departments will also be able to provide information about Important Areas.
- the effect of noise on wildlife. Noise can adversely affect wildlife and ecosystems. Particular consideration needs to be given to the potential effects of noisy development on international, national and locally designated sites of importance for biodiversity.
- where external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

- some commercial developments including restaurants, hot food takeaways, night clubs and public houses can have particular impacts, not least because activities are often at their peak in the evening and late at night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the noise that may be made by customers in the vicinity.

When proposed developments could include activities that would be covered by the licensing regime, local planning authorities will need to consider whether the potential for adverse noise impacts will be addressed through licensing controls (including licence conditions). Local planning authorities should not however presume that licence conditions will provide for noise management in all instances and should liaise with the licensing authority.

Are there further considerations relating to mitigating the impact of noise on residential developments?

Noise impacts may be partially offset if residents have access to one or more of:

- a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling.
- a relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced if this area is exposed to noise levels that result in significant adverse effects.
- a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or
- a relatively quiet, protected, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5-minute walking distance).

4.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

4.4.1 There is much guidance on the levels of intrusive noise which would be considered acceptable within residential accommodation such as this. Typical advice is found in British Standard 8233:2014 "Guidance on Sound Insulation and Noise Reduction for buildings." Following similar guidance in the 1999 World Health Organisation report "Guidelines for Community Noise", the Standard sets out the following limits for indoor ambient noise levels within living rooms and bedrooms of residential accommodation. This suggests:

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB(A) $L_{Aeq, 16\ hr}$	-
Dining	Dining room/Area	40 dB(A) $L_{Aeq, 16\ hr}$	-
Sleeping	Bedroom	35 dB(A) $L_{Aeq, 16\ hr}$	30 dB(A) $L_{Aeq, 8\ hr}$

Table 4.2 - BS8233 Indoor Guideline Values

4.4.2 It is usually considered that an open window will provide a reduction of some 10-15 dB(A)[2]. Therefore the 'good' internal standards quoted above would broadly equate to the following targets immediately outside the buildings:

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	48 dB(A) $L_{Aeq, 16\ hr}$	-
Dining	Dining room/Area	53 dB(A) $L_{Aeq, 16\ hr}$	-
Sleeping	Bedroom	48 dB(A) $L_{Aeq, 16\ hr}$	43 dB(A) $L_{Aeq, 8\ hr}$

Table 4.3 - BS8233 Derived Facade Guideline Values

4.4.3 BS8233 recognises that, 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 conditions will be achieved.

4.4.4 It should be noted that the levels quoted in BS8233 are intended to reflect the acceptability of steady, continuous noise. Sources of intermittent and tonal noise may generate greater annoyance for a similar overall magnitude. Whilst BS8233 does not explicitly state a correction for those circumstances, it may be appropriate to consider that the Good and Reasonable standards would be achieved with levels which are perhaps 5 dB lower than stated in the table above.

4.4.5 It is also noted that BS8233 was written from a view of designing new buildings to protect occupants from existing noise sources. This does necessarily infer, however, that the acceptability of an occupant to an absolute level noise within a building will be different if the introduction of the noise source post-dates the construction of the building.

[2] Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)

4.5 World Health Organisation Guidelines

4.5.1 Further advice is provided in the 1999 WHO report "Guidelines for Community Noise".

4.5.2 This indicates that the steady noise level in external amenity areas, such as gardens or outdoor living areas should not exceed 55 dB(A) $L_{Aeq,\ t}$, and should preferably be designed below 50 dB(A) $L_{Aeq,\ t}$.

4.5.3 The document also provides guidance on the impact of peak noise levels on sleeping conditions. This suggests that levels above 45 dB(A) L_{Amax} inside a bedroom would be disturbing to sleep. With windows open, this would equate to a level of approximately 58 dB(A) L_{Amax} externally.

4.6 Approved Document F Ventilation

4.6.1 Approved Document F of the Building Regulations (2010 edition, including all revisions) sets out the requirements for ventilation in dwellings. ADF describes three types of ventilation, summarised in the table below:

Type of Ventilation	Definition in ADF	Location/reason for ventilation	Required
Whole Dwelling Ventilation[3]	Whole building ventilation (general ventilation is normally continuous ventilation of rooms or spaces at a relatively low rate to dilute and remove pollutants and water vapour not removed by operation of extract ventilation, purge ventilation or infiltration, as well as supplying outdoor air into the building. For an individual dwelling this is referred to as 'whole dwelling ventilation.'	To provide fresh air to the building and to dilute and disperse residual water vapour not dealt with by extract ventilation as well as removing other pollutants which are released throughout the building	Continuously
Extract Ventilation	Extract ventilation is the removal of air directly from a space or spaces to the outside. Extract ventilation may be provided by natural means, e.g., by passive stack ventilation) or by mechanical means (e.g., by an extract fan or central system)	From rooms where most water vapour and/or pollutants are released, e.g., due to activities such as cooking or bathing. This is to minimise their spread to the rest of the building	Continuously or intermittently
Purge Ventilation	Purge ventilation is manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollution and/or water vapour. Purge ventilation may be provided by natural means (e.g., an openable window) or by a mechanical means (e.g., a fan)	Throughout the building to aid the removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating, or accidental released such as smoke from burnt food or spillage of water	Occasionally

Table 4.4 – ADF Types of Ventilation

4.6.2 Critically, ADF states:

> *Ventilation may also provide a means to control thermal comfort, but this is not controlled under the Building Regulations.*

[3] Not to be confused with 'background ventilation. ADF defines the term 'background ventilator' as a trickle vent.

4.6.3 It is important to differentiate between the need to provide 'purge ventilation' as required occasionally under ADF, against the provision of ventilation to help control overheating, which is not covered by the Building Regulations.

4.6.4 There are four types of ventilation described in ADF, as set out in the table below:

Ventilation System	Provision with ADF System / Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 1: Background ventilation and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
System 2: Passive Stack ("natural")	Background ventilators (trickle vents) and passive stack ventilation	Continuous via passive stack	Typically provided by opening windows
System 3: Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate. Trickle vents to provide inlet air	Continuous mechanical extract – minimum high rates. Trickle vents to provide inlet air	Typically provided by opening windows
System 4: Continuous mechanical supply and extract with heat recovery (MVHR)	Continuous mechanical supply and extract – minimum low rate	Continuous mechanical supply and extract – minimum high rate	Typically provided by opening windows

Table 4.5 – ADF Template Systems

4.6.5 With regard to the provision of purge ventilation within habitable rooms, the approved document notes:

> *There may be practical difficulties in achieving this (e.g., if unable to open a window due to excessive noise from outside)*

4.6.5 However, no objective guidance is provided in the Document to quantify an 'excessive' level of noise.

4.7 Approved Document O – Overheating (2021)

4.7.1 Approved Document O Overheating describes the means by which designers can protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

4.7.2 The scope of the Document applies to residential dwellings and institutions, and includes the following building types:

Title	Purpose for which the building is intended to be used
Residential (dwellings)	Dwellings, which includes both dwellinghouses and flats.
Residential (institutional)	Home, school or other similar establishment, where people sleep on the premises. The building may be living accommodation for the care or maintenance of any of the following. a. Older and disabled people, due to illness or other physical or mental condition. b. People under the age of 5 years.
Residential (other)	Residential college, hall of residence and other student accommodation, and living accommodation for children aged 5 years and older.

Table 4.6 – ADO Scope

4.7.3 In respect of the acoustic implications, the Document considers the acceptable limits for noise within bedrooms at night. This applies when the method of overheating control is active – whether that be an open window, passive vent or mechanical system. The noise limits are summarised below:

Noise

3.2 *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).*

3.3 *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).

3.4 *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. 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).*

4.7.4 Should an analysis of the external noise levels (for open windows/vents) indicate that these values will be exceeded, an alternative strategy should be adopted.

4.8 IOA/ANC Acoustics Ventilation and Overheating – Residential Design Guide

4.8.1 The Institute of Acoustic and Association of Noise Consultants have published the 'Acoustics Ventilation and Overheating – Residential Design Guide' (January 2020) to promote best practice in the design of residential buildings to control overheating in areas of high ambient noise.

4.8.2 When providing design targets inside the dwellings, the AVOG document advises that the internal noise standard of BS8233:2014 (as copied here in Table 5.1) should be achieved when providing adequate ventilation as defined in ADF. However, the document continues to propose that 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.

4.8.3 This proposition is based on the fact that overheating will occur for only part of the time, during which there will be a trade-off between acoustic and thermal conditions, given that residents would have some control over their environment (a principle well established in the field of thermal comfort).

4.8.4 The guide indicates that the sound level difference across a façade, with standard opening windows, would be 13 dB(A), but that this figure may be greater if windows are shielded by balconies.

4.8.5 BS8233:2014 states that, if internal noise levels are no more than 5 dB greater than the levels shown here in Table 4.2, this would be a 'reasonable' standard. Therefore, if external noise levels do not exceed the following values when windows are open, conditions should be considered wholly acceptable, and therefore the threshold between No and Low Observed Adverse Effect Levels:

Location	0700 - 2300	2300 - 0700
Living Room	53 dB(A) LAeq, 16 hr	-
Bedrooms	53 dB(A) LAeq, 16 hr	48 dB(A) LAeq, 8 hr

Table 4.6 – Proposed LOAEL Façade Noise Levels with Windows Open

4.8.6 To consider the upper limit, beyond which internal conditions should not be deemed acceptable, reference is made to issue of speech interference. With reference to the numerical values in BS8233 (see Table 4.6 above), the AVOG document adopts an internal daytime limit of 50 dB(A), which would then equate to an external limit of 63 dB(A) when windows are open.

4.8.7 At night, reference is made to the WHO Night Noise Guidelines, which developed the original WHO Guidelines for Community Noise report. This states that if external noise levels exceed

55 dB(A) L_{Aeq}, 'adverse health effects occur frequency and a sizeable proportion of the population is highly annoyed and sleep disturbed'.

4.8.8 The table below therefore may be taken to represent the threshold for SOAEL:

Location	0700 - 2300	2300 - 0700
Living Room	63 dB(A) LAeq, 16 hr	-
Bedrooms	63 dB(A) LAeq, 16 hr	55 dB(A) LAeq, 8 hr

Table 4.7 – Proposed SOAEL Threshold Façade Noise Levels with Windows Open

4.9 BS 6472:2008 Evaluation of Human Exposure to Vibration in Buildings (1 – 80 Hz)

4.9.1 Human response to vibration may be determined by a number of factors, including:

(i) The physical condition and mental disposition of the person experiencing the vibration;
(ii) The characteristics of the vibration (the frequency, direction, and whether it is continuous or intermittent;
(iii) Any noise which is re-radiated from the structural vibration;
(iv) The duration of the vibration and the time of the day;
(v) The nature of the existing environment, in the absence of the vibration;

4.9.2 Guidance on the acceptability of vibration levels can be found in a number of sources. For continuous exposure to vibration, BS 6742:2008 "Evaluation of Human Exposure to Vibration in Buildings (1 - 80 Hz)" provides limiting criteria for acceptable levels of vibration in different building types.

4.9.3 This defines the Vibration Dose Value of a vibration event, a quantity which may be used to estimate the probability of adverse comment from human beings experiencing vibration in buildings.

4.9.4 The Standard advises that:

> *"In homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception. In workplaces, adverse comment often arises at rather higher levels, although people in sedentary occupations respond more like home residents."*

4.9.5 The evaluation includes measurements of the frequency-weighted rms acceleration in each orthogonal axis (foot to head, back to front, side to side). The assessment of perceptibility of vibration is made with respect to the highest weighted value determined in any axis at the point of contact, at any time.

4.9.6 BS6472 confirms that human perception does depend on the vibration frequency and direction. It therefore offers a series of frequency weightings which should be applied to vibration, so that the resulting overall levels can be interpreted in terms of perception, comfort or adverse comments. In this instance, the Standard advises that Wb frequency weighting should be applied to the z-axis (foot to head) component of vibration, and that the Wd frequency weighting should be applied to the x and y planes (back-to-chest and side-to-side, respectively).

4.9.7 The range of frequencies usually associated with the effects of whole-body vibration is between 0.5 Hz and 80 Hz.

4.9.8 The Vibration Dose Value may then be calculated as the product of the weighted rms acceleration and the duration of the event over a standard 16hr daytime period (07.00 – 23.00hrs) and 8hr night-time period (23.00 – 07.00hrs). Where there are a number of different events producing the vibration (as here), of varying duration and vibration level, the Standard provides a means of combining the individual Dose Values to provide an overall VDV for the period.

4.9.9 BS6472 defines values of Vibration Dose Values above which various degrees of adverse comment may be expected in residential buildings. These limits are confirmed below:

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings 16hr Daytime	0.2 – 0.4 $m/s^{1.75}$	0.4 – 0.8 $m/s^{1.75}$	0.8 – 1.6 $m/s^{1.75}$
Residential Buildings 8hr Night-time	0.1 – 0.2 $m/s^{1.75}$	0.2 – 0.4 $m/s^{1.75}$	0.4 – 0.8 $m/s^{1.75}$
Offices 16hr Day Time	0.4 – 0.8 $m/s^{1.75}$	0.8 – 1.6 $m/s^{1.75}$	1.6 – 3.2 $m/s^{1.75}$

Table 4.8 – BS6472 Guideline Thresholds

5. RECOMMENDATIONS FOR NOISE ATTENUATION MEASURES

External Façade Construction

5.1 Section 4.4.1 of this report has provided guidance for internal noise levels within residential rooms as stated within BS8233.

5.2 It is therefore recommended that all residential dwellings be designed to achieve the following levels:

Living Rooms: 35 dB(A) $L_{Aeq,\ 07.00 – 23.00}$

Bedrooms: 30 dB(A) $L_{Aeq,\ 23.00 – 07.00}$, and also
45 dB(A) $L_{Amax,\ 23.00 – 07.00}$

5.3 Table 5.1 below defines the predicted external façade noise levels, dB(A) and overall performance targets required through each façade of the buildings. These figures are based initially on the targets of Para 5.2, the measured noise levels given in Para 3. Noise levels have been adjusted, allowing for the difference in distance between the measurement location and facades of the buildings.

Elevation	External Façade Noise Level	Target Noise Level	Outside to Inside Level Difference
Unit 1			
Living Room	59 dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	24 dB(A)
Bedroom 1	55 dB(A) $L_{Aeq,\ 8hrs}$ 76 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) $L_{Amax,fast}$	31 dB(A)
Bedroom 2	40 dB(A) $L_{Aeq,\ 8hrs}$ 61 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) $L_{Amax,fast}$	16 dB(A)
Bedroom 3	55 dB(A) $L_{Aeq,\ 8hrs}$ 76 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) $L_{Amax,fast}$	31 dB(A)
Unit 2			
Living Room	59 dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	24 dB(A)
Bedrooms 1 – 3	55 dB(A) $L_{Aeq,\ 8hrs}$ 76 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) $L_{Amax,fast}$	31 dB(A)

Table 5.1 – Predicted Facade Noise Levels

5.4 Unit 1 is a L-shaped pitched roof byre constructed in red brick. The long-sides were originally open, but have been in-filled with a variety of cement rendered blockwork and brickwork panels. The roof comprises overlapping clay tiles.

5.5 Barn 2 is a steel-framed rectangular pitched roof building. The roof comprises corrugated fibre cement sheets on steel angle purlins. The central bay is open on the west side, but elsewhere cement-rendered blockwork walls span between the stanchions, sometimes with a ventilation slot up to eaves filled with spaced, vertical timber planks.

5.6 It is assumed that walls will be refurbished to the following minimum construction:

- Block work, brick or concrete panels
- Notional 100mm partially insulated cavity
- Inner leaf of insulated timber frame (faced with 1 sheet of plasterboard) or masonry

5.7 The existing roofs of each building will be retained, and it will be assumed that the structural void between the rafters/purlins will be filled with thermal insulation. The underside of the structure will be lined with 15mm standard plasterboard, fixed directly to the structure.

5.8 Table 5.2 below confirms the minimum glazing requirement in each location, based on the facade constructions, and the objective performance associated with each glazing type. Appendix I provides detailed calculations for each of the glazing types:

	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							Possible Configuration
	63	125	250	500	1K	2K	4K	
Unit 1, Bedrooms 1 & 2 Unit 2, Bedrooms 1, 2 & 3	30	27	28	39	44	41	56	6.8 / 12 / 8.8
Units 1 & 2, Living Rooms Unit 1 Bedroom 3	13	23	18	26	38	44	38	4 / 16 / 4

Table 5.2 – Possible Glazing Configurations

5.9 In overall terms, the two glazing configurations equate to 39 dB Rw and 31 dB Rw, respectively.

5.10 Appendix 1 provides calculations to substantiate the overall performance of the recommended façade constructions.

Ventilation

5.11 Approved Document O sets out the statutory requirements for dealing with issues of overheating in new buildings, but this does not apply to converted properties.

5.12 Guidance could therefore be drawn from the IoA/ANC guidelines of acoustics and overheating (ref Section 4.8) offers wider advice on the means of ventilating buildings, whilst protecting acoustic amenity. For example, the document includes the question of day time interference as well.

5.13 Whilst not a statutory requirement, the document suggests that mechanical ventilation options should be considered if the external façade noise levels at a building exceed:

Living Rooms	53 dB(A) $L_{Aeq,\ 0700\ -\ 2300}$
Bedrooms	48 dB(A) $L_{Aeq,\ 2300\ –\ 0700}$
Bedrooms	63 dB(A) $L_{Amax,\ 2300\ -\ 0700}$

5.14 With the exception of Unit 1 Bedroom 2, these limits are likely to be exceeded. For the highest standard of design, therefore, consideration could be given to a mechanical solution (e.g. MVHR units serving the whole dwelling, or Mechanical Extract Systems coupled to acoustic trickle vents serving individual rooms).

5.15 Where trickle vents are to be used, the following performance should be procured:

Unit / Room	Trickle Vent Performance, $D_{n,e,w}$
Unit 1, Bedrooms 1 & 3 Unit 2, Bedrooms 1, 2 & 3	Min. 42 dB
Units 1 & 2, Living Rooms Unit 1 Bedroom 2	Min. 32dB

Table 5.3 – Trickle Vent Performance Targets

5.16 If mechanical solutions were to be adopted here, it would be necessary to analyse fan noise during both background and boost rates of ventilation, to ensure that the cumulative level from road traffic and fans does not exceed the internal targets of Para. 5.2.

EXTERNAL AMENITY SPACE

5.17 The World Health Organisation indicates that, to protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}.

5.18 The Proposed Site Plan (Figure 2) indicates primate amenity space in the courtyard between the two buildings. The predicted noise levels here will vary from 54 dB(A) to 56 dB(A) $L_{Aeq,\ 16\ hrs}$, from the north to south of the courtyard.

5.19 In theory, it would be possible to erect a 1.8m high close boarded timber fence along the south boundary of the courtyard, and this would reduce noise levels behind, comfortably below the 55 dB(A) threshold throughout.

5.20 However, in the context that the noise climate is determined by very low levels of noise punctuated by short periods of raised noise as the trains pass (perhaps 5 times per hour), it is questionable whether the marginal acoustic excess across part of the courtyard at present would justify the loss of visual amenity to the south, resulting from a full-width barrier.

6. ASSESSMENT OF VIBRATION LEVELS

6.1 As discussed in Para 4.7, guidance on the acceptability of vibration levels can be found in BS 6742 "Evaluation of Human Exposure to Vibration in Buildings (1 - 80 Hz)" which provides limiting criteria for acceptable levels of vibration in different building types.

6.2 Paragraph 3.14 confirms the measured vibration levels on a concrete slab within the easterly barn (to become Unit 2).

6.3 When considering the residual vibration within the new houses, however, there are a number of additional factors which could in theory affect the residual values there.

6.4 Firstly, there may be a distance correction. Vibration broadly dissipates as an inverse square law. Therefore, for a doubling of distance, there is a 6 dB reduction in amplitude.

6.5 Thereafter, there are a series of transfer functions which would be applied to the vibration as it moves from the ground, into a building foundation and then up through a building.

6.6 If upper floors are involved, two corrections should be applied – one for the loss as the vibration moves up the building frame, and one potential increase for resonance which may occur in the suspended floor structure.

6.7 If the ground floor slab were suspended, rather than a raft, there would also be a potential increase for resonance there.

6.8 Having sampled levels on the concrete foundation slab of the single-storey building to be converted, it may be assumed that vibration across the ground floor of the two barns would as directly measured.

6.9 On that basis, the predicted vibration does within the rooms of the two properties would be as follows:

Floor	Vibration Dose Value, Z-Axis, $m/s^{1.75}$	
	Day Time	Night Time
Unit 1 & 2	0.04	0.02
BS6472 Threshold for 'Low Probability of Complaint'	*0.2 – 0.4*	*0.1 – 0.2*

Table 6.1 – Predicted Floor Vibration within Dwellings

6.10 A comparison of the predicted levels against the criteria of BS6472indicates that the measured levels of ground borne vibration are significantly less than that which would be required to give a low probability of complaint.

6.11 It is therefore concluded that no remediation is required to address ground borne vibration.

7. CONCLUSION

7.1 The foregoing assessment has looked at the levels of ambient noise and vibration affecting the site on Hudds Mill Farm.

7.2 It has been concluded that, by specifying appropriate glazing to the habitable rooms and upgrading the external wall and roof construction, it will be possible to ensure that an acceptable internal environment within the proposed buildings will be met.

7.3 With respect to ventilation, a minimum acoustic performance has been provided for trickle ventilators. It has been shown that, if windows are open, the internal levels would rise to a level above the best practice guidelines currently in use (noting that Approved Document O does not apply). Consideration could therefore be given to the provision of supplementary mechanical ventilation if preferred.

7.4 It has been shown that noise levels within the amenity areas will meet the WHO's guideline figure of 55 dB L_{Aeq}, across much of the proposed courtyard garden. It is suggested that, within the context of the local noise climate (long periods of quiet punctuated by occasional raised noise due to the passing of a train), no further mitigation is warranted.

7.5 Criteria has been provided for structure borne vibration affecting the site, and results have confirmed that the measured vibration dose values are acceptable in both buildings.

FIGURE 1 – SITE LOCATION

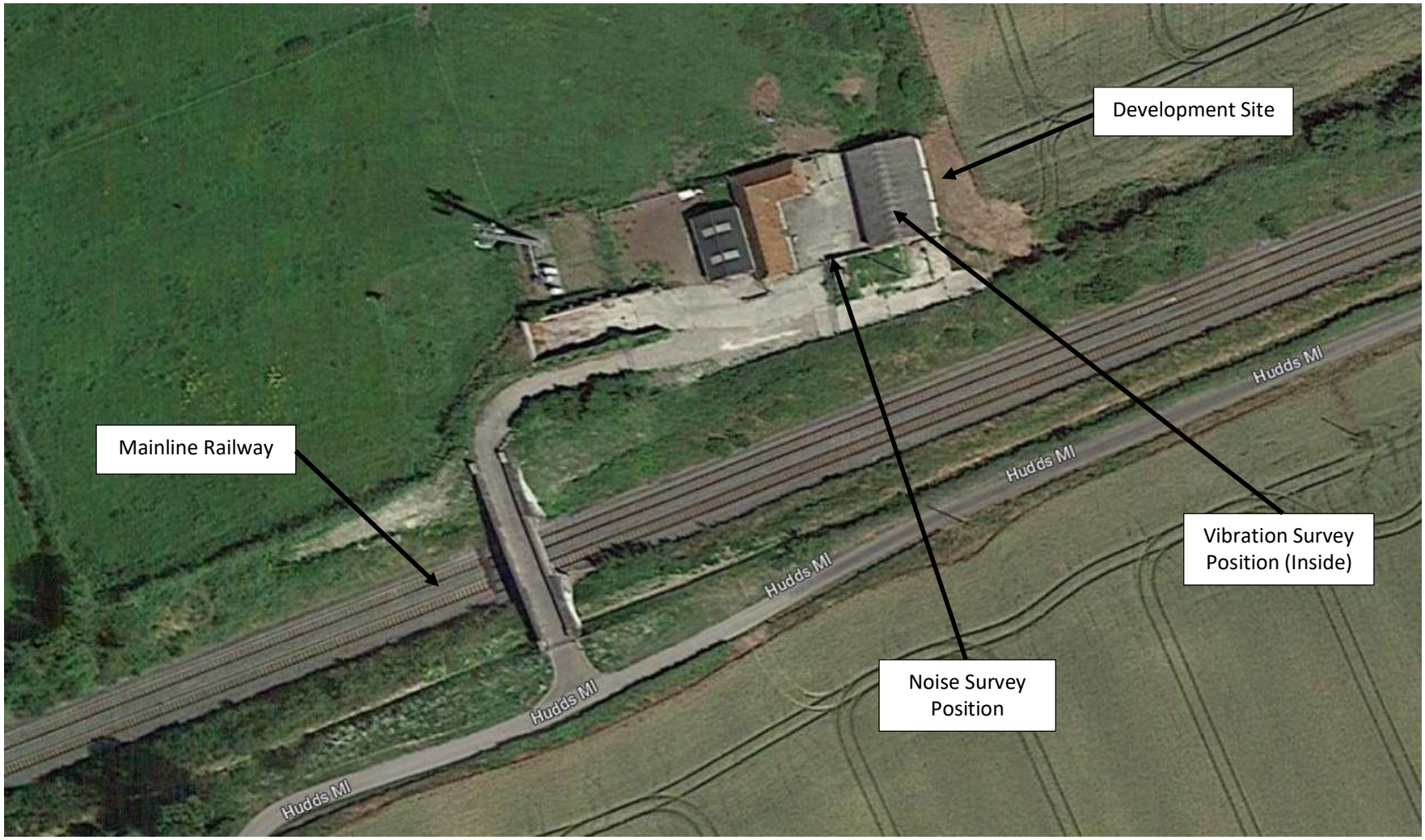
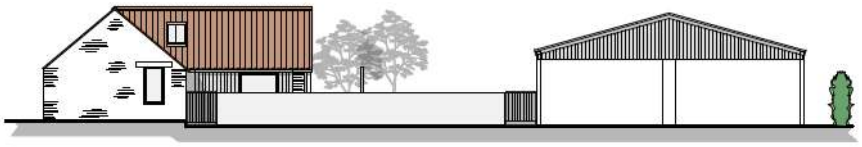
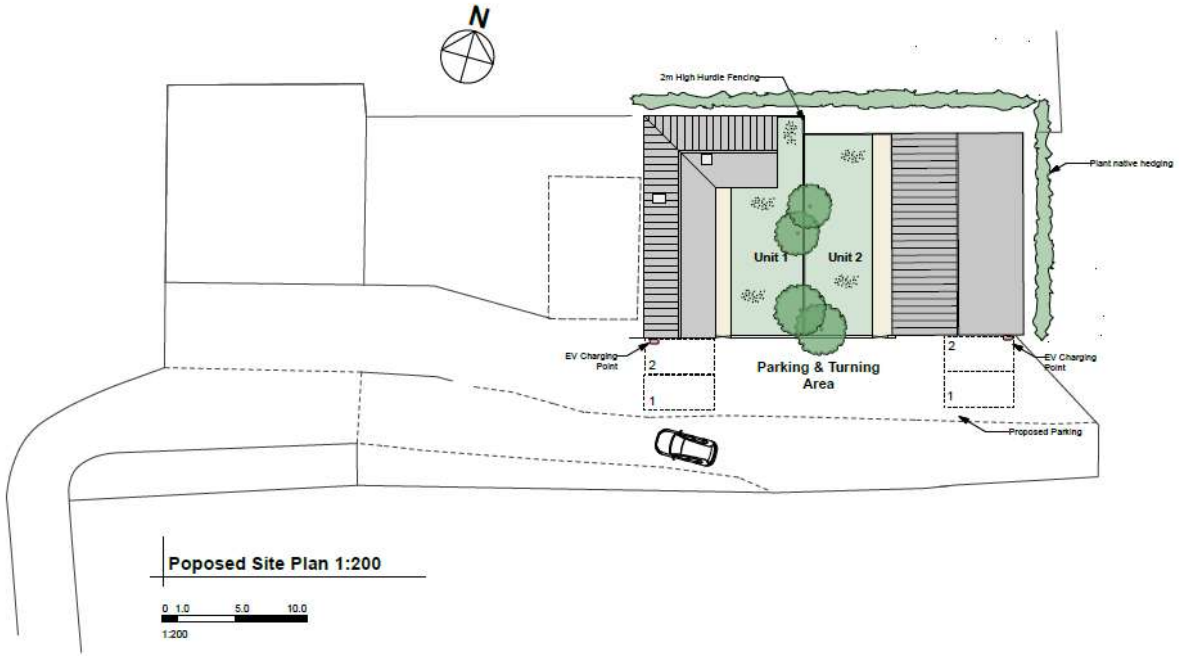


FIGURE 2 – PROPOSED SITE PLAN



South Elevation 1:100

0 .5 1.0 2.0 3.0 4.0 5.0
1:100



Poposed Site Plan 1:200

0 1.0 5.0 10.0
1:200

Job Title
Proposed Barn Conversion
Hudds Mill Farm
Hudds Mill Lane
Edington

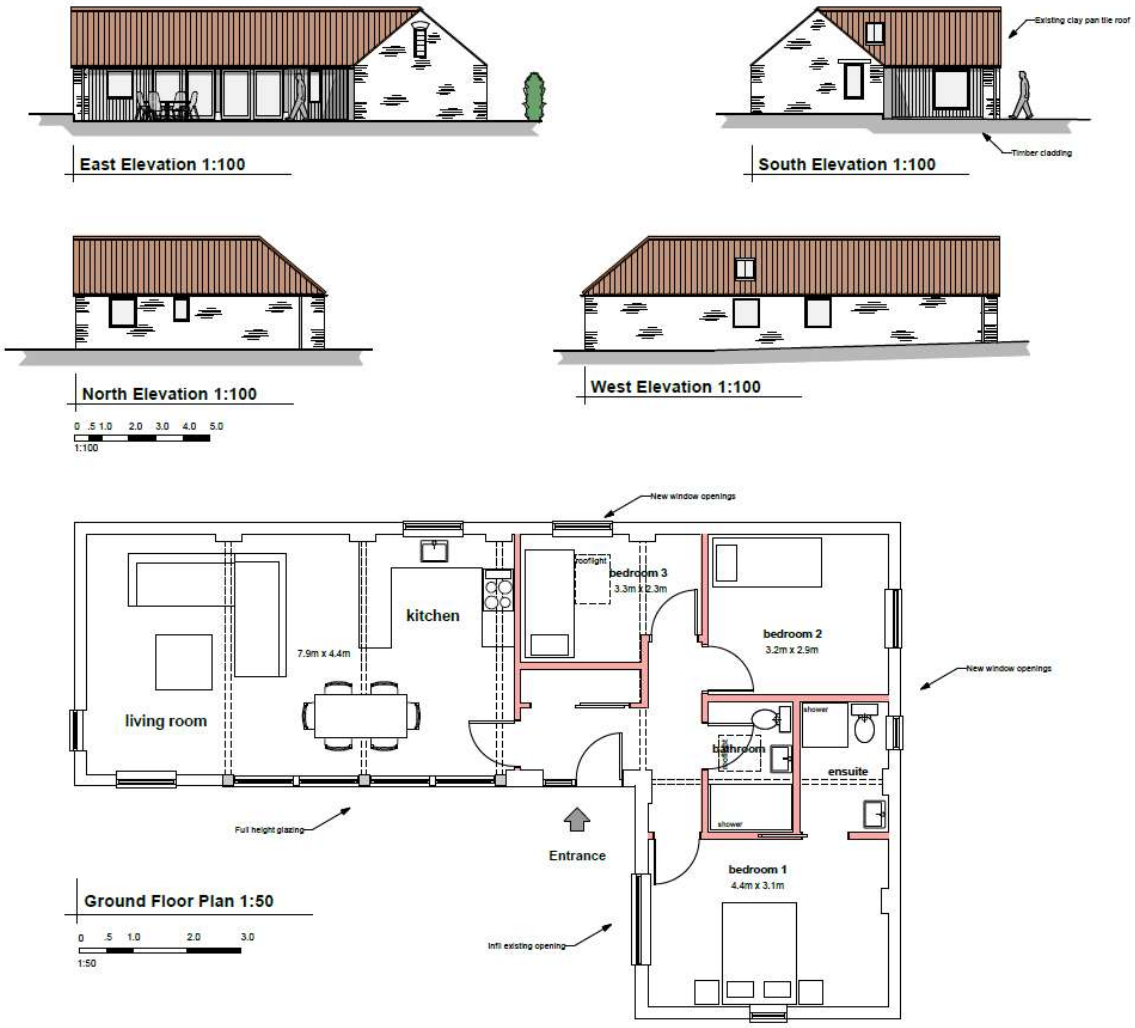
Drawing Title
Proposed Site Floor Plan and Elevation

Peter Withey
Architectural Designer
123 Clay Street Crockerton
Warminster Wiltshire BA12 8AG
Tele 01985 841111 e-mail witheydesign@btconnect.com

Scale 1:200 1:100 @ A2 Date: May 2023

Drawing No 1170/6

FIGURE 3 – PROPOSED FLOOR PLAN, UNIT 1



Job Title
Proposed Barn Conversion
Hudds Mill Farm
Hudds Mill Lane
Edington

Drawing Title
Proposed Floor Plans And Elevations Unit 1

Peter Withey
Architectural Designer
123 Clay Street Crookerton
Warminster Wiltshire BA12 8AG
Tele 01985 841111 e-mail withydesign@btconnect.com

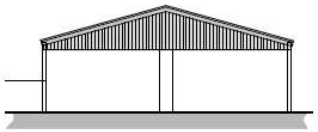
Scale 1:50 1:100@A2 Date: May 2023

Drawing No 1170/4

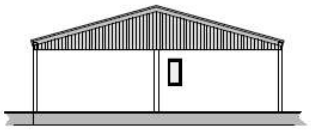
FIGURE 4 – PROPOSED FLOOR PLAN, UNIT 2



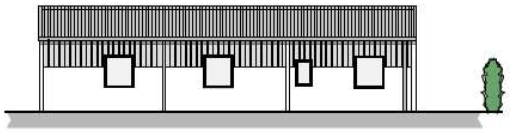
West Elevation 1:100



South Elevation 1:100

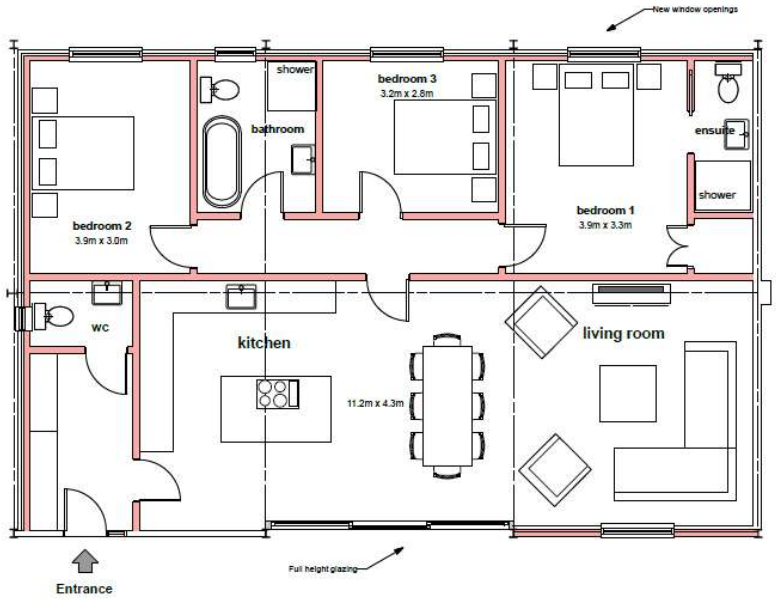


North Elevation 1:100



East Elevation 1:100

0 .5 1.0 2.0 3.0 4.0 5.0
1:100



Ground Floor Plan 1:50

0 .5 1.0 2.0 3.0
1:50

Job Title
Proposed Barn Conversion
Hudds Mill Farm
Hudds Mill Lane
Edington

Drawing Title
Proposed Floor Plans
And Elevations Unit 2

Peter Withey
Architectural Designer
123 Clay Street Crookerton
Warminster Wiltshire BA12 8AG
Tele 01985 841111 e-mail witheydesign@btconnect.com

Scale 1:50 1:100@A2 Date: May 2023

Drawing No 1170/ 5

FIGURE 5 – VARIATION OF MEASURED NOISE LEVELS

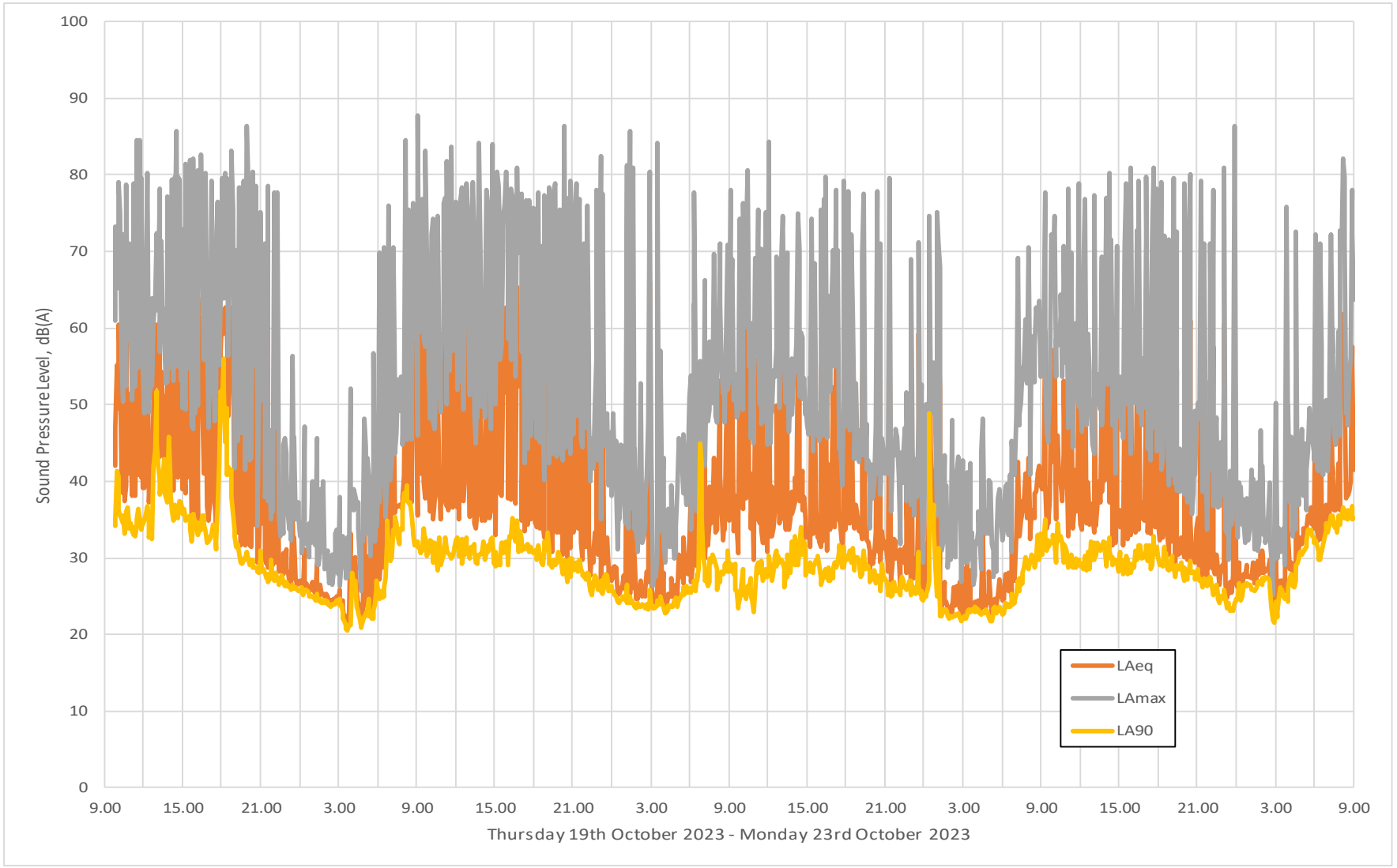
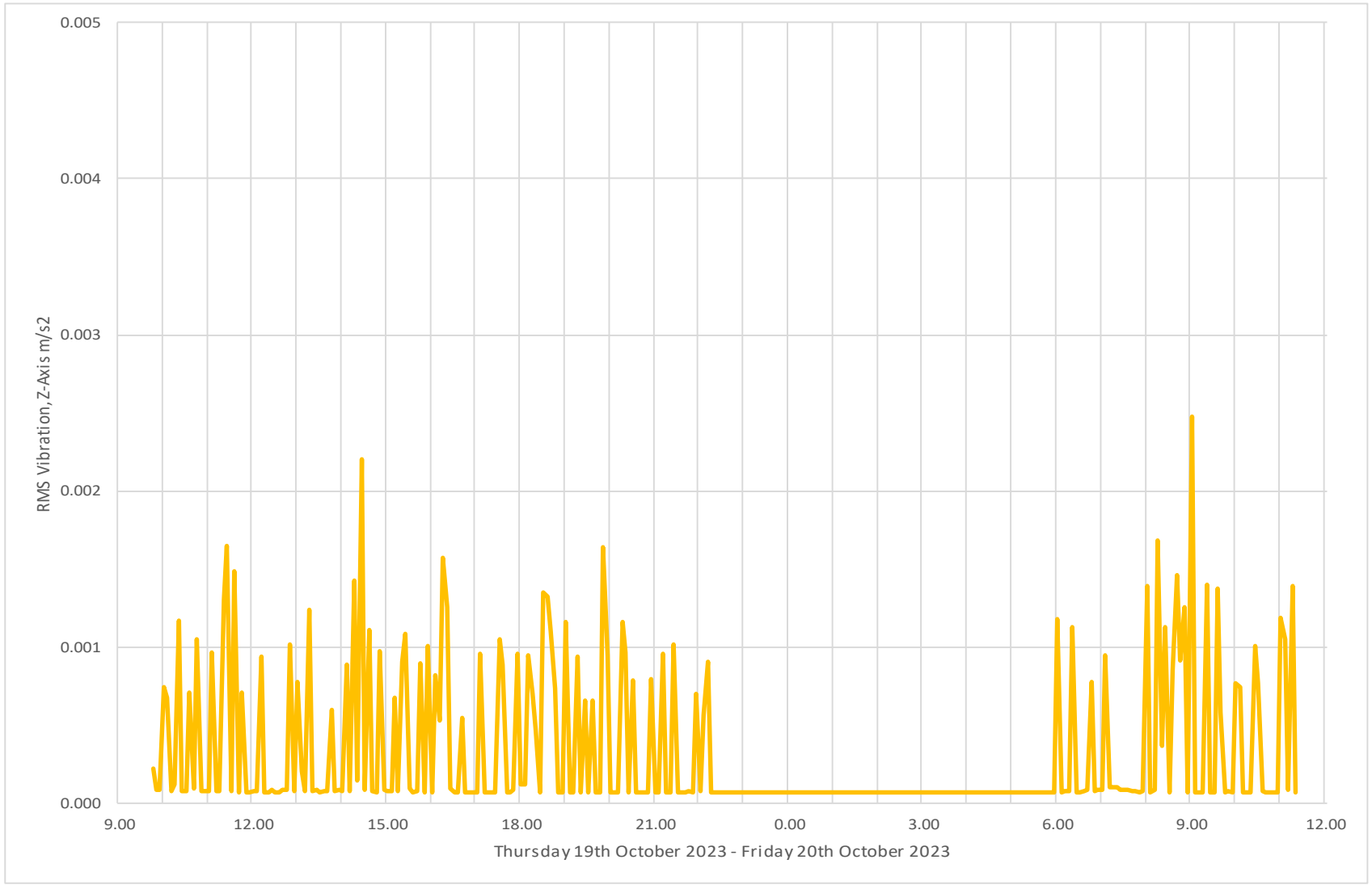


FIGURE 6 – VARIATION OF MEASURED VIBRATION LEVELS



APPENDIX I – OUTSIDE TO INSIDE CALCULATIONS

Frequency Units 1 & 2 Living Rooms	Hz	63	125	250	500	1K	2K	4K	8K	dB(A)
Façade Level, LAeq, 16hr	**dB**	59	53	50	52	54	54	47	37	**59**
SRI Glazing, 4/16/4, 31 Rw	dB	-21	-21	-18	-26	-37	-42	-33	-35	
Area Correction, 10m2	dB	10	10	10	10	10	10	10	10	
Room Volume	m3	84	84	84	84	84	84	84	84	
Acoustic Absorption to 0.5s RT	m2	27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14	-14	-14	-14	-14	-14	-14	-14	
Net SPL	dB	34	28	28	22	13	8	10	-2	**23**
SRI External Wall, masonry outer, 45 dB Rw	dB	-36	-42	-41	-43	-53	-64	-65	-65	
Area Correction, 15m2	dB	12	12	12	12	12	12	12	12	
Room Volume	m3	84	84	84	84	84	84	84	84	
Acoustic Absorption to 0.5s RT	m2	27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14	-14	-14	-14	-14	-14	-14	-14	
Net SPL	dB	20	8	6	6	-2	-13	-21	-31	**6**
SRI Roof	dB	-12	-25	-40	-46	-52	-53	-53	-57	
Area Correction, 35m2	dB	15	15	15	15	15	15	15	15	
Room Volume	m3	84	84	84	84	84	84	84	84	
Acoustic Absorption to 0.5s RT	m2	27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14	-14	-14	-14	-14	-14	-14	-14	
Net SPL	dB	48	29	11	7	3	2	-5	-19	**23**
Dnew of trickle ventilator, 32 dB Dn,e,w	dB	-40	-39	-35	-35	-31	-32	-35	-40	
Acoustic Absorption in room	m2	27	27	27	27	27	27	27	27	
Aborption Correction to ref 10m2	dB	-4	-4	-4	-4	-4	-4	-4	-4	
Net SPL	dB	15	10	11	13	19	18	8	-7	**22**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Combined SPL	**dB**	51	35	31	25	23	21	15	2	**31**

Frequency Units 1 Bedroms 1 & 3, Unit 2 Bedrooms 1 - 3	Hz	63	125	250	500	1K	2K	4K	8K	dB(A)
Typical night Time Façade Level, LAmax	**dB**	86	74	75	74	71	67	61	52	**76**
	dB	-30	-27	-28	-39	-44	-41	-56	-60	
Area Correction, 3m2	dB	5	5	5	5	5	5	5	5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	51	42	42	30	22	21	0	-13	**35**
SRI Roof, 35 dB Rw	dB	-24	-34	-40	-45	-49	-53	-55	-55	
Area Correction, 12m2	dB	11	11	11	11	11	11	11	11	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	63	41	36	30	23	15	7	-2	**38**
SRI External Wall, masonry outer	dB	-36	-42	-41	-43	-53	-64	-65	-65	
Area Correction, 20m2	dB	13	13	13	13	13	13	13	13	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	53	35	37	34	21	6	-1	-10	**34**
Dnew of trickle ventilator, 42 dB Dn,e,w	dB	-40	-41	-42	-37	-43	-46	-40	-40	
Acoustic Absorption in room	m2	10	10	10	10	10	10	10	10	
Aborption Correction to ref 10m2	dB	0	0	0	0	0	0	0	0	
Net SPL	dB	46	33	33	37	28	21	21	12	**36**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Combined SPL	**dB**	67	48	47	43	34	28	24	15	**45**
Frequency Units 1 Bedrom 2	Hz	63	125	250	500	1K	2K	4K	8K	dB(A)
Typical night Time Façade Level, LAmax	**dB**	71	59	60	59	56	52	46	37	**61**
SRI Glazing, 4/16/4, 31 Rw	dB	-21	-21	-18	-26	-37	-42	-33	-35	
Area Correction, 3m2	dB	5	5	5	5	5	5	5	5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	45	33	37	28	14	5	8	-3	**30**
SRI Roof, 35 dB Rw	dB	-24	-34	-40	-45	-49	-53	-55	-55	
Area Correction, 12m2	dB	11	11	11	11	11	11	11	11	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	48	26	21	15	8	0	-8	-17	**23**
SRI External Wall, masonry outer	dB	-36	-42	-41	-43	-53	-64	-65	-65	
Area Correction, 20m2	dB	13	13	13	13	13	13	13	13	
Room Volume	m3	30	30	30	30	30	30	30	30	
Acoustic Absorption to 0.5s RT	m2	10	10	10	10	10	10	10	10	
Absorption Correction	dB	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL	dB	38	20	22	19	6	-9	-16	-25	**19**
Dnew of trickle ventilator, 32 dB Dn,e,w	dB	-40	-39	-35	-35	-31	-32	-35	-40	
Acoustic Absorption in room	m2	10	10	10	10	10	10	10	10	
Aborption Correction to ref 10m2	dB	0	0	0	0	0	0	0	0	
Net SPL	dB	31	20	25	24	25	20	11	-3	**28**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Combined SPL	**dB**	53	37	40	33	29	23	16	3	**36**

APPENDIX II - TERMINOLOGY RELATING TO NOISE

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
Leq,T	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
Lmax,T	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L90,T	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade Noise Level	At a distance of 1m in front of a large sound reflecting object such as a façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	Range of frequencies whose upper limit is twice the lower limit.
DnT,w	The single number quantity that characterises airborne sound insulation between rooms over a range of frequencies.
Rw	Single number quantity that characterises the airborne sound insulating properties of a material or building element over a range of frequencies.