Residential Noise Assessment

Site Address: Yew Tree Farm, The Village, Farnley Tyas, Huddersfield, HD4 6UQ

Client Name: Orange Design Studio Ltd

Project Reference No: NP-010805

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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 Yew Tree Farm, The Village, Farnley Tyas, Huddersfield, HD4 6UQ ('the Site'). The site is subject to noise from the surrounding road network, minor entertainment noise from "The Golden Cock" public huse and an electrical substation located to the western boundary of the site.

The applicant has received conditional approval for planning application No.2021/62/93006/E ('the Application') from Kirklees Council. This report has been prepared to discharge condition 8 imposed on the application by the Local Planning Authority ('LPA').

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

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

1.1 Standards, Legislation, Policy & Guidance

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

- The LPAs conditional approval; specifically, Condition 08.
- National Planning Policy Framework (2023).
- Noise Policy Statement for England (2010).
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'.
- Approved Document F: Volume 1 Dwellings (2021).
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide).
- British Standard BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'.

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

1.2 Proposal Brief

The proposal is for the conversion of existing barns into 8 residential dwellings, and the erection of 9 new build dwellings. The figure below shows the proposed development.

Drawing Ref No.ODS_20/294, (20)001 from 'Orange Design Studio'

Figure 1 – Proposed Development Ground Floor Plans

1.3 Local Planning Authority & Background

Condition 8 of the approved planning application requires discharging:

"8. Before construction work commences a report specifying the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development (including the Golden Cock Public House and electricity substation) shall be submitted to and approved in writing by the Local Planning Authority.

The report shall:

- *Determine the existing noise climate;*
- *Predict the noise climate in gardens (daytime), bedrooms (night-time) and other habitable rooms of the development; and*
- *Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required).*

The development shall not be occupied until all works specified in the approved report have been carried out in full and such works shall be thereafter retained.

Reason: To protect the amenity of occupiers of the proposed development from noise or disturbance from nearby noise generating premises to accord with the aims of Policies LP24 and LP52 of the Kirklees Local Plan and Chapters 12 and 15 of the National Planning Policy Framework.

This pre-commencement condition is necessary to ensure noise mitigation measures are devised and agreed at an appropriate stage of the development process."

2. Environmental Noise Survey

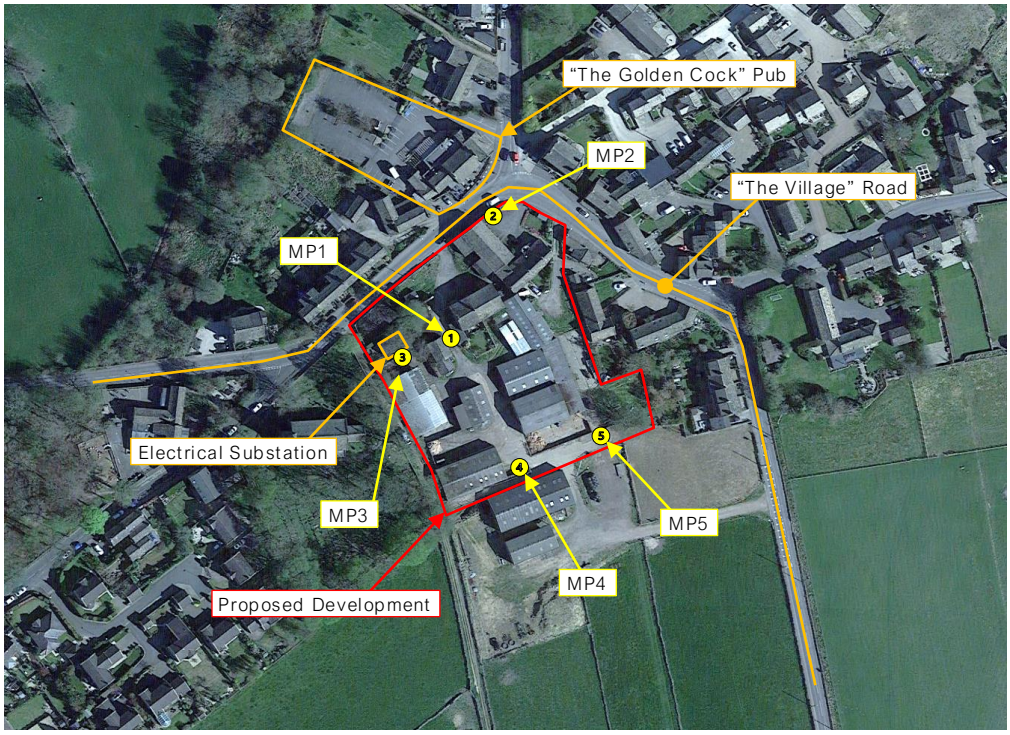
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars. In all instances a 130mm diameter windshield was fitted to the microphones. All sound level meters were field calibrated before and after each set of measurements; negligible drift was noted. The weather conditions and survey equipment register can be found in Appendix D.

Location	Survey Dates	Measurement Particulars
MP1	01-04/03/2024	Equipment mounted on a tripod 1.5m above the ground, towards the centre of the proposed development. A 3 dB façade correction has been applied due to the microphone's proximity to the fabric of the building.
MP2	01-04/03/2024	Equipment mounted on a tripod 3m above the ground overlooking "The Village" road facing "The Golden Cock" pub.
MP3	04/03/2024	Equipment mounted on tripod at 1.5m height adjacent to substation building.
MP4	04/03/2024	Equipment mounted on tripod at 1.5m height adjacent located in amenity area of proposed plot 11.
MP5	04/03/2024	Equipment mounted on tripod at 1.5m height adjacent located in amenity area of proposed plot 10.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



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

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site is located on a disused farm off The Village, Farnley Tyas, Huddersfield HD4 6UD. The area surrounding the site consists primarily of residential dwellings and arable farmland to the south and east.

Situated 20m from the northern boundary of the site is 'The Golden Cock', a public house with a small external patron area at the front which operating between 12:00 – 00:00 hours on Friday & Saturday. According to the pubs social media pages and window advertisement, the Golden Cock hosts live music on occasions. It was also noted that multiple other residential dwellings are situated in closer proximity to the public house that the development site under assessment in this report.

There is also an electrical substation which is located on the western boundary of the proposed development. The noise emissions generated by the substation were not audible over the residual acoustic climate at greater than 1m from the unit.

The acoustic environment is deemed to be low to moderate in level and the noise profile is dominated by road traffic noise emissions from The Village Road.

2.3 Environmental Noise Survey Results

The following section outlines the measured sound levels during the survey. The time history results can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							$L_{Aeq,T}$ (dB)	'Typical' $L_{AFmax,1min}$ (dB)
		63	125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	57	52	48	45	49	43	36	51	--
	$L_{eq,8hr}$ (Night)	46	43	39	35	39	32	26	41	63
MP2	$L_{eq,16hr}$ (Day)	68	63	61	59	61	58	53	65	--
	$L_{eq,8hr}$ (Night)	58	57	54	51	51	47	43	55	77
MP3	$L_{eq,19min}$	58	51	44	43	43	38	38	47	--
MP4	$L_{eq,15min}$	52	46	42	38	37	35	31	42	--
MP5	$L_{eq,16min}$	55	47	40	36	40	40	40	46	--

Table 2 – Sound Level Results Summary

3. Noise Impact Assessments

3.1 Low Frequency Entertainment Noise Analysis

Due to the potential for entertainment noise breakout emissions from "The Golden Cock" to adversely impact the future occupant of the proposed development, further analysis has been undertaken.

The following figures outline the low frequency noise survey time histories of MP2. Periods when entertainment noise was present (according to the event timings and venues operational times) have been highlighted in red.

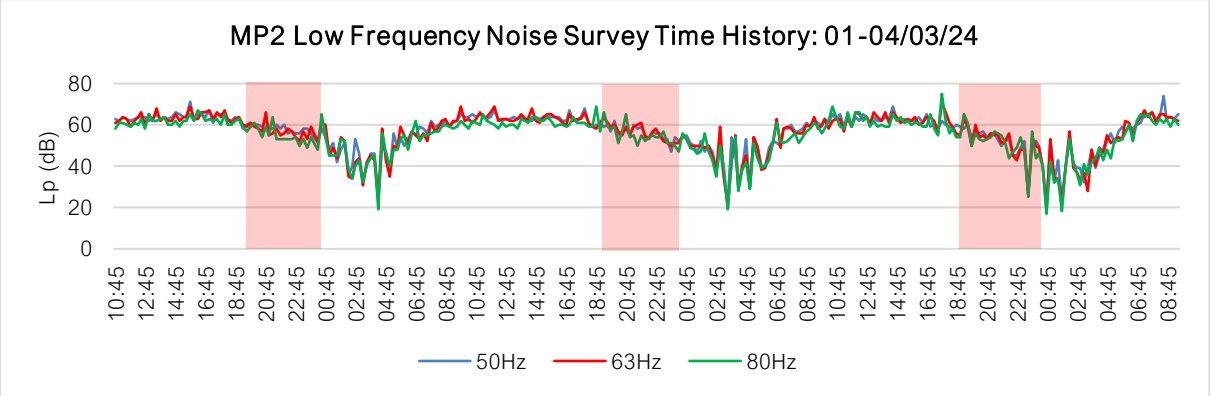


Figure 3 – Low-Frequency Noise Survey Time History – MP2

Based on the low frequency noise survey time history of MP2 above, any entertainment noise breakout emissions from the 'Golden Cock' public house would be unlikely to adversely impact the future occupants of the development. This outcome is based on the absolute level of the low frequency noise and the fact that the noise emissions are reducing in level (from the loudest part of the day) throughout the operational hours of the public house. However, to ensure the residential amenity of the future occupants is fully protected, the specified sound insulation scheme shall consider these periods highlighted above and a more stringent low frequency criteria (the Moorhouse Curve) shall be used.

3.2 Electricity Substation Noise Impact Assessment – BS4142 & NANR45

The subjective impression obtain on-site was that a faint electrical hum from the substation was just perceptible over the residual noise climate at 1m from the unit, and inaudible at plot No. 15.

The ambient sound level measured at MP3 (1m from the unit) and residual sound level measured at MP5 results in a specific sound level in the order of 41 dB $L_{Aeq,T}$. A 4m point source distance correction to the closest façade of plot No. 15 means a specific sound level of 29 dBA. BS4142 comments that where ambient and residual sound levels are within 3 dB of one another, an alternative calculation method should be utilised or, as is the case in this instance, note that there may a degree of uncertainty within the calculation of the specific sound level.

$L_{A90,15min}$ background sound levels measured during the night (23:00 – 07:00 hours) at MP1 are very low; the modal $L_{A90,15min}$ measurement was 14 dB (note that the daytime background sound level is 35 dB $L_{A90,15min}$). Given the absolute level of specific sound calculated at plot No. 15, no acoustic features are thought to be perceptible, thus, a rating sound level of 29 dBA is assumed. This rating sound level would exceed the background sound level by 15 dB, which is in indication of 'significant adverse impact,

dependant on context' in accordance with BS4142. The daytime background sound level would not be exceeded which indicates 'low impact' in accordance with BS4142.

However, BS4142 comments that where background sound levels are particularly low, it is often prudent to consider other criteria from relevant standards, including absolute sound level criteria. The WHO Night Noise Guidelines for Europe comment that external noise levels of less than 40 dBA L_{night} are thought to prevent sleep disturbance considering the attenuation provided by a partially open window. It should be recognised that the specific sound level from the substation is calculated at 11 dB below this criterion and would be inaudible within the dwelling.

1.3 of BS4142:2014 comments that in situations where low-frequency noise is of concern, an assessment of the noise emissions against the NANR45 curve is appropriate.

The table below shows the specific sound levels calculated at the closest façade of plot No. 15 (approximately 4m from the substation). Where a specific sound level could not be calculated due to the difference between the ambient and residual levels, the ambient sound level has been used as a conservative approach.

Description	Octave Frequency Band (Hz, $L_{eq,T}$, dB)												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
MP5 Ambient Sound Level	50	51	53	53	55	58	59	56	53	50	48	44	43
MP3 Residual Sound Level	62	59	57	53	51	50	50	52	51	46	44	41	38
Specific Sound Level at MP3	50	51	53	53	52	57	58	54	47	47	46	42	40
Specific Sound Level at Plot No. 15	38	39	41	41	40	45	46	42	35	35	34	30	28
NANR45 Curve	92	87	83	74	64	56	49	43	42	40	38	36	34
Exceedance of NANR45	-54	-48	-42	-33	-24	-11	-3	-1	-7	-5	-4	-6	-6

Table 3 – Substation NANR45 Assessment

As can be seen in the assessment above the low frequency noise emission from the substation are not precited to exceed the NANR45 curve in any 1/3 octave frequency bands. This is an indication that the substation would be unlikely to adversely affect the proposed development.

It is thought that the noise impact from the substation is below 'No Observed Effect Level' ('NOEL') when assessed in accordance with the NPSE and NPPF, despite the numerical outcome of the BS4142 assessment.

4. Noise Break-in Assessment and Sound Insulation Scheme

4.1 Internal Noise Level Criteria

The following table outlines the internal acoustic design criteria used in the following assessment. Whilst the entertainment noise emissions from the Golden Cock public house are not thought to adversely impact the proposed development site, the Moorhouse Curve criteria are applied to ensure a robust assessment; as presented in the table below.

Location	Day & Night
All Rooms	63Hz limit of 47dB 125Hz limit of 41dB

Table 4 – Low Frequency Acoustic Design Criteria (Moorhouse)

BS8233:2014 Acoustic Design Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 07:00)**
Resting	Living Room	35 dB $L_{Aeq,16hr}$ / NR30	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$ / NR35	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$ / NR30	30 dB $L_{Aeq,8hr}$ / NR25 45 dB L_{AFmax}*

**NOTE 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.*

**NOTE 2: ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".*

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

Note 5; BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 5 – Internal Acoustic Design Criteria

The measured sound levels at the proposed development (Table 2) are assessed against the relevant criteria, and a sound insulation scheme is provided to achieve a good internal acoustic environment.

4.2 Glazing and Background Ventilation Specification

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

Sound Insulation Scheme – Plots 1-4 Living Rooms & Bedrooms									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
6mm Glass / 16mm Argon Cavity / 6.8mm Glass (Optiphon) (SRI)*	21	21	28	37	48	48	54	39 (R_W)	33 ($R_W + C_{tr}$)
Greenwoods 2500EA.AC1 (2 No. Trickle) (D_{ne})*	31	41	40	37	47	43	46	42 ($D_{ne,W}$)	40 ($D_{ne,W} + C_{tr}$)
Sound Insulation Scheme – All Other Plots Living Rooms and Bedrooms									
4mm Glass / 16mm Air Cavity / 6mm Glass (SRI)*	20	21	20	26	38	37	39	31 (R_W)	27 ($R_W + C_{tr}$)
Titon Standard Vent + C25 (2 No. Trickle) (D_{ne})*	--	36	38	36	32	37	39	35 ($D_{ne,W}$)	33 ($D_{ne,W} + C_{tr}$)

Table 6 – Glazing & Background Ventilation Specification

**Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.*

4.3 Roof Specification – Plots No. 1 to 4

According to drawing No. (72)011 by Orange Design Studio, plots No. 1 to 4 include bedrooms on the first floor that extend up to the roof to allow for skylights. To ensure noise ingress is adequately controlled, it is advised to adhere to the following roof construction:

- Roof slates,
- Weatherproof membrane,
- Existing trusses with min. 100mm mineral wool insulation (min. density 45 kg/m^3),
- Resilient bars or isolation clip and channels affixed to trusses (e.g., iKoustic MuteClip and Channel),
- 2 No. 15mm Gyproc SoundBloc plasterboards (min. surface mass 12.6 kg/m^2 per board).

5. Open Window Noise Break-in Assessment

5.1 Internal Noise Levels with Open Windows Criteria

BS8233:2014 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 5 dB relaxation of the internal noise criteria and an open window providing 13 dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

5.2 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 – Plots 1-4				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
65 $L_{Aeq,16hr}$ (Day)	53	+12	63	+2
55 $L_{Aeq,8hr}$ (Night)	48	+7	55	0
77 $L_{AFmax,1min}$ (Night)	58	+19	78	-1
AVO Open Window Assessment – All Other Plots				
51 $L_{Aeq,16hr}$ (Day)	53	-2	63	-12
41 $L_{Aeq,8hr}$ (Night)	48	-7	55	-14
63 $L_{AFmax,1min}$ (Night)	58	+5	78	-15

Table 7 – 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 at plots 1-4 marginally 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 TM59 assessment should be conducted to define the level of ventilation required to provide adequate cooling to prevent overheating

(considering closed windows) in accordance with Approved Document O. It is thought that continuous MEV extract fans installed in conjunction with the specified trickle ventilators 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 do not exceed the specified criteria. It is noted that the windows will remain openable at the occupant's choice.

For all other plots on site the L_{AFmax} night-time external noise levels exceed the BS8233 relaxed criteria by 5 dB but does not exceed the AVO Guide's 'Windows Rarely Open' criteria. This exceedance means that windows being used for the primary means of ventilation (whilst maintaining reasonable internal noise levels) could vary dependent on the outcome of a TM59 overheating assessment. To assist in the design of the alternative ventilation strategy a TM59 assessment should be conducted to define the level of ventilation required to provide adequate cooling to prevent overheating (considering closed windows) in accordance with Approved Document O. The TM59 assessor should be provided with this report to base their study. If the outcome of the TM59 overheating assessment states that windows will be open often to mitigate the overheating condition, the alternative ventilation strategy and internal noise levels will require further assessment.

6. External Noise Level Assessment

6.1 External Noise Level Criteria

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

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

Table 8 – External Acoustic Design Criteria

6.2 External Noise Level Assessment

The following section analyses the external amenity area noise levels across the proposed development.

The $L_{Aeq,16hr}$ noise level distance corrected from MP2 to the centre of the gardens for plots No. 1 to 4 and 15 is shown below; this based on the formula -10*LOG(r2/r1), where r2 is the distance between the road and the garden (10m(plot 1-4), 23m(plot 15)), and r1 is the distance between the road and MP2 (2m). The external amenity area sound levels are summarised in the table below.

External Amenity Area Noise Level Assessment			
Plot No.	$L_{Aeq,16hr}$ Noise Level (dB)	BS8233:2014 Criteria (dB)	Exceedance (dB)
1-4	58 (MP2 corrected)	50 – 55 $L_{Aeq,16hr}$	+3
15	54 (MP2 corrected)		0
All Other Plots	51 (MP1)		0

Table 9 – BS8233 External Amenity Area Noise Level Assessment

It is noted that there is a 1.8m tall stone wall to the northern border of plots 1-4 which slopes down to approximately 1.4m and has a gap for use as a driveway entrance. Whilst this wall provides some shielding at its tallest point, it will provide negligible shielding at the lower section and no shielding at the gap. Therefore, an additional barrier is required if the amenity area target criteria is to be met. However, it is understood that due to the listed nature of the site, in a conservation area, it may be problematic to allow the erection of barrier; it is at the discretion of the LPA whether a 3 dB exceedance is deemed acceptable given the context of the site. If screening is required to achieve garden levels as low as practicable, then the following mitigation is advised.

The following elements of the design proposals are contingent on the external noise levels being achieved.

- The site layout as per drawing Ref No.ODS_20/294 (20)001 from 'Orange Design Studio'
- The perimeter fencing around the external amenity areas of plot No. 1 to 4 is required to be a minimum height of 1.8m, have a minimum surface mass of 15 kg/m3, be of close-board construction and not contain any no holes or gaps.
- There should be a gate which carries the same design as the fence for the driveway access.
- The perimeter fencing should be installed in the locations outlined in the figure on the overleaf.

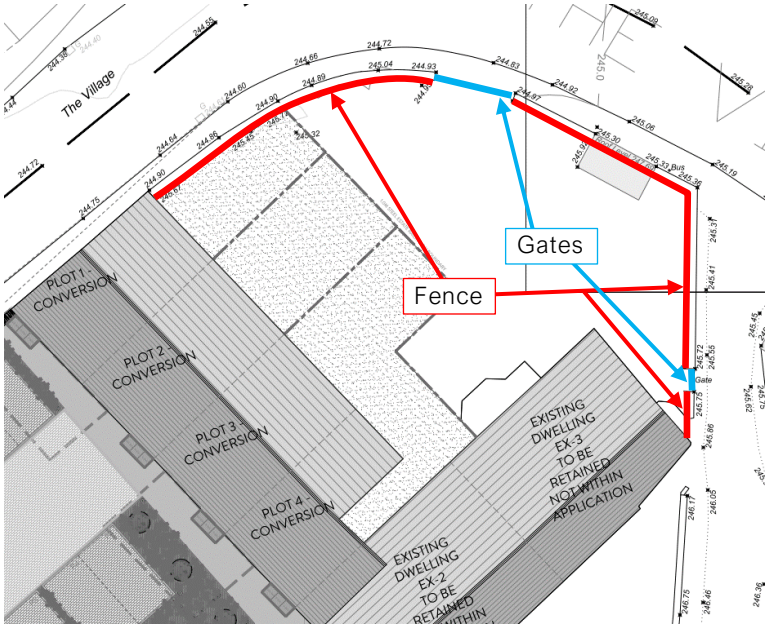


Figure 4 – Proposed Garden Fencing Plots No. 1 to 4

7. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in section 4.2.
2. The proposed roof construction for plot No. 1 to 4 should be installed as per Section 4.3.
3. 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. A TM59 assessment should also define the level of ventilation required to provide adequate cooling to prevent overheating (considering closed windows) in accordance with Approved Document O. The TM59 assessor should be provided with this report to base their study.
4. There is a marginal exceedance of the BS8233 upper design target of 55 dB $L_{Aeq,16hr}$ at plots No. 1 to 4. If this exceedance is not acceptable after considering the context of the site, then the mitigation measures outlined in Section 6.2 should be implemented.

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.

7.1 B.1 – National Planning Policy Framework (2023)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2023. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 180, it states:

Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

Paragraph 191 states:

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life:*
b) *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.*

7.2 B.2 – Noise Policy Statement for England (2010)

Paragraph 191 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

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

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life:
- Mitigate and minimise adverse impacts on health and quality of life:
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

This is further expanded using the updated "Noise Exposure Hierarchy Table" which includes an additional level of impact referred to as the 'No Observed Adverse Effect Level' ('NOAEL'). It is stated that at this level: *"noise can be heard, but does not cause any change in behaviour, attitude or other physiological response"*. In addition, noise at this level *"can slightly affect the acoustic character of the area but not such that there is a change in the quality of life".*

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

7.3 B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, 'WHO Guidelines on Community Noise, 1999'. The Guidelines on Community Noise (1999) document defines community noise to include noise from "industries" and "construction". The desirable criteria levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

BS8233 Internal Ambient Noise Level Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 07:00)**
Resting	Living Room	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{AFmax}*

Table 10 – BS8233 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.

7.4 B.4 – 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.

7.5 B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

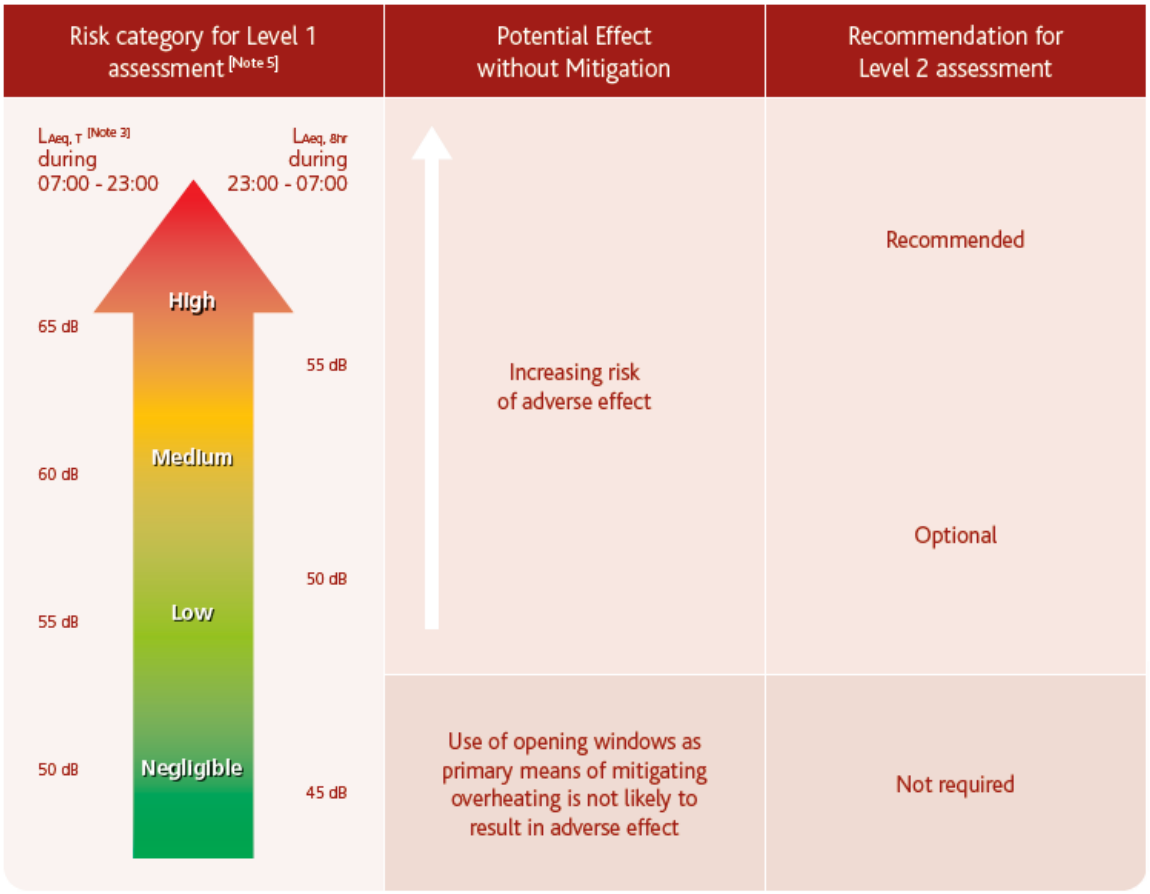


Table 3-2 of AVO Guide (2020)

Figure 5 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

AVO Guide (2020) Level 1 Risk Assessment			
Daytime (07:00 – 23:00)	**Night-time (23:00 – 07:00)**	**Risk Category**	**Mitigation**
≥63 dB $L_{Aeq,16hour}$	≥55 dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤53 dB $L_{Aeq,16hour}$	≤48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 11 – 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 6 – AVO Guide Level 2 Internal Ambient Noise Levels

7.6 B.6 – BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'

Overview

BS4142:2014 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

Rating Penalty

Section 9 of BS4142:2014 describes how the rating sound level should be derived from the specific sound level, by deriving a rating penalty.

BS4142:2014 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

a) subjective method;
b) objective method for tonality;
c) reference method."

Due to the nature of the development the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed. Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

a) *Tonality*

A rating penalty of +2 dB is applicable for a tone which is "just perceptible", +4 dB where a tone is "clearly perceptible", and +6 dB where a tone is "highly perceptible".

b) *Impulsivity*

A rating penalty of +3 dB is applicable for impulsivity which is "just perceptible", +6 dB where it is "clearly perceptible", and +9 dB where it is "highly perceptible".

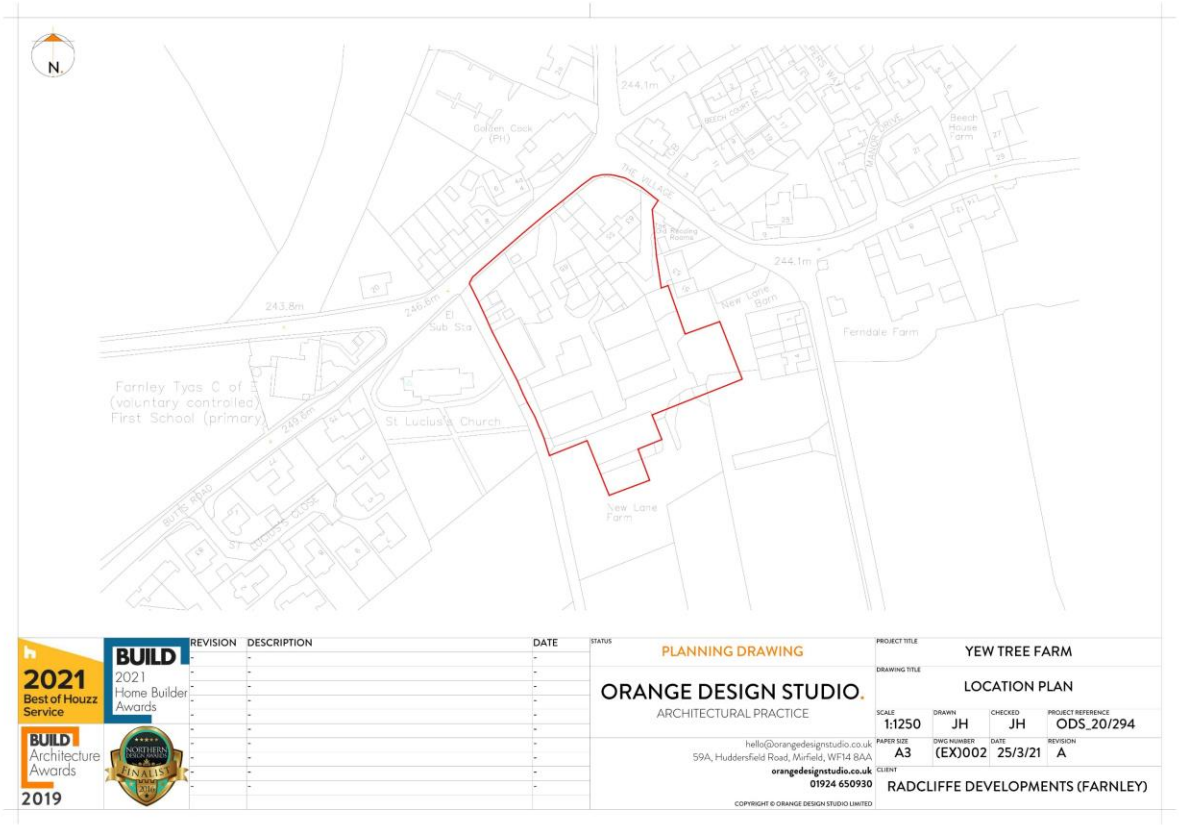
c) Other Sound Characteristics

BS4142:2014 states that where "the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."

d) Intermittency

BS4142:2014 states that when the "specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time ... if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."

Appendix C – Location Plans



Appendix D – Environmental Survey

7.7 D.1 – Time History Noise Data

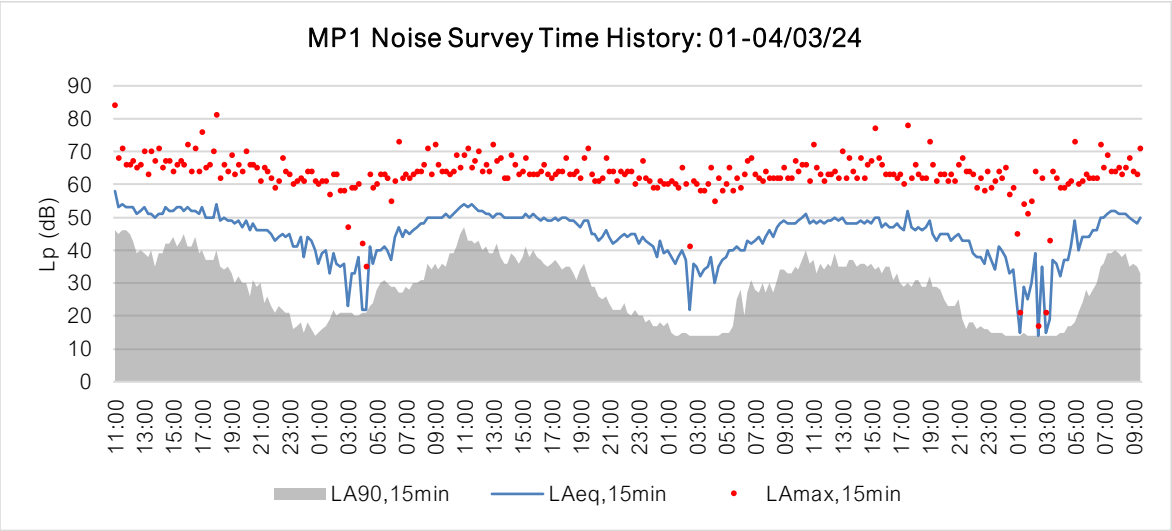


Figure 7 – MP1 Noise Survey Time History

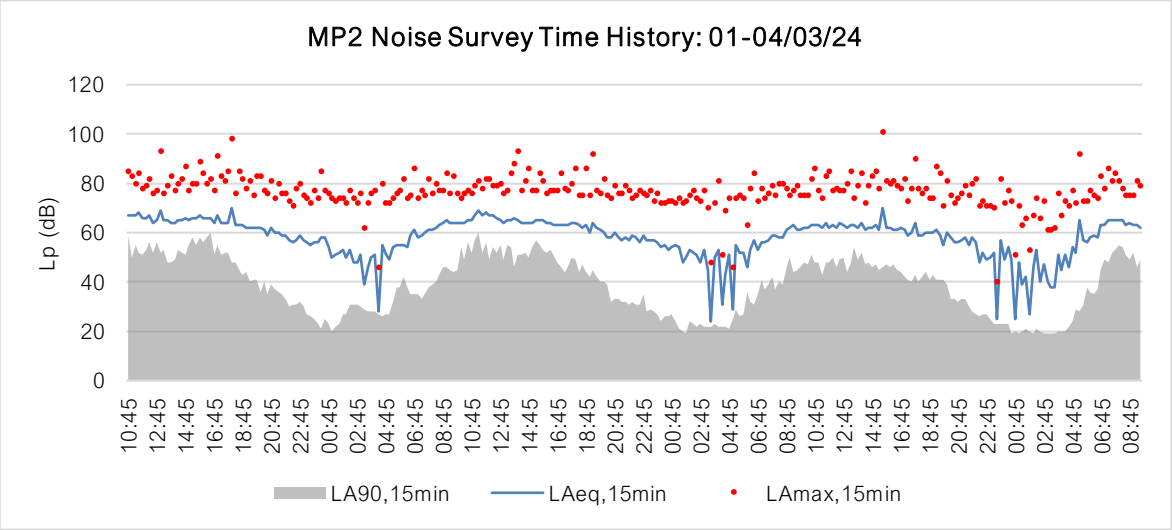


Figure 8 – MP2 Noise Survey Time History

7.8 D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC250 Class 1 Sound Level Meter	T252917	≤0.1
CESVA CB011 Class 1 Calibrator	T253524	
Svantek SV971A Class 1 Sound Level Meter	143581	≤0.1
CESVA CB006 Class 1 Calibrator	T253524	

Table 12 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.1dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

7.9 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. 3.2km NNE of Site)				
Time Period	Air Temp (⁰C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
01/03/24: 00:00 – 23:59	-0.9 – 5.0	0.0	ESE	0.0 – 10.8[1]
02/03/24: 00:00 – 23:59	-0.7 – 5.7	0.0	ENE	0.0 – 5.8
03/03/24: 00:00 – 23:59	-1.4 – 8.5	0.0	SE	0.0 – 2.7
04/03/24: 00:00 – 23:59	-3.9 – 9.1	0.0	ENE	0.0 – 8.0

Table 13 – Weather Conditions

[1] Windspeed recorded at 10m above local ground and measured before the environmental sound survey had commenced.

Appendix E – Noise Break-in Calculations

7.10 E.1 – Façades with Background Ventilation

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 and 0.3s seconds across the relevant frequency range for a furnished living room and bedrooms in the UK, respectively.
- Based on the technical drawings provided to NOVA Acoustics, for plots 1-4 window areas of 1.5m2 and room volumes of 33m3 are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 7m2 and room volume of 75m3 as a worst-case scenario.
- Based on the technical drawings provided to NOVA Acoustics, for all other plots window areas of 3m^2 and room volumes of 28m^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 3m^2 and room volume of 25m^3 as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturer's 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).

Living Room (Plots 1-4)

Description	Height (m)	Width (m)	Length (m)	Volume (m3)	Area (m2)
Room	2.4	3.7	8.42	74.8	120.5
Corner Room Façades	--	--	--	--	29.1
Glazing	1.4	--	5.2	--	7.3
Wall Element	--	--	--	--	21.8
Area of Roof / Ceiling	--	--	--	--	0.0
No. of Ventilators	2				
Room in Roof?	No				

Bedroom (Plots 1-4)

Description	Height (m)	Width (m)	Length (m)	Volume (m3)	Area (m2)
Room	2.5	4.4	3.0	32.6	62.9
Single Aspect Façade	--	--	--	--	11.1
Glazing	1	--	1.5	--	1.5
Wall Element	--	--	--	--	9.6
Area of Roof / Ceiling	--	--	--	--	13.0
No. of Ventilators	2				
Room in Roof?	Yes				

Living Room (Plots 1-4) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	65	68	63	61	59	61	58	53
Glazing Noise Ingress	24	41	36	27	16	7	4	-7
Ventilation Noise Ingress	21	35	20	19	20	12	13	5
Wall Noise Ingress	13	26	23	18	8	5	-3	-8
Roof Noise Ingress								
Room Absorption Correction		2	2	1	1	1	0	-1
Total Noise Ingress	**30**	**47**	**41**	**32**	**26**	**18**	**17**	**8**
NR30 & Moorhouse	35	47	41	39	33	30	26	24
Exceednce of Criteria	-5	0	0	-7	-7	-12	-9	-16

Bedroom (Plots 1-4) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	65	68	63	61	59	61	58	53
Glazing Noise Ingress	17	35	30	21	10	1	-2	-13
Ventilation Noise Ingress	24	36	21	20	21	13	14	6
Wall Noise Ingress	10	23	20	15	5	2	-6	-11
Roof Noise Ingress	11	34	15	8	1	3	0	-5
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**29**	**46**	**36**	**29**	**26**	**19**	**18**	**10**
NR30 & Moorhouse	35	47	41	39	33	30	26	24
Exceednce of Criteria	-6	-1	-5	-10	-7	-11	-8	-14

Bedroom (Plots 1-4) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	55	58	57	54	51	51	47	43
Glazing Noise Ingress	11	25	24	14	2	-9	-13	-23
Ventilation Noise Ingress	13	26	15	13	13	3	3	-4
Wall Noise Ingress	3	13	14	8	-3	-8	-17	-21
Roof Noise Ingress	2	24	9	1	-7	-7	-11	-15
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**20**	**36**	**30**	**22**	**18**	**9**	**7**	**0**
NR25 & Moorhouse	30	47	41	35	28	25	21	19
Exceednce of Criteria	-10	-11	-11	-13	-10	-16	-14	-19

Bedroom (Plots 1-4) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	77	80	79	76	73	73	69	65
Glazing Noise Ingress	32	47	46	36	24	13	9	-1
Ventilation Noise Ingress	35	48	37	35	35	25	25	18
Wall Noise Ingress	25	35	36	30	19	14	5	1
Roof Noise Ingress	24	46	31	23	15	15	11	7
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**42**	**57**	**52**	**44**	**40**	**30**	**29**	**21**
NR40	45	67	56	49	43	40	37	34
Exceednce of Criteria	-3	-10	-4	-5	-3	-10	-8	-13

Living Room (Remaining Plots)

Description	Height (m)	Width (m)	Length (m)	Volume (m3)	Area (m2)
Room	2.5	3.07	3.2	24.6	51.0
Corner Room Façades	--	--	--	--	15.7
Glazing	1.5	--	2.0	--	3.0
Wall Element	--	--	--	--	12.7
Area of Roof / Ceiling	--	--	--	--	0.0
No. of Ventilators	2				
Room in Roof?	No				

Bedroom (Remaining Plots)

Description	Height (m)	Width (m)	Length (m)	Volume (m3)	Area (m2)
Room	2.5	3.6	3.1	27.7	55.6
Corner Room Façades	--	--	--	--	16.7
Glazing	1.5	--	2.0	--	3.0
Wall Element	--	--	--	--	13.7
Area of Roof / Ceiling	--	--	--	--	11.0
No. of Ventilators	2				
Room in Roof?	Yes				

Living Room (Remaining Plots) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	52	57	52	48	45	49	43	36	36
Glazing Noise Ingress	16	30	24	21	12	4	-1	-10	-10
Ventilation Noise Ingress	19		17	11	10	18	7	-2	-2
Wall Noise Ingress	1	15	12	5	-6	-7	-18	-25	-25
Roof Noise Ingress									
Room Absorption Correction		4	4	3	3	3	3	1	0
Total Noise Ingress	**27**	**37**	**32**	**28**	**20**	**24**	**13**	**3**	**2**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-8	-22	-16	-11	-13	-6	-13	-21	-20

Bedroom (Remaining Plots) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	52	57	52	48	45	49	43	36	36
Glazing Noise Ingress	13	27	21	18	9	1	-4	-13	-13
Ventilation Noise Ingress	17		15	9	8	16	5	-4	11
Wall Noise Ingress	-1	13	10	3	-8	-9	-20	-27	-27
Roof Noise Ingress	19	44	27	8	-2	-3	-11	-19	-19
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**28**	**51**	**35**	**25**	**18**	**22**	**11**	**1**	**13**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-7	-8	-13	-14	-15	-8	-15	-23	-9

Bedroom (Remaining Plots) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	41	46	43	39	35	39	32	26	26
Glazing Noise Ingress	4	16	12	9	-1	-9	-15	-23	-23
Ventilation Noise Ingress	7		6	0	-2	6	-6	-14	-14
Wall Noise Ingress	-10	2	1	-6	-18	-19	-31	-37	-37
Roof Noise Ingress	8	33	18	-1	-12	-13	-22	-29	-29
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**18**	**40**	**26**	**16**	**8**	**12**	**0**	**-9**	**-11**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-17	-19	-22	-23	-25	-18	-26	-33	-33

Bedroom (Remaining Plots) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	63	68	65	61	57	61	54	48	48
Glazing Noise Ingress	25	38	34	31	21	13	7	-1	-1
Ventilation Noise Ingress	28		27	21	19	27	15	7	7
Wall Noise Ingress	11	23	22	15	3	2	-10	-16	-16
Roof Noise Ingress	30	55	40	21	10	9	0	-7	-7
Room Absorption Correction		4	4	3	3	3	2	1	0
Total Noise Ingress	**39**	**61**	**47**	**38**	**29**	**33**	**21**	**12**	**11**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-6	-6	-9	-11	-14	-7	-16	-22	-22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