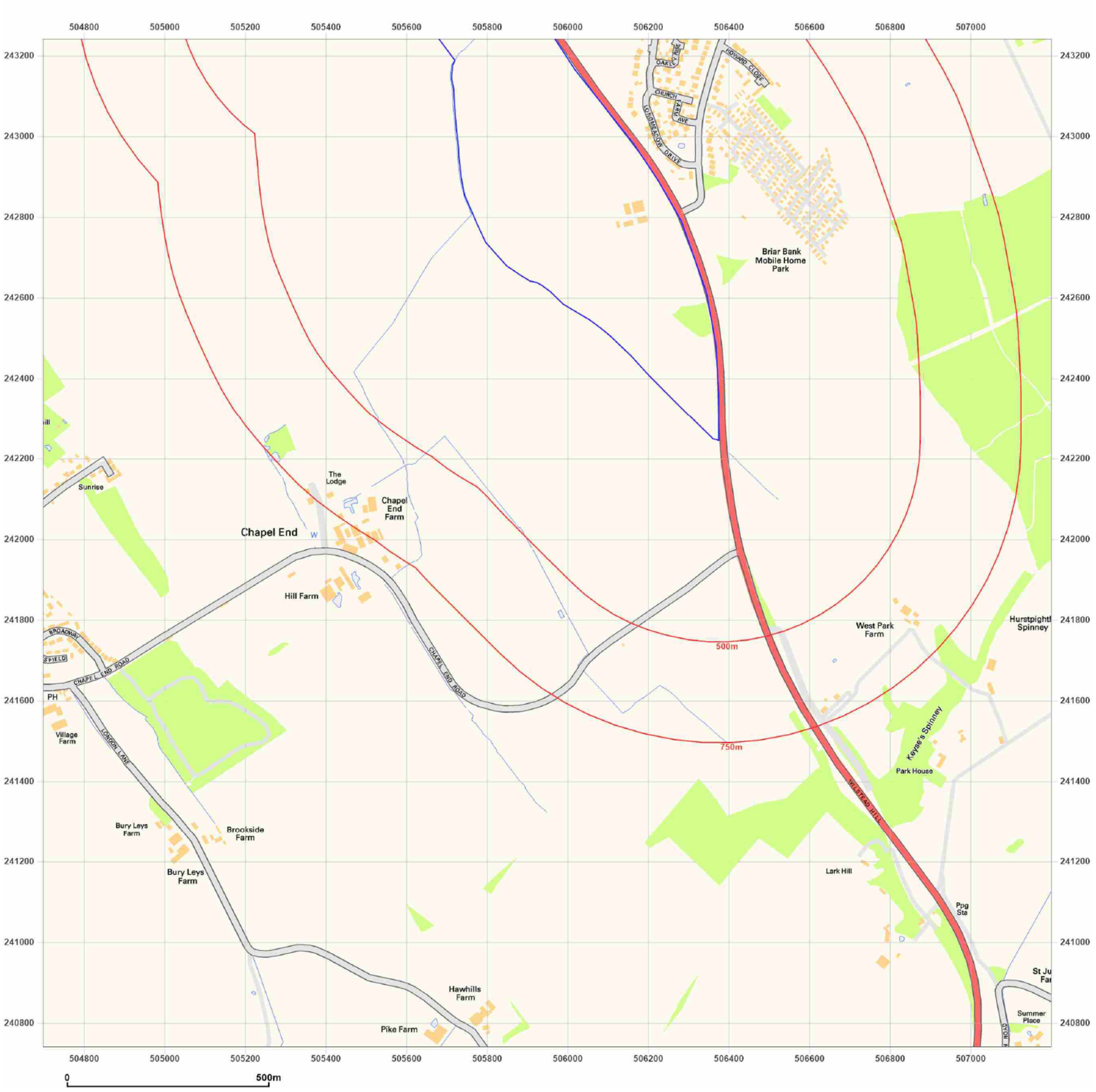

Groundsure INSIGHTS

Site Details:

Wixams - Land west of A6;
WIXAMS, MK42 6DH

Client Ref: 1620042479
Report Ref: HMD-33-8090950_SS_1_1
Grid Ref: 505949, 241991

Map Name: National Grid
Map date: **2010**
Scale: 1:10,000
Printed at: 1:10,000

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Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 02 August 2021

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf

Appendix 6: Feasibility Noise Assessment, RSK Acoustics, dated 31 August 2021, Ref 206/0466/R1

RSK Acoustics

Land at Wixams, Bedfordshire

Feasibility Noise Assessment

Report 206/0466/R1

Land at Wixams, Bedfordshire

Feasibility Noise Assessment

Report 206/0466/R1

Wates

Wates House
Station Approach, Leatherhead, Surrey
KT22 7SW

Revision	Description	Date	Prepared	Approved
0	1st Issue	31 August 2021	[redacted]	[redacted]
1	2nd Issue	1 September 2021	[redacted]	[redacted]

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End of Section

Feasibility Noise Assessment

1 Introduction

1.1 Wates Developments are proposing a new residential allocation in the emerging Bedford Borough Council Local Plan to the west of the A6, south of Wixams. The land is currently used for agricultural activities and is bounded by the A6 to the east.

1.2 This Report provides details of an environmental noise survey undertaken at the site along with a level 1 risk assessment for the development in line with guidance from the Acoustics, Ventilation and Overheating, residential design guide (AVO).

2 Site Description

2.1 The site can be found to the South of Bedford between the Wixams, Chapel End and Wilstead. Most of the site is located to the west of A6 highway with a small plot located to the east of A6, south of Duck End.

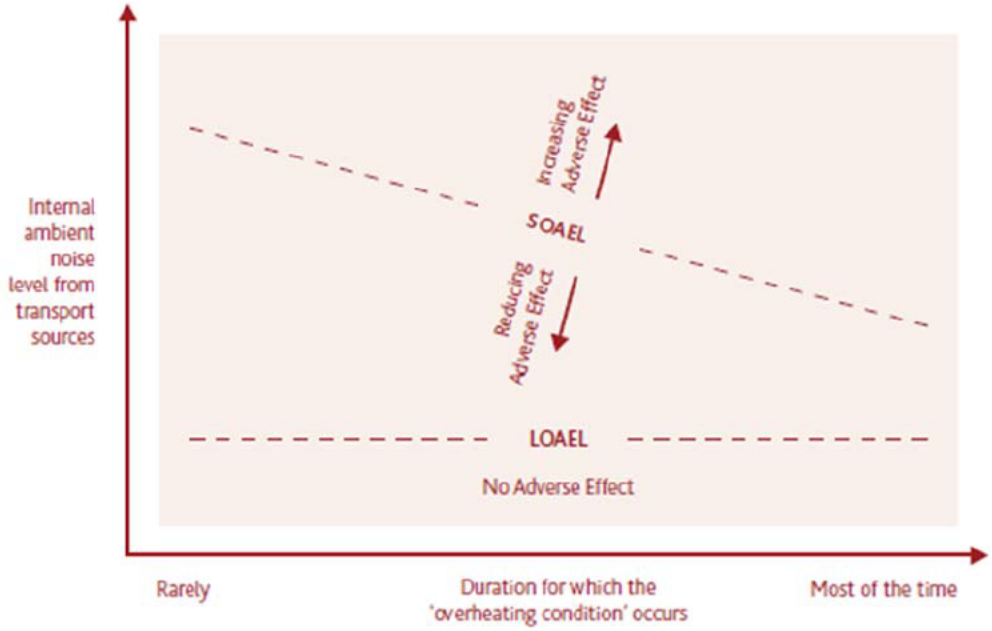
2.2 The site Is bounded by arable land, A6 highway and Warble Groove to the north, beyond which are Wixams residential development. The western side of A6 is currently being used as arable land while the eastern side is not utilised. The site surrounding area can be seen on the attached site plan 206/0466/SP1

3 Planning and Guidance

3.1 Appendix A to this report sets out guidance from NPPF, NPSE, ProPG, BS 8233:2014 and AVO. Internal and external noise criteria have been derived from these.

3.2 The guidance within the ProPG has a preference for ventilation to combat overheating to be provided via open windows. However, additional guidance is now available from the IOA and ANC: *The Acoustics Ventilation and Overheating Guide* (AVO:2020), which provides a more detailed assessment and allows for other ventilation methods. Although the weight of this guidance in planning terms is questionable, given there are no statutory obligations to achieve certain temperatures inside residential dwellings, we have assessed with reference to the guidance to ensure a suitable standard of amenity.

3.3 The graph below shows how criteria should be selected for the overheating scenario:



AVO guide figure 3-2: Qualtitative guidance on combined effect of internal ambient noise level and duration for the overheating scenario

3.4 The guidance notes that no specific single noise threshold can be determined and it suggests each site is considered on its own merits; however, it does indicatively suggest that a range of external noise levels of 53 and 63dB $L_{Aeq,16h}$ daytime and 48 and 55dB $L_{Aeq,8h}$ night time as thresholds of Medium and High risk sites, depending on duration and occurrence of overheating, as well as context.

3.5 The examples at the end of the AVO guide set an internal range of Significant Observed Adverse Effect Levels (SOAEL's – please see Appendix A for a more detailed description) between 40 and 50 dB $L_{Aeq,16hr}$, when the duration for which the overheating scenario occurs varies between "rarely" and "most of the time". For the same duration identifiers, the equivalent range during the night is 35 to 42 dB $L_{Aeq,8hr}$.

3.6 An upper limit of 64 dB L_{Amax} is stated for individual noise events, applying the logic of the above ranges compared to the lower level would give a range of 50 to 64 dB L_{Amax}

4 Environmental Noise Survey

4.1 Methodology and Instrumentation

4.1.1 An unattended environmental noise survey was undertaken at the site between approximately 15:00 on 20th of August and 12:15 in 25th of August.

4.1.2 The noise measurements were used to quantify the ambient noise levels at the site, to demonstrate that the noise levels from the motorway were consistent over several days and to calibrate the noise modelling.

4.1.3 The noise measurement positions are marked on the attached site plan 206/0466/SP1, and are described below:

- MP1 – 1.5m above ground level at the northern site boundary, close to A6 in a free-field conditions
- MP2 – 3m above ground level in the middle of the site, further away from highway in a free-field conditions
- MP3 – 1.5m above ground level at the south eastern site boundary, close to A6 in a free-field conditions

4.1.4 The noise measurements were performed using the equipment detailed in table T1 below:

Item	Manufacturer	Type
Sound Level Analyser (x2)	Rion	NL-52
Sound Level Analyser (x1)	Norsonic	118
Acoustic Calibrator (x1)	Rion	NC-74
Acoustic Calibrator (x1)	Norsonic	1251
Weatherproof Windshield (x1)	Norsonic	1212
Weatherproof Windshield (x2)	Rion	WS-15

T1 Equipment used during environmental noise survey

4.1.5 Weather conditions when setting up the equipment were overcast, dry and hot. The noise climate in all locations was dominated by traffic noise emanating from A6 highway while occasional farming vehicle was heard on MP2 location. It was noted from publicly available weather data that during the survey, on August 22nd, there was significant precipitation in Wixams which could have cause increase in measured noise levels. When collecting the survey equipment, the weather was overcast, dry and mild with noise climate remaining unchanged.

4.2 Results

4.2.1 The unattended noise survey results can be seen in the attached time history graphs 206/0466/TH01 - TH03. The representative day - and night-time noise levels ($L_{Aeq,}$) are shown in table T2 below:

Location	Measured Noise Levels, (dB)	
	Daytime $L_{Aeq,16hr}$ (0700-2300 only)	Night time $L_{Aeq,8hr}$ (2300-0700 only)
MP1 – 20th August	-	60
MP1 – 21st August	67	60
MP1 – 22nd August (rainy)	68	63
MP1 – 23rd August	68	62
MP1 – 24th August	68	62
MP2 – 20th August	-	45
MP2 – 21st August	50	44
MP2 – 22nd August (rainy)	49	46
MP2 – 23rd August	52	47
MP2 – 24th August	52	46
MP3 – 20th August	-	60
MP3 – 21st August	67	62
MP3 – 22nd August (rainy)	68	63
MP3 – 23rd August	68	61
MP3 – 24th August	68	61

T2 Measured day time and night time noise levels from unattended measurement positions

5 Noise Assessment

5.1 Noise Model

5.1.1 An acoustic model has been developed using *SoundPLAN 8.2* noise modelling software to calculate the noise levels across the site. Site maps and topographical information provided by *Emapsite* has been used to help create the model.

5.1.2 The model takes into account the topography of the site, the traffic flow through A6 (calibrated to the measured noise levels) and any buildings inside the map area.

5.1.3 The noise model has been calibrated to the noise levels measured at measurement positions MP1 and MP3 during the day and night-time periods as these are located close to the main noise source (A6). Table T3 shows the difference between modelled and measured daytime and night time $L_{Aeq,T}$ after calibration. The results of the noise model at MP2 are up to 5 dB higher during daytime and up to 6 dB higher during night time than those measured on site. This is expected to be partly down to wind direction on site and slight differences in topography compared to mapped data. As the results of the model are higher than measured they are considered to be worst case and so have been used as the basis of our assessment.

Location	Measured Noise Levels, (dB)		Modelled Noise Levels, (dB)	
	Daytime $L_{Aeq,16hr}$ (0700-2300 only)	Night time $L_{Aeq,8hr}$ (2300-0700 only)	Daytime $L_{Aeq,16hr}$ (0700-2300 only)	Night time $L_{Aeq,8hr}$ (2300-0700 only)
MP1	68	62	68.0	62.1
MP2	52	46	57.3	52.0
MP3	68	61	66.8	61.0

T3 Measured and modelled day time and night time noise levels at measurement positions

5.1.4 Following calibration of the mode, calculations have been carried out of noise levels across the site at 1.5m (ground floor window level). This has been done to quantify the noise levels across the whole site so that input can be given into the layout of the site.

5.2 Level 1 Assessment

5.2.1 An AVO Level 1 assessment has been undertaken using the noise model detailed above. The results of the assessment are shown on attached noise contour plots 206/0466/D01 and 206/0466/N01. The plots show the areas of the site which are in the 'Negligible', 'Low', 'Medium' or 'High' risk categories.

5.2.2 The results show that the majority of the site is within the 'Negligible' or 'Low' risk categories with a small amount considered to be medium or high risk.

5.2.3 Additionally, AVO guideline states that a Level 2 assessment is recommended in areas that exceed 78dB L_{AFmax} during the night-time period (23:00-07:00). The areas where this value is exceeded are displayed in 206/0466/NE1.

5.2.4 In line with the guidance provided within the AVO where houses are proposed within 'High' Risk areas a Level 2 risk assessment would be required as part of the design process. Therefore, if any houses are proposed within the buffer zone shown on the attached sketch 206/0466/SK1 a further assessment would be required. This takes account of both the $L_{Aeq,T}$ and the L_{Amax} levels.

5.2.5 If development is required within this 'high' risk area, it will be necessary to undertake an assessment of noise break-in to the dwellings during periods of overheating. This will be undertaken with a view to establish the need for enhanced ventilation in order to satisfy the requirements of the AVO guide.

5.2.6 As acoustic consultants, we are not qualified to undertake assessments of the time that an overheating condition will occur within a dwelling across a given year, and, as such, cannot give comment on the likely level of disturbance from noise that residents will experience when opening their windows to control overheating.

5.2.7 As such, we recommend that a TM59 assessment is undertaken by a suitably qualified party in order to establish the likely duration for which the overheating scenario will occur throughout a given year.

5.2.8 Following the issue of a TM59 assessment, it will then be possible to undertake a Level 2 AVO assessment as per the figure below. This will conclude as to whether alternative methods of cooling will be required to reduce the need to open windows. The relevant thresholds for the Level 2 assessment are shown in the following figure.

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.

Table 4-3 Guidance for Level 2 assessment of noise from transport sources [note 1] relating to overheating condition.

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.

5.2.9 Should the TM59 assessment show that the overheating scenario will occur regularly then mitigation may be required. The AVO states that any mitigation measures should either provide alternative methods of cooling habitable rooms without the need to open windows i.e. through mechanical ventilation/comfort cooling, or by reducing how often the overheating scenario occurs such as through solar shading. Potential examples which can be looked at in more detail include:

Reduction of noise levels at habitable room windows

- Consideration should be given to the orientation of façades so that habitable rooms face away from the nearest road. It should be noted that these windows would have to be on the opposite façade to the given road (not at a 90° angle to it).

Reduction of overheating time

- This could potentially be done though the use of solar shading/changing the orientation of the houses to reduce solar gain. Details of how this should be achieved, and its effectiveness must be provided by a mechanical services engineer. While this will not change the overall internal noise levels, it does alter the threshold for acceptable internal noise levels.

Provision of alternative cooling methods

- This could be achieved through large acoustic vents, comfort cooling systems or potentially through mechanical ventilation with a suitable boost mode (it should be noted however that the AVO guide does warn that this would require a system capable of providing a significant airflow). The requirements for either of these systems would need to be provided by a mechanical services consultant.

6 Conclusions

6.1 It is proposed to add a plot of land to the west of A6, south of Wixams, to the local authorities Local Plan for residential development. The land is currently used for agricultural activities and is bounded by the A6 to the east.

6.2 RSK Acoustics has been instructed to conduct a feasibility noise assessment for the proposed development to establish if it is suitable for residential development.

6.3 The assessment has shown that the majority of the site falls into the 'Negligible' and 'Low' risk categories detailed within the AVO. A small portion of the site is within the 'High' Risk category, which is to be expected for a site bounded by a highway.

6.4 If houses are to be constructed within the high risk area mitigation can be provided. The exact extent of this would be assessed during the detailed design, however general information regarding how this can be achieved has been provided within this report.

End of Section

Glossary of Acoustic Terms

L_{Aeq}:

The notional steady sound level (in dB) which over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measurement over that period. Values are sometimes written using the alternative expression dB(A) L_{eq}.

L_{Amax}:

The maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise when occasional loud noises occur, which may have little effect on the L_{Aeq} noise level. Unless described otherwise, L_{Amax} is measured using the "fast" sound level meter response.

L_{A10} & L_{A90}:

If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The L_{An} indices are used for this purpose. The term refers to the A-weighted level (in dB) exceeded for n% of the time specified. L_{A10} is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. Similarly L_{A90} gives an indication of the lower levels of fluctuating noise. It is often used to define the background noise.

L_{A10} is commonly used to describe traffic noise. Values of dB L_{An} are sometimes written using the alternative expression dB(A) L_{n}.

L_{AX}, L_{AE} or SEL

The single event noise exposure level which, when maintained for 1 second, contains the same quantity of sound energy as the actual time varying level of one noise event. L_{AX} values for contributing noise sources can be considered as individual building blocks in the construction of a calculated value of L_{Aeq} for the total noise. The L_{AX} term can sometimes be referred to as Exposure Level (L_{AE}) or Single Event Level (SEL).

End of Section

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Figure 206/0466/SP1

Title:

Site plan showing measurement and assessment positions

Key:

- MP Measurement Position
- AP Assessment Position
- Site Outline

North

Project:

Land at Wixams, Bedfordshire

Date: 24 August 2021

Revision: 0

Scale:

Not to scale

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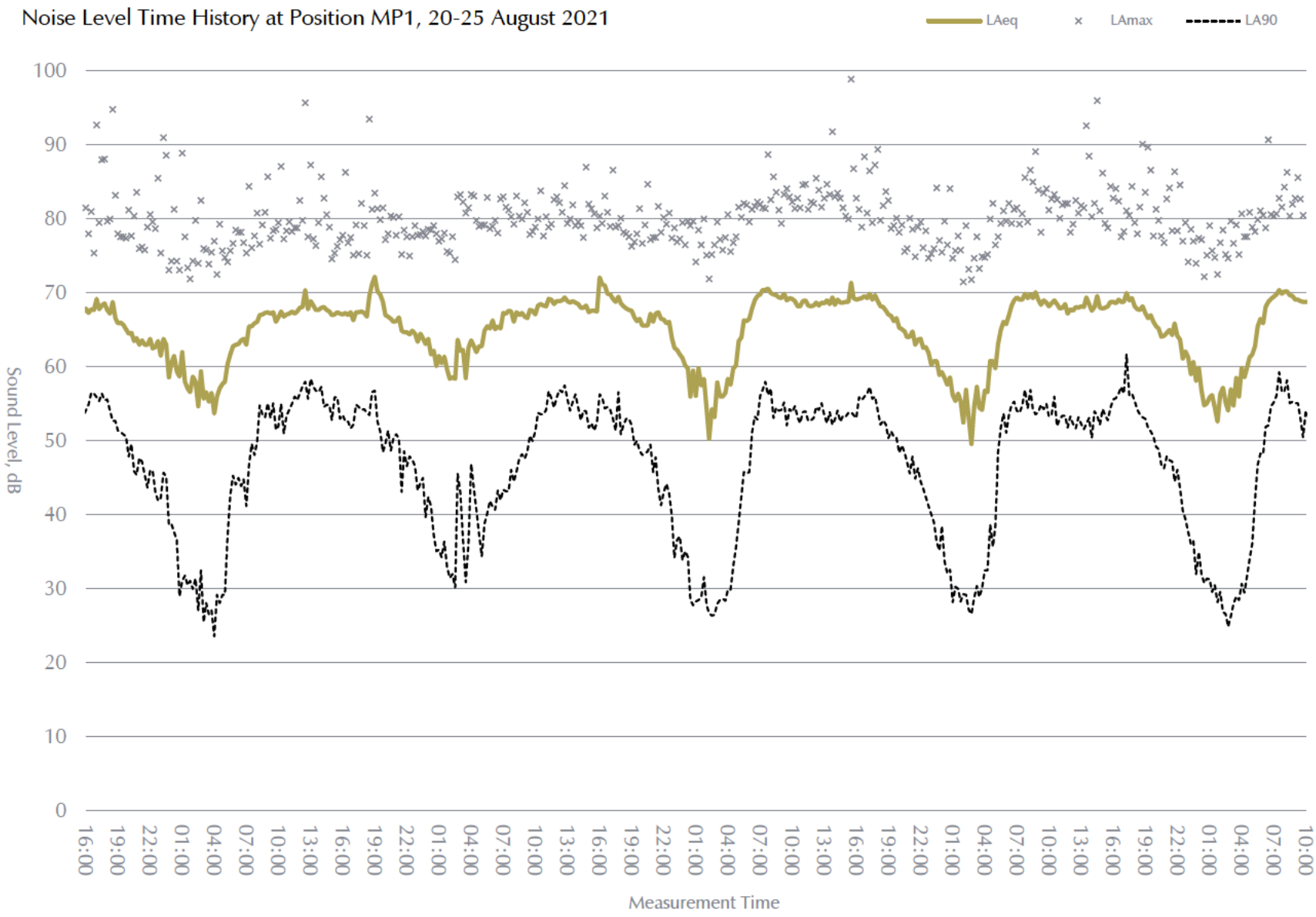


Figure 206/0466/TH01

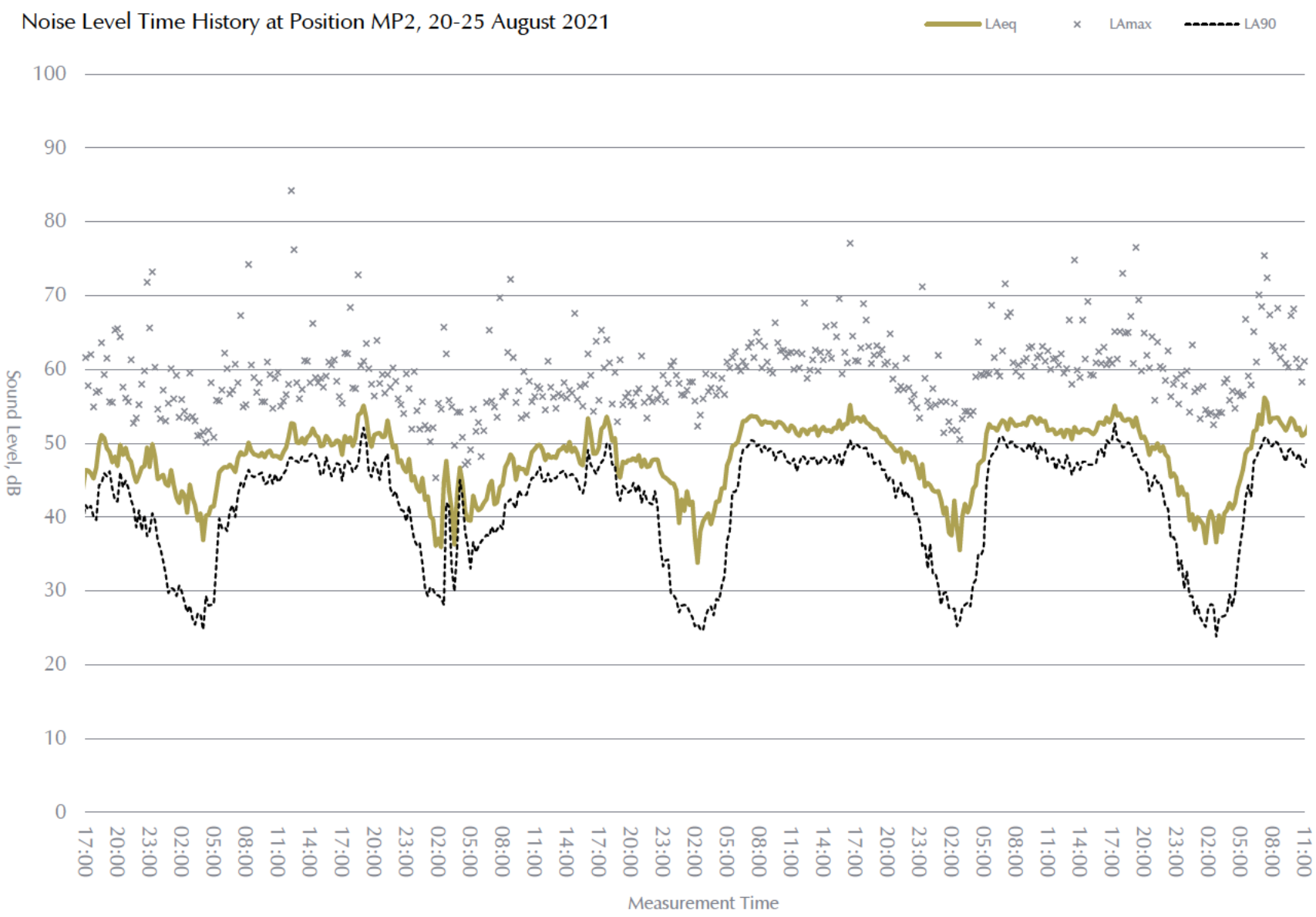


Figure 206/0466/TH02

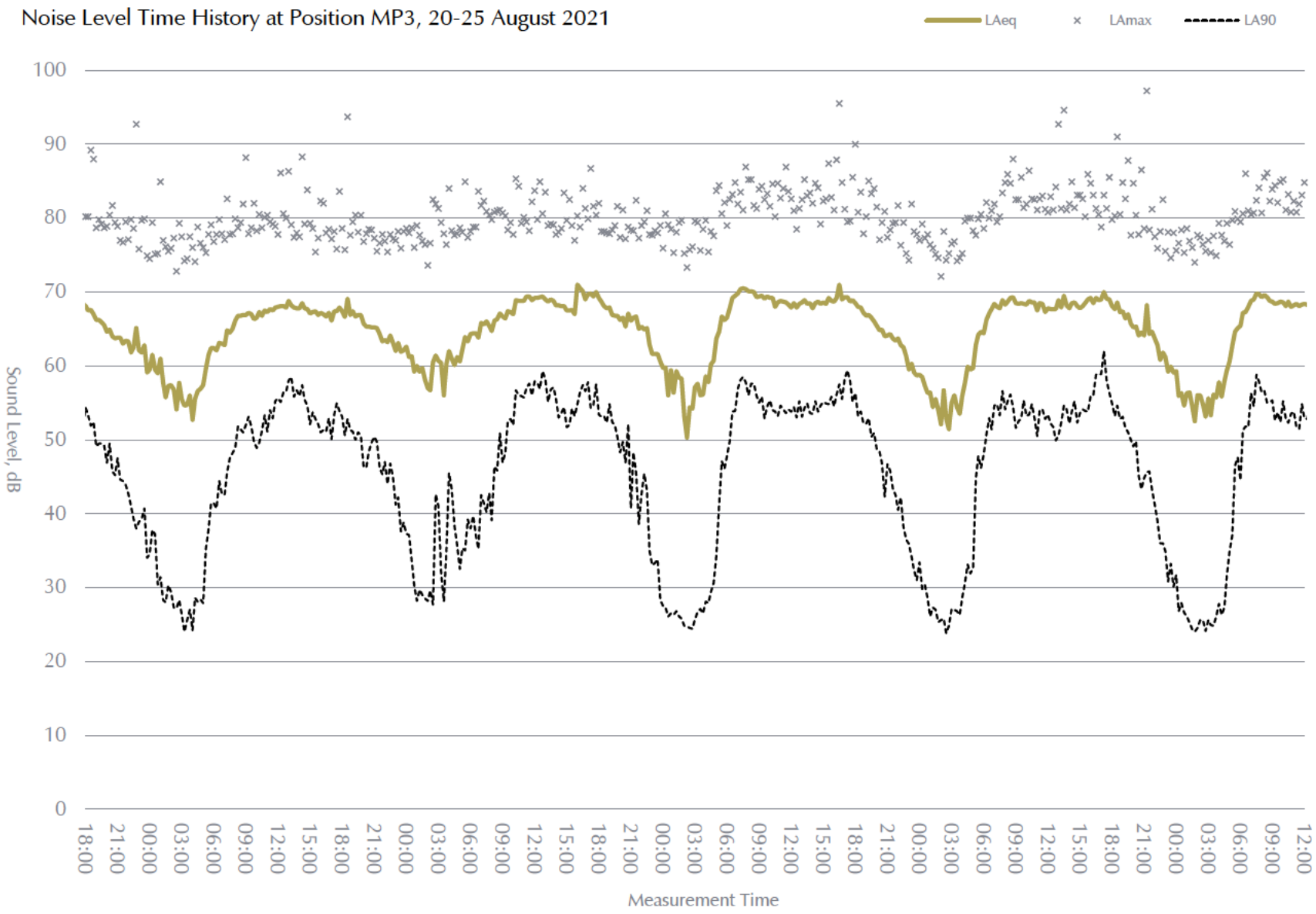
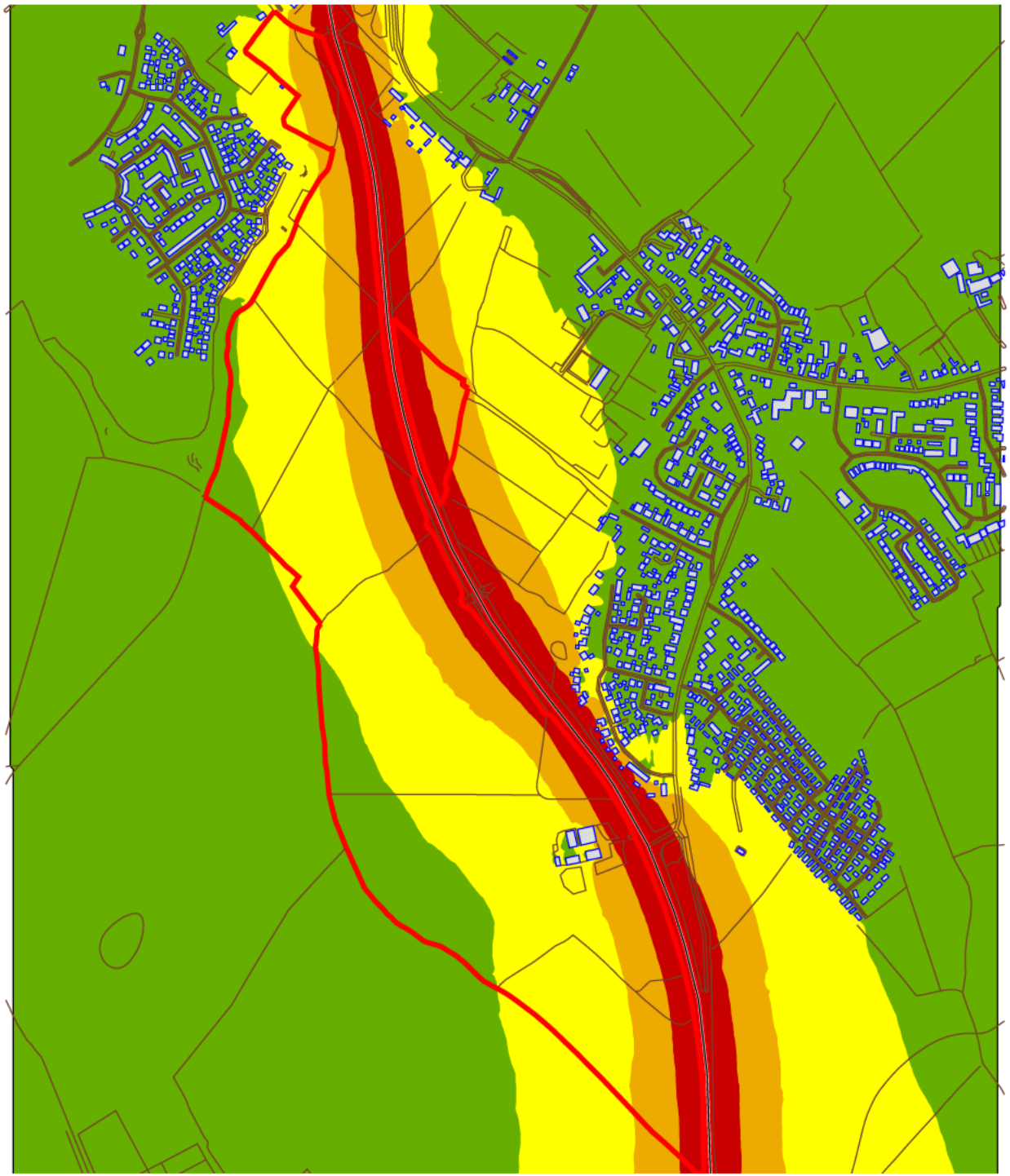


Figure 206/0466/TH03



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LAeq 16hour Day

Noise map showing LAeq daytime contours

<= 52	Negligible
52 - 58	Low
58 - 63	Medium
> 63	High

Symbols

- Elevation line
- Site Boundary
- Main building
- Road
- Road axis
- Emission line

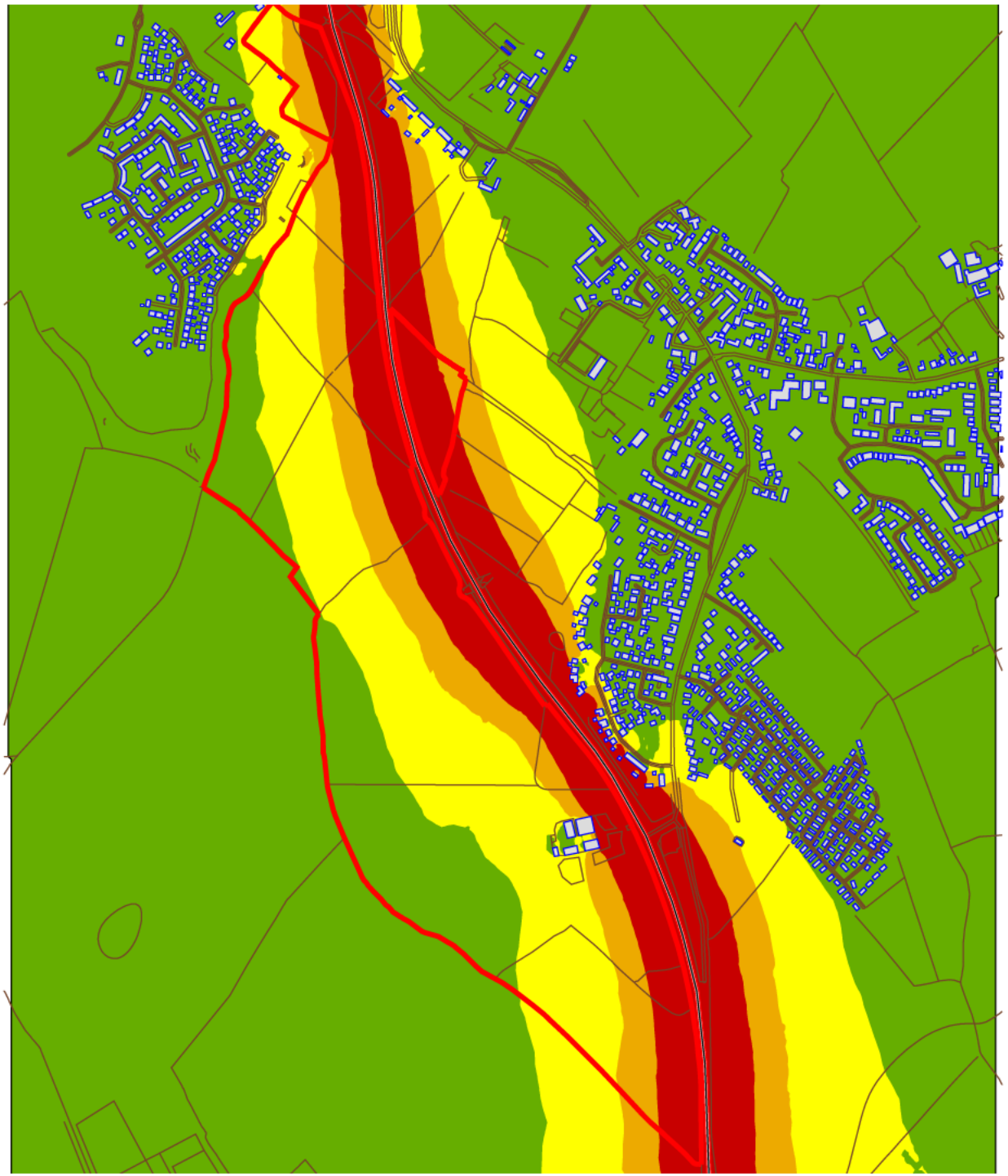
Project:
Land at Wixams, Bedfordshire

Project number:
206/0466/DO1

Date: 24 August 2021

Revision: -

Scale:
Not to Scale



RSK Acoustics

LAeq 8 hour Night

Noise map showing LAeq night time contours

<= 48	Negligible
48 - 52	Low
52 - 55	Medium
> 55	High

Symbols

- Elevation line
- Site Boundary
- Main building
- Road
- Road axis
- Emission line

Project:
Land at Wixams, Bedfordshire

Project number:
206/0466/NO1

Date: 24 August 2021

Revision: -

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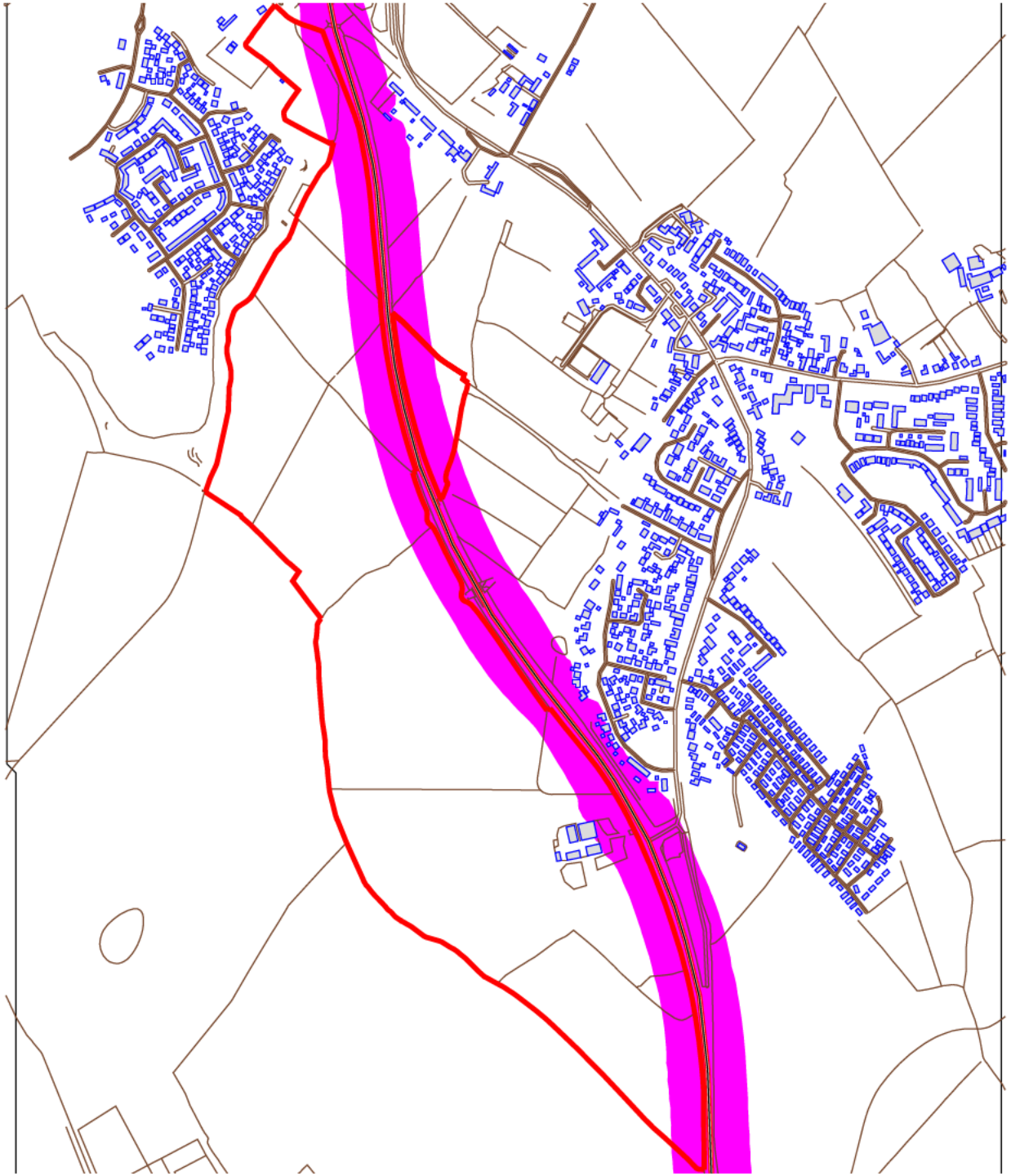

RSK Acoustics

AVO Buffer zone

Noise map showing areas that that are at high risk

Buffer zone

Symbols

- Elevation line
- Site Boundary
- Main building
- Road
- Road axis
- Emission line

Project:
Land at Wixams, Bedfordshire

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206/0466/SK1

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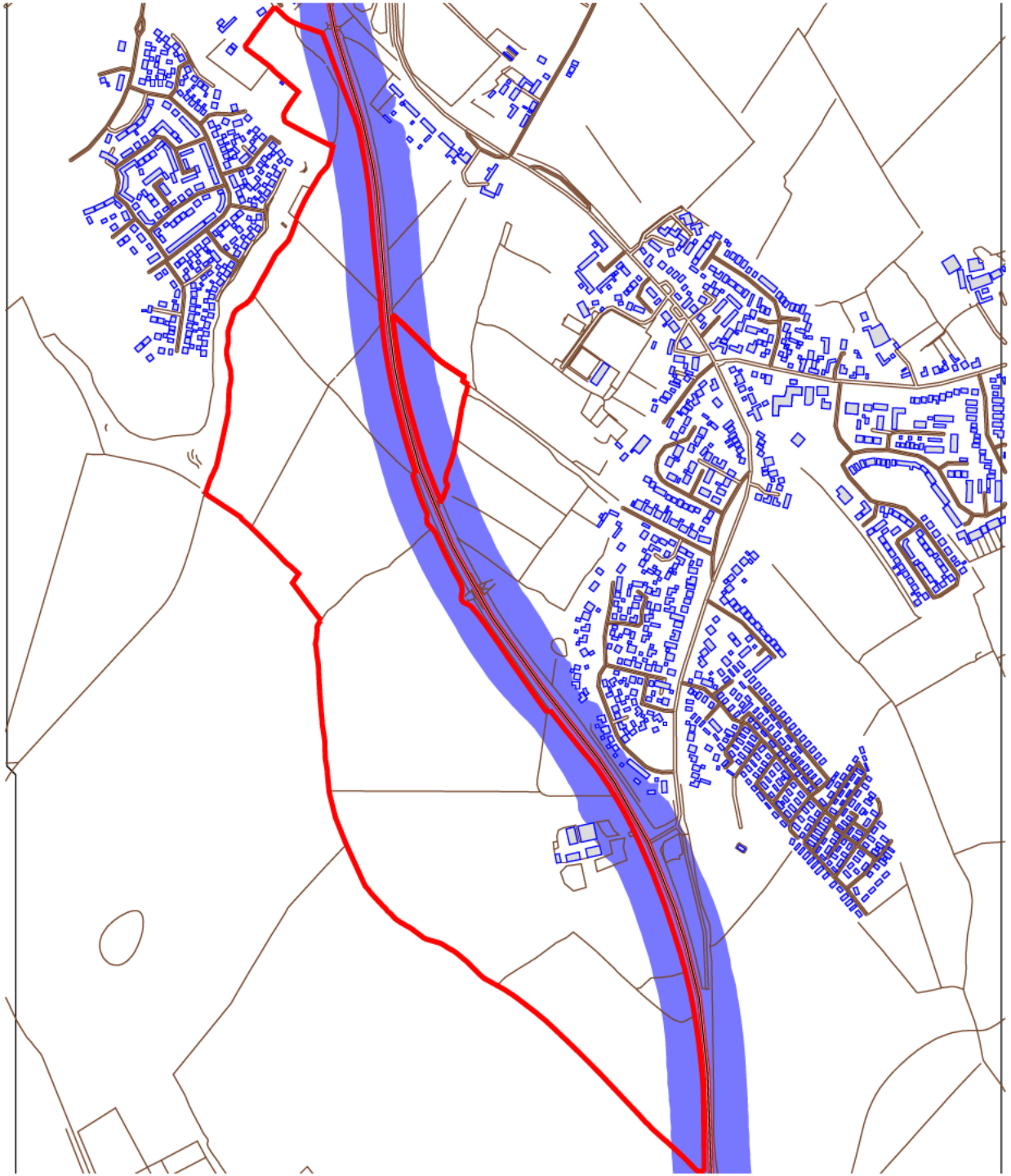


RSK Acoustics

AVO LAmax

Noise contours showing LAmax AVO guidance exceedances

High Risk

Symbols

- Elevation line
- Site Boundary
- Main building
- Road
- Road axis
- Emission line

Project:
Land at Wixams, Bedfordshire

Project number:
206/0466/NE1

Date: 24 August 2021

Revision: -

Scale:
Not to Scale

RSK Acoustics

Appendix A

Subject:	**Planning Considerations and Guidance**		
Project:	**Land at Wixams, Bedfordshire**		
Date:	**August 2021**	**Prepared:**	**KK**
Revision:	**0**	**Approved:**	**MH**

This document sets out the various standards and national guidance upon which the design advice has been based.

A1 National Planning Policy Framework (NPPF)

A1.1 The National Planning Policy Framework (NPPF), published in March 2012 and updated in July 2021, is currently the relevant document for defining the national policy toward noise sensitive development. It refers to the Noise Policy Statement for England (NPSE), which is discussed in the subsequent section.

A1.2 The current policy on sustainable development influences the emphasis of any noise assessment. The development of a quiet, rural site is by most measures less sustainable than the development of a site located near existing infrastructure and facilities. The rating of development sites based on prevailing noise levels should reflect this.

A1.3 Specifically, on the subject of noise, paragraph 180 of NPPF 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 impacts 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;"

A1.4 Paragraph 180 references the Noise Policy Statement for England and no other particular standards.

A1.5 On the general issue of amenity, paragraph 127 states that planning policies and decisions should ensure that developments:

"create places that […] promote health and well-being, with a high standard of amenity for existing and future users…"

A1.6 Further to this, paragraph 170 states that planning policies and decisions should contribute to and enhance the natural and local environment by:

"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"

A1.7 A notable inclusion in the July 2018 edition of NPPF is the 'agent of change' principle in paragraph 182. In terms of noise, this principle requires that those proposing a new noise sensitive development incorporate sufficient mitigation such that the operation of existing premises in the area is not unreasonably restricted in order to control noise impact upon the new development:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

A2 Noise Policy Statement for England (NPSE)

A2.1 This NPSE does not set quantitative guidelines for the suitability of noise sensitive development in an area depending on the prevailing levels of noise. Absent, therefore, is reference to specific noise thresholds which determine whether noise sensitive development is suitable and, if so, whether particular mitigation factors need to be considered.

A2.2 Instead, the NPSE sets out three aims:

The first aim of the Noise Policy Statement for England

"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

The second aim of the Noise Policy Statement for England

"Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

The third aim of the Noise Policy Statement for England

"Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

A2.3 Paragraph 2.24 states that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life. It also states that this does not mean that such adverse effects cannot occur.

A2.4 In essence, therefore, each development site must be judged on its ability to deliver on each of the stated aims. Quantifying the prevailing noise levels is therefore an essential first step in assessing a given site.

A2.5 The NPSE refers to SOAEL, the Significant Observed Adverse Effect Level. This is defined as the level above which significant adverse impacts on health and quality of life occur. Given the overall thrust of the NPSE, the SOAEL is therefore an important assessment standard although the document also comments that:

"It is not possible to have a single objective noise based measure that defines 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."

A2.6 Attention is drawn to the fact that the SOAEL is the level above which significant adverse effects can be observed. Importantly, it should be noted that the overall objective is to avoid or minimise significant adverse impacts; some degree of impact is acceptable and it is not necessary to seek to achieve no impact at all.

A3 Planning Practice Guidance (PPG)

A3.1 The Department for Communities and Local Government 'Planning Practice Guidance' (PPG) was published on 6 March 2014 and updated in July 2019.

A3.2 The PPG on Noise expands upon the NPPF and NPSE and sets out more detailed guidance on noise assessment. Like the NPPF and NPSE, the guidance does not include any specific noise levels but sets out further principles that should underpin an assessment.

A3.3 The PPG includes a section on noise, which states:

"Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

whether or not a significant adverse effect is occurring or likely to occur;

whether or not an adverse effect is occurring or likely to occur; and

whether or not a good standard of amenity can be achieved."

A3.4 It then refers to the NPSE and states that the aim is to identify where the overall effect of the noise exposure falls in relation to Significant Observed Adverse Effect Level [1] (SOAEL), the Lowest Observed Adverse Effect Level [2] (LOAEL) and the No Observed Effect Level [3] (NOEL).

A3.5 The guidance then presents a table, which is reproduced as table AT1 overleaf. The implication of the final line of the table is that only the 'noticeable and very disruptive' outcomes are unacceptable and should be prevented. All other outcomes (i.e. all other lines in the table) can be acceptable, depending upon the specific circumstances and factors such as the practicalities of mitigation.

[1] The level of noise exposure above which significant adverse effects on health and quality of life occur.
[2] The level of noise exposure above which adverse effects on health and quality of life can be detected.
[3] The level of noise exposure below which no effect at all on health or quality of life can be detected.

Response	Examples of Outcomes	Increasing effect level	Action
***NOEL** (No Observed Effect Level)*			
Not present	No Effect	No Observed Effect	No specific measures required
***NOAEL** (No Observed Adverse Effect Level)*			
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
***LOAEL** (Lowest Observable 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
***SOAEL** (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

AT1 Summary of Noise Exposure Hierarchy (from PPG)

A3.6 Under the topic of further considerations relating to mitigating the impact of noise on residential developments, the PPG states:

"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)."

A4 Internal and External Noise Design Criteria

A4.1 The World Health Organisation (WHO) Guidelines 1999

A4.1.1 The Guidelines for Community Noise (World Health Organisation, 1999) included values for community noise in specific environments.

A4.1.2 It is important to note that the WHO Guidelines are aspirational, as illustrated by the National Noise Incidence Study (NNIS, 2000), which indicates that 55% of the population of England and Wales are exposed to external noise levels above 55 dB $L_{Aeq,\ day}$. A National Physical Laboratory (NPL) report (with reference CMAM 16, dated September 1998) reviewing the original 1980 WHO Guidelines and the 1995 draft version of the current Guidelines stated:

"*Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached.*"

"*As such, it would be unwise to use the WHO guidelines as targets for any form of strategic assessment, since, given the prevalence of existing noise exposure at higher noise levels, there might be little opportunity for and little real need for any across the board major improvements. On the other hand, the most constructive use for the WHO guidelines will be to set thresholds above which greater attention should be paid to the various possibilities for noise control action when planning new developments. It is important to make clear at this point that exceedances do not necessarily imply an over-riding need for noise control, merely that the relative advantages and disadvantages of noise control action should be weighed in the balance.*"

A4.1.3 To prevent moderate annoyance in outdoor living areas, such as gardens and balconies of dwellings, the WHO guideline value is 50 dB $L_{Aeq,\ 16h}$. This can be described as an upper limit for the average noise level across the daytime and evening period (07:00h to 23:00h). The corresponding guideline value to prevent serious annoyance is stated as 55 dB $L_{Aeq,\ 16h}$.

However, it is again noted that these levels are aspirational in nature, as described in A4.1.2 above.

A4.1.4 In terms of the internal noise environment, in order to achieve maximum speech intelligibility and to avoid moderate annoyance, the guideline value for noise levels within dwellings is stated as 35 dB $L_{Aeq,\ 16h}$ (covering the day and evening 07:00h to 23:00h). The corresponding value for the night period (23:00h to 07:00h) to avoid sleep disturbance is 30 dB $L_{Aeq,\ 8h}$.

A4.1.5 Additionally in terms of sleep disturbance, a guideline value of 45 dB L_{Amax} is given. In relation to this value, the Guidelines state:

"When the background noise is low, noise exceeding 45 dB L_{Amax} should be limited, if possible…"

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night…"

A4.2 WHO Environmental Noise Guidelines 2018

A4.2.1 An updated version of the Guidelines was published in October 2018. It constitutes a significant revision of the 1999 Guidelines, rather than comprising minor amendments. In relation to road traffic and railway noise, the guidance states the following:

Road Traffic Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic below **53 decibels (dB)** L_{den}, as road traffic noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night time below **45 dB** L_{night}, as night-time road traffic noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from road traffic in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions, the GDG recommends reducing noise both at the source and on the route between the source and the affected population by changes in infrastructure.

Railway Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic below **54 dB** L_{den}, as railway noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic during night time below **44 dB** L_{night}, as night-time railway noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from railways in the population exposed to levels above the guideline values for average and night noise exposure. There is, however, insufficient evidence to recommend one type of intervention over another.

A4.2.2 The L_{den} is an equivalent sound level that represents the situation over the full 24 hour day, taking account of the L_{day} (0700-1900h), with a penalty of 5dB(A) for evening noise $L_{evening}$ (1900-2300h) and a penalty of 10dB(A) for night time noise L_{night} (2300-0700). The L_{night} index is equivalent to the $L_{Aeq,\ 8h}$ index as used in other standards such as BS 8233 (but not necessarily with the same numerical guidelines).

A4.2.3 The guidance no longer specifies L_{Amax} criteria but states in section 2.2.2:

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level ($L_{A,max}$) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

A4.2.4 As with the 1999 WHO document, the guideline values in the 2018 document represent aspirational targets to be achieved in the long term, rather than values that should immediately be adopted into relevant policy.

A4.2.5 This is reflected in the following excerpt from the government's Aviation 2050 consultation document (which relates to aircraft noise but the principle of the statement is relevant to other noise sources):

"The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organisation (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of action and recent UK specific evidence which the WHO report did not assess."

A4.2.6 Therefore, other current standards and guidance, such as BS 8233, still represent the most relevant and appropriate basis for assessment.

A4.3 British Standard BS 8233:2014

A4.3.1 Guideline values for dwellings with respect to internal and external noise levels are included in BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (BSi).

A4.3.2 The standard states 50 dB $L_{Aeq,\,T}$ as being desirable as a steady state noise level not to be exceeded in gardens. It also states 55 dB $L_{Aeq,\,T}$ as an upper guideline value. The time period *T* is usually taken to be the 16 hour day (07:00h to 23:00h).

A4.3.3 Paragraph 7.7.3.2 of the standard goes on to say the following:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

A4.3.4 It can be seen that external noise levels, especially on small balconies to apartment blocks, are not proposed to be a controlling index by which suitability of a residential site is defined.

A4.3.5 Therefore, when designing noise sensitive developments that incorporate gardens or other external amenity areas, the intent shall be to provide an area for each property in which the noise levels are consistent with these standards. Where these standards cannot be achieved, then reasonable measures shall be employed to provide screening or other forms of mitigation so as to minimise the noise levels in the external amenity areas.

A4.3.6 An important principle here is that sustainable development sites will often be exposed to relatively high levels of environmental noise, and while means are available to insulate internal

spaces, they are not always available to protect external spaces. Strict adherence to the enforcement of such external noise criteria would preclude development in the majority of areas considered for development in semi-urban or urban environments or in areas in the vicinity of transportation noise sources. This is why the external standards shall be viewed as targets or triggers of mitigation measures rather than thresholds not to be exceeded in all circumstances.

A4.3.7 Buildings can be designed to achieve specific levels of insulation against external noise. It is reasonable, therefore, to set specific internal noise standards as the test of whether a development satisfies the requirements of the NPPF and the aims of the NPSE. In essence, these require a high quality design that achieves a good standard of amenity.

A4.3.8 Guidance in respect of indoor ambient noise levels is contained in Table 4 of BS 8233:2014 and tabulated below.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq, 16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq, 16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16h}$	30 dB $L_{Aeq, 8h}$

Note 7 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.

AT2 Table 4 of BS 8233:2014

A4.3.9 The previous edition of BS 8233 included quantitative guidance with respect to night-time L_{Amax} noise levels in bedrooms. BS 8233:2014 does not provide such guidance, however in paragraph 7.7.5.1.1 it is noted that the recommendations for ambient noise in hotel bedrooms are similar to those for living accommodation and Table H.3 in Annex H.3 gives example night-time L_{Amax} limits in hotel bedrooms of 45-55 dB.

A4.3.10 The WHO study informing the 1999 Guidelines derived the L_{Amax} night time noise standard on the basis of 10 to 15 occurrences per night.

A4.4 ProPG: Planning and Noise (2017)

A4.4.1 ProPG is a guidance document prepared by a working group consisting of representatives of the Association of Noise Consultant (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH). It provides professional practice guidance on Planning and Noise with regard to new residential development that will be exposed to airborne noise from transport sources. It is also noted that good professional guidance should have regard to any

reasonably foreseeable changes to existing, and/or new sources, as well as sources currently effecting the site.

A4.4.2 ProPG provides two stages of assessment, the first being an initial site risk assessment and the second being a full assessment. The second is only necessary when the initial risk assessment and circumstances dictate.

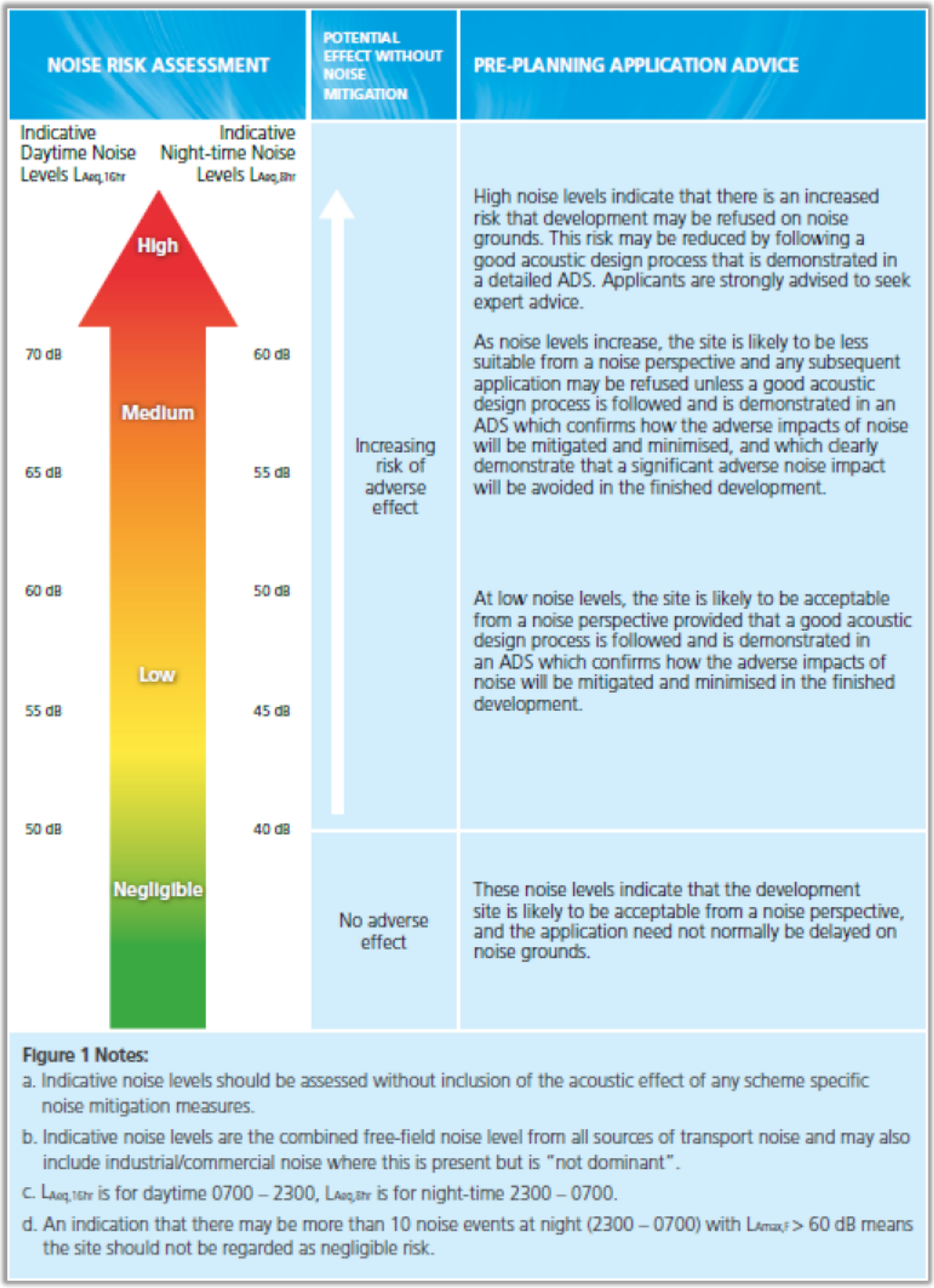
Stage 1: Initial Site Noise Risk Assessment

A4.4.3 ProPG suggests that a Stage 1 initial site risk assessment should be undertaken on all sites at the earliest possible opportunity in order to gauge the potential effect of noise on future residential premises, without the benefit of any noise mitigation measures.

A4.4.4 It is important to note that the initial 'Stage 1' assessment at a proposed residential development is not the basis for the eventual recommendation to the decision maker. It is intended to highlight the importance of good acoustic design within a scheme. For example, a site with a high risk of adverse effect without noise mitigation may not necessarily be unsuitable for development; however, the importance of good acoustic design provided by experts would be critical at such a site, with a detailed acoustic design statement provided.

A4.4.5 ProPG states that a site which displays a low risk of adverse effect without noise mitigation is more likely to be acceptable from a noise perspective, provided that a good acoustic design process is followed, and sites with no risk of adverse effect need not normally be delayed on noise grounds.

A4.4.6 The criteria provided for Stage 1 assessment of the L_{Aeq} noise levels for day and night within the initial site risk assessment are provided below:



A4.4.7 The initial noise risk assessment also considers the effect of L_{Amax} maximum noise levels at night (2300-0700h), where the guidance states:

"An indication that there may be more than 10 noise events at night (2300 – 0700) with $L_{Amax,F}$ > 60 dB means the site should not be regarded as a negligible risk."

Stage 2: Overview

A4.4.8 Stage 2 of the ProPG guidance provides a systematic consideration of key elements of acoustic design. The guidance advocates a proportional, risk based approach to the Stage 2 assessment. The Stage 1 risk assessment should inform whether careful consideration is required, with the detailed input of specialist acoustic consultants essential at higher risk sites, or straightforward accelerated decision making potentially possible in relation to lower risk sites.

Stage 2: Element 1 – Good Acoustic Design Process

A4.4.9 ProPG states that a good acoustic design process is an implicit part of achieving the requirements of government noise policy, as set out in the NPSE and NPPF, and outlined in Supplementary Document 1 of the ProPG.

A4.4.10 However, it is also stated that good acoustic design does not simply constitute compliance with recommended internal and external criteria, if the solution adversely affects living conditions within the spaces, and hence the quality of life of the inhabitants. The following example is provided:

"Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided; occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for the approach, is not regarded as good acoustic design."

A4.4.11 Applicants must therefore consider all possibilities for mitigation including but not limited to:

- Checking the feasibility of relocating, or reducing noise levels from relevant sources;
- Considering options for planning the site or building layout;
- Considering the orientation of proposed building(s);
- Selecting construction types and methods for meeting building performance requirements;
- Assessing the viability of alternative solutions;
- Assessing external amenity area noise;
- Examining the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.

Stage 2: Element 2 – Internal Noise Level Guidelines

A4.4.12 ProPG considers the guidance provided within BS 8233:2014 to be suitable for the assessment of internal noise levels. However, the ProPG provides additional commentary. The following table reproduces the internal ambient criteria provided within Figure 2 of ProPG. The guidance from BS 8233:2014 is displayed in black, with additional comments and criteria from ProPG in blue:

Activity	Location	0700h to 2300h	2300h to 0700h
Resting	Living room	35 dB $L_{Aeq, 16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq, 16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16h}$	30 dB $L_{Aeq, 8h}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. 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 (see Appendix A [which advocates reference to available dose-response relationships appropriate for the types of noise source being considered]).

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (see Section 3.D [which states that if certain criteria are fulfilled the noise practitioner should recommend refusal on noise grounds alone, regardless of any case for the development]).

AT3 Table 4 of BS 8233:2014 with ProPG annotations in blue

A4.4.13 It should be noted that the guidance above includes criteria for L_{Amax} noise levels, along with further guidance relating to the assessment of maximum levels in Note 4.

A4.4.14 The ProPG also states in Note 5 that where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed. However, any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position.

A4.4.15 At this point, it is also worth noting the typical expectation that noise criteria can be exceeded for limited times when additional natural ventilation may be used to provide a cooling effect. For example, this is reflected in the design of schools, where the current statutory guidance

(BB93 [4]) allows for up to 55 dB L_{Aeq} **internally** under such conditions in the warmest summer months. This represents a clear pragmatic approach to ventilation and cooling in a sustainable manner, without the need for mechanical comfort cooling methods.

Stage 2: Element 3 – External Amenity Area Noise Assessment

A4.4.16 With regard to external amenity spaces, ProPG references the guidance provided within BS 8322:3014, section 6. ProPG presents a statement summarising BS 8233:2014 section 6 which states:

"The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq, 16h}$"

A4.4.17 The standard continues:

"These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited."

A4.4.18 ProPG also references guidance within the PPG on noise, which states:

"If 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"

A4.4.19 It is highlighted within ProPG that both BS 8233:2014 and the PPG on noise require a decision to be made as to whether or not external amenity areas are intrinsically important to the required design. However, it is noted that the PPG also states that noise impacts may be partially offset if the residents of affected dwellings are provided, through the design of the development or the planning process, with access to alternative spaces as set out in paragraph A3.6 of this appendix.

A4.4.20 ProPG section 2.51 states that Local Planning Authorities (LPAs) will be best placed to provide guidance in relation to what is 'relatively quiet', as the concept will inherently vary between scenarios.

A4.4.21 The advice in section 2.52 of ProPG highlights the increased importance of LPAs protecting publically accessible external amenity spaces in areas that typically exhibit heightened existing noise climates, such as cities, where development is necessary but private external amenity areas below 55 dB $L_{Aeq,16h}$ are not practicable. Publically accessible spaces such as parks and squares in these areas may be providing respite for nearby residents and, therefore, should be protected.

[4] Building Bulletin 93: Acoustic design of schools - performance standards (2015)

Stage 2: Element 4 – Assessment of Other Relevant Issues

A4.4.22 This section of the guidance relates to all other relevant issues and seeks to build upon relevant national and local planning and noise policies. Examples are provided including, but not limited to, the following:

- Compliance with relevant national and local policy
- Magnitude and extent of compliance with ProPG
- Likely occupants of the development
- Acoustic design v unintended adverse consequences
- Acoustic design v wider planning objectives

A4.4.23 Other issues specific to the site may be added by the LPA, where relevant.

A4.5 The AVO Guide

A4.5.1 The Association of Noise Consultants document *'Acoustics, Ventilation and Overheating Guide'* (AVO) provides guidance for internal noise criteria when additional ventilation is required for thermal comfort.

A4.5.2 A key principle which must be understood is that "Overheating" in the context of the AVO relates to "chronic" overheating. This does not cover overheating during short term heatwaves or similar such events, but rather sustained periods where the internal spaces within a building remain at elevated temperatures.

A4.5.3 Overheating within buildings is a complex problem to measure and analyse and there is no single temperature above which an internal space can be classed as "overheating". The overheating condition is dependent on many factors such as duration, external ambient temperatures and other factors.

A4.5.4 The Chartered Institute of Building Services Engineers (CIBSE) have issued two main tools which are intended to help building designers determine whether internal areas are overheating and to determine thermal comfort (not in relation to acoustics). These are known as TM52[5] and TM59[6].

A4.5.5 Whilst these tools are not directly relevant to acoustics, TM59 is referenced in the AVO as an assessment tool (which would be utilised by services engineers or similar) which can be drawn from to help inform an AVO assessment.

A4.5.6 The three main methods for providing control of overheating provided by the AVO guidance are:

- Passive ventilative cooling – Introducing external air to a space to provide a cooling effect without the use of fans. The most common method is to use open windows but other façade

[5] CIBSE TM52: *The Limits of Thermal Comfort: Avoiding Overheating in European Buildings* (2018)
[6] CIBSE TM59: *Design methodology for the assessment of overheating risk in homes* (2017)

openings can also be used. Note that trickle vents do not enable sufficient airflow to have a significant cooling effect.

- Mechanical ventilative cooling – Using fans to introduce external air to a space to provide a cooling effect. Due to the airflow required, this type of system often involves significant plant and duct size requirements.

- Comfort cooling – Using a mechanical system to cool the air within a space to achieve a user-defined setpoint. This type of system will require some form of mechanical device to cool the air, such as a fan coil unit (FCU).

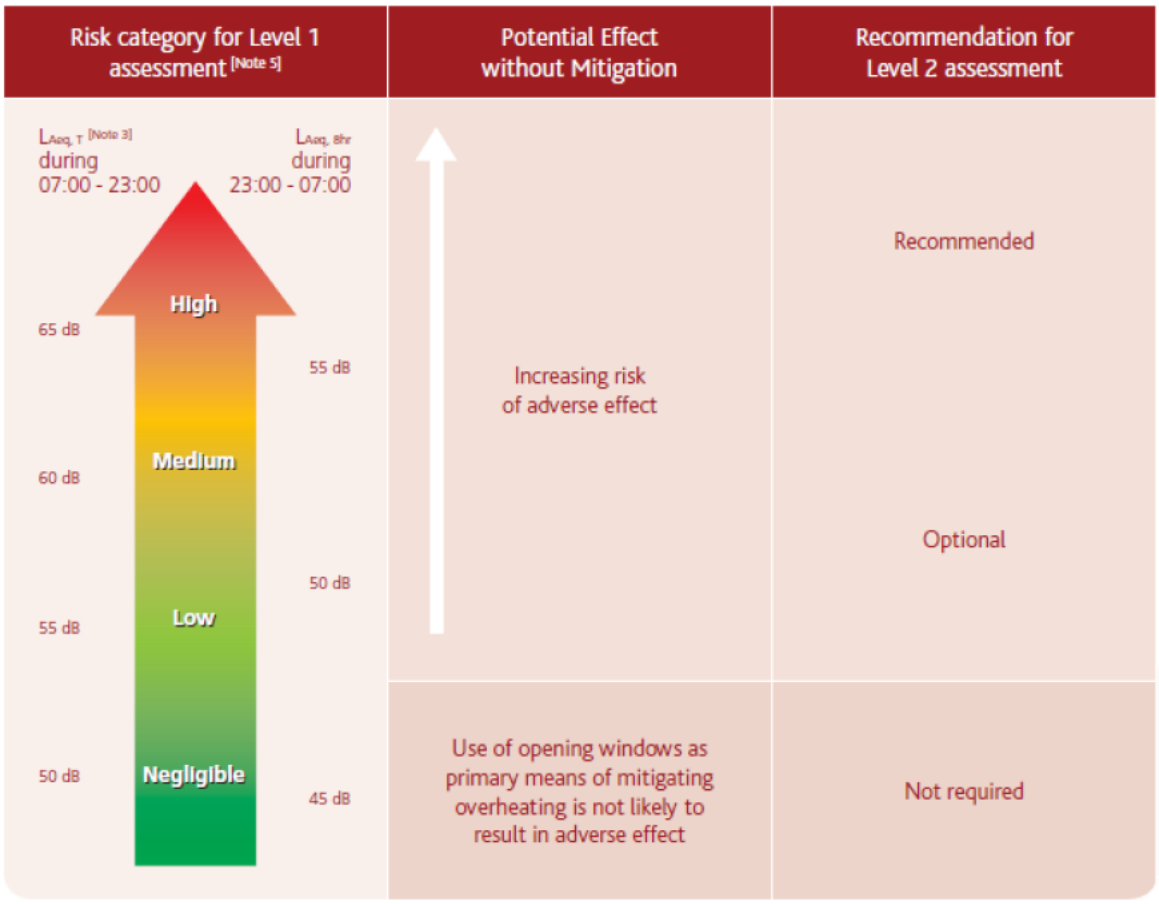
A4.5.7 It is proposed to adopt a scheme of mechanically ventilated cooling.

A4.5.8 Where windows are opened in order to provide passive ventilative cooling to a residential building, the AVO guidance states that it is reasonable for the internal ambient noise levels to be higher than those set out in BS 8233:2014 for background ventilation:

'It is suggested here that the desirable internal noise standard within Table 4 of BS 8233:2014 should be achieved when providing adequate ventilation as defined by ADF whole dwelling ventilation. However 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.'

A4.5.9 The guidance suggests an initial 'Level 1' assessment, where day and night-time **external** noise levels are correlated to a number of risk categories ranging from 'Negligible' to 'High'. The "risk" is taken to relate the potential for issues to arise in respect to the levels of noise affecting receptors, when overheating control is provided via open windows.

A4.5.10 Table 3-2 of the guidance, which sets out the Level 1 risk assessment categories, potential effects and recommendations for further assessment is reproduced below (along with its explanatory notes):



T1 Table 3-2 Guidance for Level 1 site risk assessment of noise from transport noise sources [Note 1] relating to overheating condition.

Note 1 - The noise levels suggested assume a steady road traffic noise source but may be adapted for other types of transport. All levels are external free-field noise levels.

Note 2 - The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships [15, 17].

Note 3 - A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise source, the occupancy profile and times at which overheating might be likely to occur. Further guidance can be found within the 2014 IEMA Guidelines.

Note 4 - Refer also to references [1, 17, 18, 22] for further guidance regarding individual noise events. Where 78dB $L_{AF,max}$ is normally exceeded during the night-time period (2300 – 0700), a Level 2 assessment is recommended.

Note 5 - The risk of an adverse effect occurring will also depend on how frequently and for what duration the overheating condition occurs. Refer to Figure 3-2.

Note 6 - To evaluate the risk category for a dwelling, all three aspects of external noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated. The highest risk category for any of the three aspects applies.

A4.5.11 If following the initial Level 1 assessment, it is determined that a more detailed Level 2 assessment may be necessary, a more involved and detailed consideration of **internal** noise levels can be undertaken. The Level 2 assessment considers internal noise levels and the proposed façade mitigation measures (including the method of providing cooling). The duration over which overheating may occur is also an important consideration.

A4.5.12 The noise levels within habitable rooms, with the cooling strategy in place, are calculated and compared to the thresholds provided within Table 3-3 "Guidance for Level 2 assessment of noise from transport noise sources relating to overheating condition". This table is reproduced below (again with the associated informative notes):

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 $L_{Ar,max}$	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 $L_{Ar,max}$ 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.

T2 Table 3-3 Guidance for Level 2 assessment of noise from transport noise sources [note 1] relating to overheating condition.

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.

Note 2 - The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships such as those described in a DEFRA 2014 study [15, 21, 22]. With the exception of individual noise events, the references [15, 21] are based on evidence drawn from external noise levels. There is currently very little robust

evidence linking internal averaged noise levels with health outcomes and occupant behaviour. Internal ambient noise levels would normally be considered for living rooms and bedrooms during the daytime. At night, the levels would normally only be applicable to bedrooms.

Note 3 - A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise source, the occupancy profile and times at which overheating might be likely to occur. Further guidance can be found within the 2014 IEMA Guidelines.

Note 4 - Refer to references [1, 17, 18, 22] for further guidance regarding individual noise events. The $L_{AF,max}$ indicator associated with the upper category is intended for road traffic; it may be more appropriate to use the "one additional noise-induced awakening" method for noise from rail traffic or aircraft.

Note 5 - The potential for adverse effect will also depend on how frequently and for what duration the overheating condition occurs. Refer to Figure 3-2.

Note 6 - The daytime levels presented in this table may not be appropriate for residential care homes or other situations where conditions for daytime resting are known to be of particular importance.

Note 7 - When evaluating the potential for adverse effect, all three aspects of noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated.

Note 8 - BS 8233 states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.

Note 9 - It is known that physiological responses do occur at lower levels of L_{AFmax} than 45dB.

A4.5.13 As detailed in Note 5 above, the level of assessed impact varies depending on the duration for which the 'overheating condition' occurs. Figure 3-2 provides qualitative guidance on combined effect of internal ambient noise level and duration for the overheating situation and is reproduced below (notionally referred to as an AVO diagram):

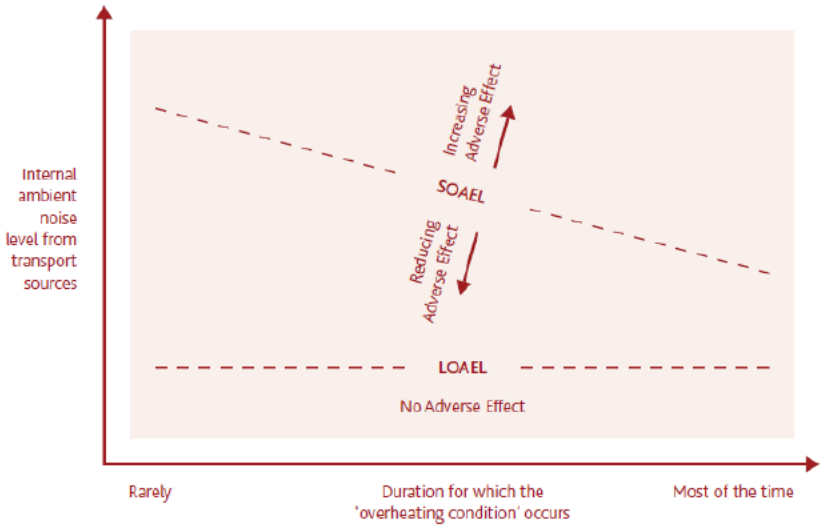


Figure 3-2 Qualitative guidance on combined effect of internal ambient noise level and duration for the overheating situation

A4.5.14 The aim would be to ensure that internal noise levels are mitigated to fall below the Significant Observed Adverse Effect Levels (SOAEL), taking due account of the duration over which overheating occurs. No quantitative guidance is provided in respect to the "Duration" aspect of the plot above, and consultants are required to use professional judgement to determine appropriate levels to be adopted for the SOAEL and Lowest Observed Adverse Effect Level (LOAEL).

A4.5.15 The guidance notes that no specific single noise threshold can be determined, and it suggests each site is considered on its own merits; however, it does indicatively suggest that a range of external noise levels of 53 and 63dB $L_{Aeq,16h}$ daytime and 48 and 55dB $L_{Aeq,8h}$ night time as thresholds of Medium and High risk sites, depending on duration and occurrence of overheating, as well as context.

A4.5.16 The examples at the end of the AVO Guide set a range of SOAELs between 40 and 50dB $L_{Aeq,16h}$, when the duration for which the overheating scenario occurs varies between 'rarely' and 'most of the time'. For the same duration identifiers, the equivalent range during the night is 35 to 42dB $L_{Aeq,8h}$.

A4.5.17 An upper limit of 64dB L_{Amax} is stated for individual noise events, applying the logic of the above ranges compared to the lower level would give a range of 50 to 64dB L_{Amax}.

A4.5.18 The following noise levels are however attributed to the graph y-axis in the worked example set out in Appendix B of the guide (linked to the stage 2 assessment level criteria and 8233 criteria +5dB):

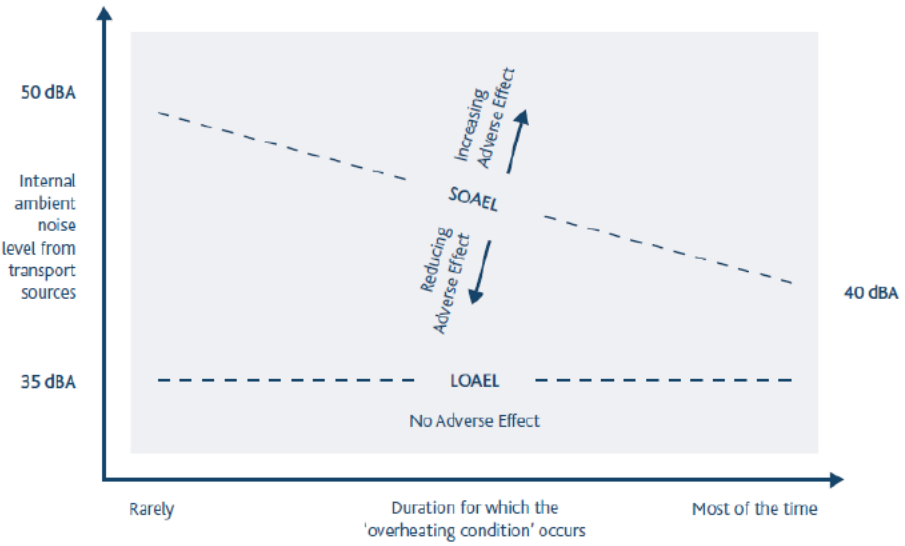


Figure B-2 'AVO Diagram' indicating noise levels associated with adverse effects during the daytime used in [the Appendix B] worked example.

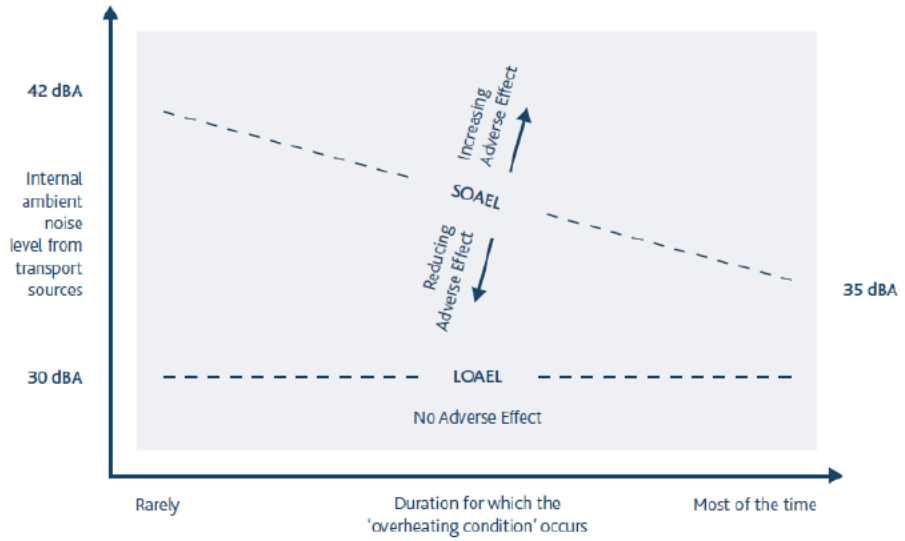


Figure B-3 'AVO Diagram' indicating noise levels associated with adverse effects during the night-time used in [the Appendix B] worked example

A4.5.19 The duration for which overheating occurs is clearly a significant consideration. To provide context – a receptor which may be classified as Medium and High risk (in the context of the AVO) at Level 1 assessment stage (using openable windows as a cooling strategy), may in fact be acceptable with no change to the ventilation strategy, providing the overheating condition only occurs rarely.

End of Section

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