

## Appendix 7.1

<b>Title</b>	Outline Noise Assessment		
<b>Project</b>	NW Bicester		
<b>Date</b>	30 July 2025	<b>Author(s)</b>	TF

### 1.0 Introduction

1.1 This appendix provides an update to the issued Appendix 7.1 as part of the 2021 Environmental Statement (ES). The previous version was also written by Tim Fox, but whilst under the employment of RSK Acoustics.

1.2 Planning permission is sought for mixed-use development to include up to 3,100 residential dwellings, a primary school and commercial spaces on a broad area of land to the north-west of Bicester.

1.3 Suono have been instructed to conduct an updated noise impact assessment for the proposed development and provide details of any mitigation measures required to ensure that a good level of amenity can be achieved within the new dwellings.

1.4 This appendix document provides details of the updated noise survey undertaken at the site with reference to the previous noise survey. The assessment of noise break-in to the proposed dwellings is also detailed in line with relevant planning and guidance documentation. Where necessary, details of mitigation measures have been provided.

### 2.0 Site Description

2.1 The proposed development site is located to the north-west of Bicester. The site is currently farmland which has been allocated for a residential development as well as the development of a new primary school, together with social and community facilities, business and retail accommodation.

2.2 The site is bound to the south by the A4095 beyond which is the town of Bicester and to the west by a trainline which runs the length of the site. The A4095 is to be realigned within the southern parcel of the site. The rail line is raised approximately 5 m above the level of the adjacent field. Bucknell Road leading to Bicester Road runs through the site on the west side.

2.3 To the north of the site is arable land leading up to the small village of Bucknell. To the east of the site is Elmsbrook containing residential and business properties as well as a primary school, the 1st phase of the North West Bicester development. The B4100 is beyond this development.

2.4 There are existing properties located within the development area which will be retained. These include Hawkwell Farm towards the western side of the site and Blanchford Building Supplies in the south-west corner of the site.

## 3.0 Planning Guidance and Criteria

### Planning Guidance

3.1 Guidance is available from various sources to aid the assessment and establish suitable criteria which the development should strive towards. Full details of relevant national planning guidance, local planning policy and design criteria are included in the attached **Annex A**.

### Proposed Residential Noise Criteria

3.2 Based on the guidance as set out in attached **Annex A**, the following noise level criteria are proposed:

#### Road Traffic and Railway Noise

- Daytime  $L_{Aeq,16hour}$  within habitable rooms no greater than 35 dB;
- Night-time  $L_{Aeq,8hour}$  within all bedrooms no greater than 30 dB;
- Night-time  $L_{Amax}$  within bedrooms no greater than 45 dB (for typical<sup>1</sup> events).

3.3 We note the ‘typical’ event for maximum noise levels should apply to regularly occurring maximum noise levels experienced.

#### External Amenity Areas

3.4 External areas cannot, by definition, be contained or benefit from the levels of noise mitigation that are available to internal spaces within buildings. As a consequence, design standards for external noise cannot be considered as thresholds that determine whether a high quality design has been implemented and a good level of amenity achieved. Rather, the external noise standards should be used to establish whether mitigation is appropriate as a means of minimising the adverse impacts of environmental noise.

3.5 Paragraph 7.7.3.2 of BS 8233:2014 states:

*“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.”*

3.6 The 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. This is why the external target of 55 dB  $L_{Aeq,16hr}$  shall be viewed as an aspirational target or trigger where mitigation measures should be considered rather than thresholds not to be exceeded in all circumstances.

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<sup>1</sup> Typical  $L_{Amax}$  corresponding to the level no exceeded more than 10 times per night-time period.

## Proposed School Noise Criteria

### Building Bulletin 93 (BB93)

- 3.7 The proposed new school block will have to be fully compliant with BB93 as it is a means of complying with Building Regulations' requirements.
- 3.8 BB93 indicates the minimum required performance standards for teaching spaces within school buildings, in terms of noise ingress and other acoustic parameters. Section 1.1 is related to indoor ambient noise levels (IANLs).
- 3.9 The assessment IANLs should include noise contributions from external sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises) as well as building services (i.e. mechanical ventilation systems).
- 3.10 The IANLs should exclude noise contributions from teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. This is specifically set out in section 1.1.1 of BB93.
- 3.11 The criterion for typical classrooms is 35 dB  $L_{Aeq,30mins}$ . There is some flexibility on these limits depending on ventilation strategy; under some circumstances the limits can be relaxed.

### Ventilation Design Requirements

3.12 Table 2 of BB93 and its accompanying notes set out the following requirements in terms of IANLs for different ventilation methods.

- With normal condition ventilation provided mechanically, either via fully mechanical or hybrid systems, IANLs from the mechanical elements should not exceed those levels set out in BB93 Table 1.
- With normal condition ventilation provided naturally, or using a hybrid system, IANLs from total system noise should not exceed those levels set out in BB93 Table 1 by more than 5 dB.
- With summertime and intermittent boost ventilation provided mechanically, IANLs should not exceed those levels set out in BB93 Table 1 by more than 5 dB.
- With summertime and intermittent boost ventilation provided naturally, IANLs should not exceed 55 dB  $L_{Aeq,30min}$ .
- Normal condition for a mechanical supply is typically equivalent to approximately 8 l/s per person (additional carbon dioxide concentration requirements apply).
- Normal condition for a natural or hybrid supply is typically equivalent to approximately 5l/s per person (additional carbon dioxide concentration requirements apply).
- The + 5 dB criteria do not apply to teaching and learning spaces where the Table 1 level is 45 dB or greater.

3.13 In addition to the above, noise from ventilators actuators or dampers should not exceed 5 dB above the resultant IANL based on the points set out above.

3.14 Discrete noise events, such as aircraft flyovers, should not exceed 60 dB  $L_{A1,30mins}$ . It is stated within BB93 that this is achieved by default for spaces with IANLs up to 40 dB  $L_{Aeq,30min}$ .

## 4.0 Environmental Noise Survey

### 2021 Noise Survey Methodology

4.1 An unattended environmental noise survey was undertaken previously by Tim Fox, whilst at *RSK Acoustics*, at the site between 25<sup>th</sup> February and 1<sup>st</sup> March 2021.

4.2 Noise measurements were used to quantify the ambient noise levels at the site during day and night-time periods at key locations around the site. The sound level meters were left for multiple days to ensure that the measured noise levels were representative.

4.3 The measurement positions are marked up on **Figure 1** and described subsequently.

**Figure 1: Noise measurement positions for both the 2021 and 2024 surveys**



- MP1 – Free-field position located 1.5 m above local ground level on the southern boundary (towards the eastern side of the boundary) of the site approximately 12 m from the kerb of the A4095.

- MP2 – Free-field position located 4 m above local ground level on the western boundary of the site, approximately 16 m from the raised rail line that runs parallel with the site boundary.
- MP3 – Free-field position located 1.5 m above local ground level approximately 6 m from the kerb of Bicester Road.

4.4 Measurements of the  $L_{Aeq}$ ,  $L_{Amax}$  and  $L_{A90}$  indices were recorded over consecutive 15-minute periods for the duration of the survey.

4.5 The sound level meters were fitted within weatherproof enclosures and the meters calibrated both before and after the survey to confirm an acceptable level of accuracy. No significant drift was noted to have occurred.

4.6 Weather conditions remained suitably free from significant wind or precipitation for the duration of the survey.

## 2024 Noise Survey Methodology

4.7 An updated unattended environmental noise survey was undertaken by Suono, at the site between 24<sup>th</sup> October and 29<sup>th</sup> October 2024. Measurements were undertaken at similar locations, as shown on **Figure 1** and described below.

- MP1 – Free-field position located 1.5 m above local ground level on the southern boundary (towards the eastern side of the boundary) of the site approximately 12 m from the kerb of the A4095.
- MP2 – Free-field position located 4 m above local ground level on the western boundary of the site, approximately 16 m from the raised rail line that runs parallel with the site boundary.
- MP3a – Free-field position located 1.5 m above local ground level approximately 5 m from the kerb of Bicester Road.
- MP4 – Free-field position located 2 m above local ground level on the southern boundary (centrally along the boundary) of the site approximately 22 m from the kerb of the A4095.

4.8 Measurements of the  $L_{Aeq}$ ,  $L_{Amax}$  and  $L_{A90}$  indices were recorded over consecutive 15-minute periods for the duration of the survey.

4.9 The sound level meters were fitted within weatherproof enclosures and the meters calibrated both before and after the survey to confirm an acceptable level of accuracy. No significant drift was noted to have occurred.

4.10 Weather conditions remained suitably free from significant wind or precipitation for the duration of the survey.

## Results

4.11 A summary of the measured baseline noise levels at the previously mentioned positions is presented in the following table.

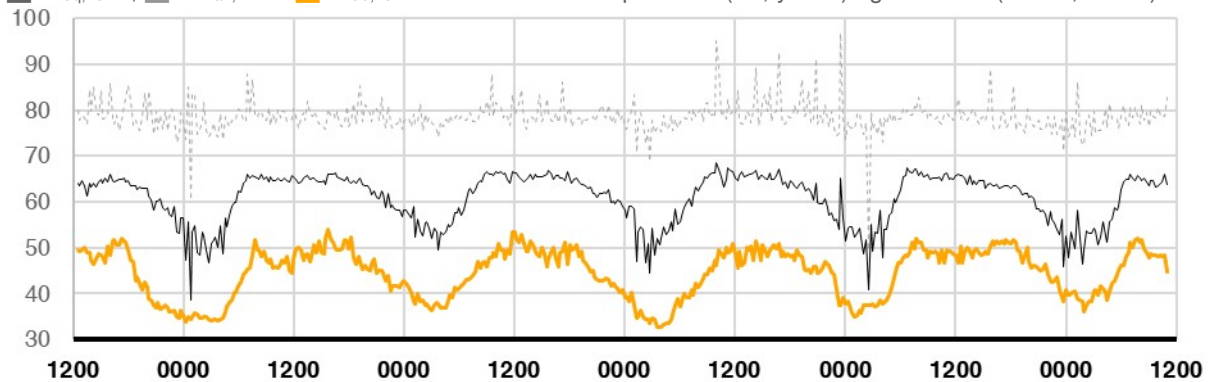
**Table 1** Noise survey results

Location	Survey	Daytime (07:00 – 23:00)		Night-time (23:00 – 07:00)
		dB $L_{Aeq,16h}$	dB $L_{Aeq,8h}$	dB $L_{Amax}$
MP1	2021	68	60	77
	2024	65	57	78
MP2	2021	55	50	74
	2024	55	51	74
MP3	2021	61	53	77
MP3a	2024	65	56	80
MP4	2024	61	52	71

4.12 The results of the 2024 survey are also presented in time history graphs below.

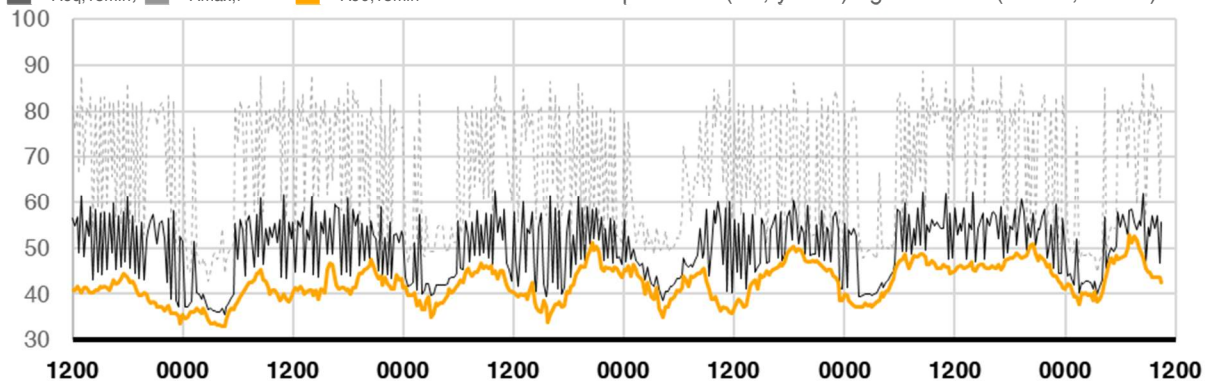
**Figure 2: Noise measurement results at position MP1**

■  $L_{Aeq,15min}$ , ■  $L_{Amax,f}$  and ■  $L_{A90,15min}$  in terms of sound pressure (dB, y-axis) against time (hhmm, x-axis)

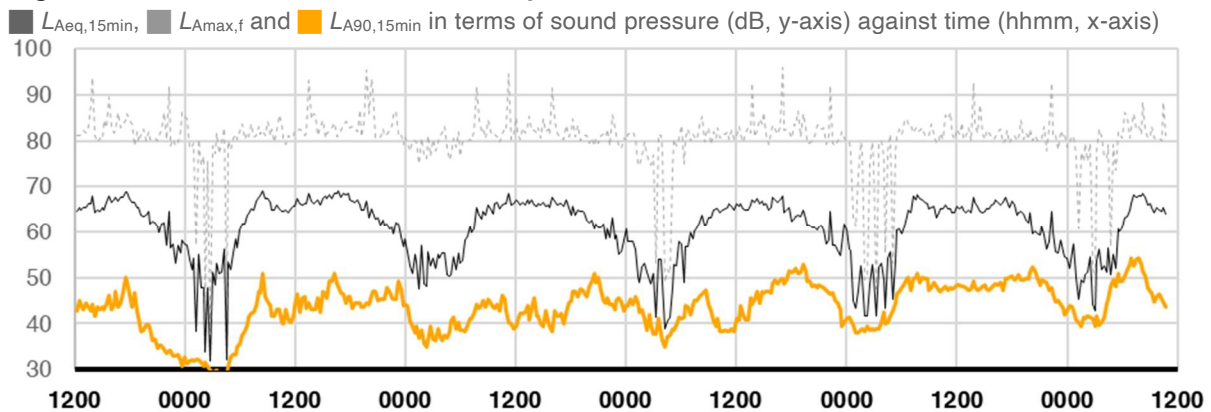


**Figure 3: Noise measurement results at position MP2**

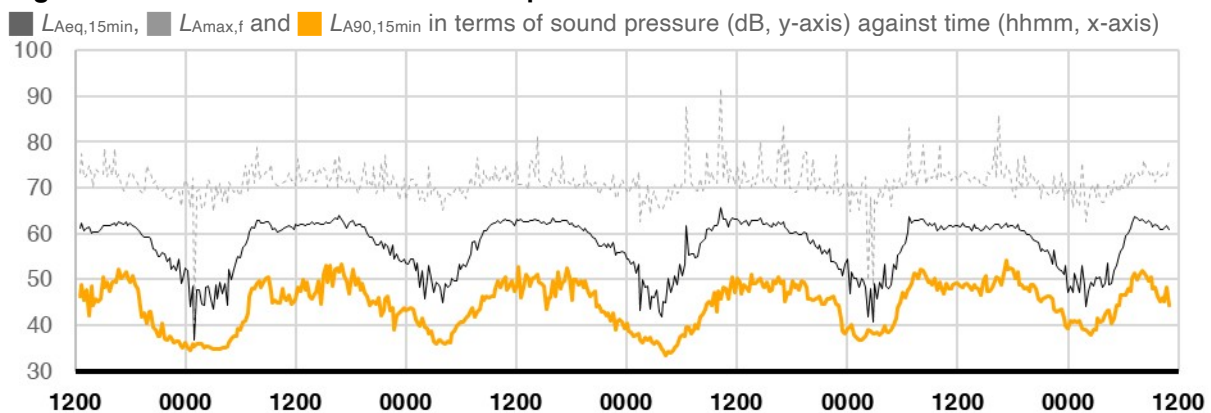
■  $L_{Aeq,15min}$ , ■  $L_{Amax,f}$  and ■  $L_{A90,15min}$  in terms of sound pressure (dB, y-axis) against time (hhmm, x-axis)



**Figure 4: Noise measurement results at position MP3a**



**Figure 5: Noise measurement results at position MP4**



4.13 It should be noted that the clocks changed back by one hour at 02:00 on 27<sup>th</sup> October to mark the end of British Summer Time. For ease of presentation the worst-case noise measurements for the two consecutive hours between 01:00 and 02:00 on this day are shown for each measurement position.

4.14 Comparatively, noise levels at MP1 and MP4 showed a decrease in noise levels from the A4095 (when corrected for distance) during the 2024 survey. It is noted that road works with traffic light control was taking place on the A4095, near to where MP1 was located. Therefore, the higher recorded levels from the 2021 survey have been used to represent the A4095.

4.15 The trainline measurements showed that noise levels remained consistent between the two noise surveys.

4.16 When corrected for distance, the noise levels at MP3a during the 2024 survey showed an increase of 2-3 dB in comparison to the levels at MP3 during the 2021 survey. Therefore, the higher recorded levels from the 2024 survey have been used to represent Bicester Road.

## 5.0 Residential Noise Control Strategy

### Overview and Assumptions

5.1 As the development is currently conceptual, the construction type of the proposed dwellings is unknown. It is assumed for the purposes of the assessment that the dwellings will be up to four

storeys of traditional masonry construction. Any alternative constructions should be reviewed and confirmed to ensure suitable sound insulation.

5.2 It is on this basis that the glazing and ventilation elements have been assessed, as discussed below. Typical room sizes have been assumed as follows:

- Living rooms 5 x 4 x 2.7 m with 3.6 m<sup>2</sup> of glazed elements
- Bedrooms 4 x 3 x 2.7 m with 1.8 m<sup>2</sup> of glazed elements

5.3 These dimensions are provided for information only, to illustrate the assumptions made for the purpose of assessment. They should not be taken as constraints in terms of the design of the proposed dwellings.

## Glazing

5.4 For the purposes of this indicative assessment, three enhanced acoustic glazing types of glazing have been used in the calculations, as stated in **Table 2** below, and are referred to in the following sections. Where an indicative configuration or product is suggested, alternatives can be employed, so long as they perform to an equal or better performance than the octave band specification stated. These are to provide an indication of the amount of mitigation needed at set distances from the roads and railway line and are not restricting factors.

**Table 2** Acoustic performance of glazing elements, dB

Code	Typical Construction	Index	Minimum Apparent Sound Reduction Index, dB at Octave Band Centred Frequency, Hz					
			125	250	500	1k	2k	4k
G1	8.4 mm acoustic laminate glass, 16 mm air space, 10.4 mm acoustic laminate glass	$R'$	28	29	39	44	50	56
G2	10 mm glass, 16 mm air space, 6 mm glass	$R'$	26	27	34	40	39	46
G3	6 mm glass, 16 mm air space, 6 mm glass	$R'$	20	19	29	38	36	45
G5	4 mm glass, 16 mm air space, 4 mm glass	$R_w$	Good quality standard thermal double glazing achieving an acoustic performance of $R_w$ 30 dB					

5.5 The typical glazing configuration is quoted for guidance only and an alternative may be utilised, in any case acoustic performance of the system proposed must be demonstrated to the satisfaction of the appointed acoustic consultant. The sound reduction performances quoted above must be achieved by the glazing systems taken as a whole, in their installed condition.

5.6 The performance specifications therefore apply to the glazing, frames and all seals on any openable parts of the systems and any required ventilation or condensation control mechanisms. This list is not exhaustive: no part of the glazing system shall cause the above figures not to be achieved. The glazing supplier should be expected to prove that the above sound reduction figures can be achieved by the system being proposed.

## Ventilation

5.7 Two ventilator types have been used in the calculations and as with glazing types, are to provide an indication of mitigation necessary, rather than to serve as a restricting factor. These are:

**Table 3** Acoustic performance of trickle ventilator elements

Code	Example Product	Index	Element Normalised Level Difference, dB at Octave Band Centred Frequency, Hz					
			125	250	500	1k	2k	4k
V1	<i>Glidevale</i> Fresh 80 dB	$D_{n,e}$	48	39	44	52	66	61
V2	Direct path trickle ventilators	$D_{n,e}$	35	35	34	35	34	29

5.8 Noise intrusion calculations have included the effects of up to three trickle ventilators to living rooms and two to bedroom areas (noting that fewer would be acceptable). The ventilation strategy should be confirmed as acceptable by a suitably qualified party, in relation to the requirements of Approved Document F.

5.9 The above  $D_{n,e}$  values related to the performance of a single vent in its “open” position, based on its area, standardised to an absorption area of 10 m<sup>2</sup>. Therefore, the figure is higher than the actual insertion loss that will be provided by the ventilator, as it is dependent on the area of the vent. The  $D_{n,e}$  figure is only therefore useful in specifying the product against a given  $D_{n,e}$  requirement.

5.10 The ventilator example set out in the table above is a through wall product; this is provided as an example only and other through-frame or wall configurations may be acceptable, providing the minimum octave band performance requirements are met. The ventilator product supplier should be expected to demonstrate that the above sound reduction figures can be achieved by the system being proposed (in an open position).

## Internal Noise

5.11 The A4095 is the principal noise source across the southern boundary of the site. The railway to the west of the site is seen to be the principal noise source in this part of the site. Bicester Road, which dissects the site in two towards the western side has also been noted as a significant noise source and has been considered in our assessment.

5.12 Just as an example, if façade mitigation measures were to be selected, to the first row of dwellings at **10 m from the A4095**, Glazing Type G1 and Vent Type V1 would be appropriate on any façades with a view of road.

5.13 For dwellings near to the western boundary, at the first row of dwellings at **15 m from the railway**, Glazing Type G3 and Vent Type V1 would be appropriate on any façades with a view of the railway lines.

5.14 For dwellings near Bicester Road, at the first row of dwellings at **12 m from Bicester Road**, Glazing Type G2 and Vent Type V1 would be appropriate on any façades with a view of the road.

5.15 With the above mitigation measures in place, it will be possible to achieve the internal noise criteria as set out within **section 3.0** in the dwellings adjacent to the A4095, set back by 10 m, those adjacent to the railway line set back by 15 m and those set back by 12 m from Bicester Road. Dwellings behind these would typically be screened and could utilise good quality standard thermal double glazing and non-acoustic trickle ventilators.

5.16 It is noted that the distances above of 10m, 12m, and 15m are not a restriction - dwellings are not prohibited from being positioned closer than this but may require enhanced or different glazing and ventilation compared to the examples provided.

5.17 Within the site, the need for mitigation along the realigned A4095 will need to be considered at the reserved matters stage and have regard also to place-making principles requiring a strong design response close to the edge of the carriageway.

## Overheating

5.18 An initial review of overheating has been undertaken by *Turley*, and is detailed further in the Sustainability Statement. The conclusions being that it is not expected that any of the homes will need active cooling. However, this section provides a review of where openable windows for overheating control would not be possible, due to noise, if means of overheating control was deemed to be necessary.

5.19 Based on the guidance set out in **Annex A** and the requirements of Approved Document O, it has been determined that it will not be possible to rely on partially open windows for overheating control for any dwellings that have a direct view of the A4095, the railway or Bicester Road, up to a distance of 100 m from each noise source. Dwellings located closer but screened by other houses will likely be able to utilise openable windows but this should be confirmed at the detailed design stage.

5.20 For dwellings where openable windows cannot be utilised, it is expected that it may be necessary to use alternative / additional methods of ventilation to those described previously. The use of MVHR in these areas may be required, which may then remove the need for the previously described trickle ventilators.

5.21 If mechanical ventilation systems are to be adopted as part of the ventilation strategy, the mechanical ventilation systems should utilise continuously operating fans – with a user operated setting, where possible, to allow an increased ventilation rate when desired.

## External Amenity Areas

5.22 If it is preferable to avoid the need for acoustic fences, dwellings should be orientated such that their associated external amenity areas are screened by the dwellings themselves.

5.23 This would mean locating external amenity areas for dwellings adjacent to the A4095 to the north of the associated dwellings and to the east for dwellings adjacent to the railway. By doing this noise levels within garden spaces should fall at or below the aspirational target of 55 dB  $L_{Aeq,16hr}$ .

5.24 Any gardens directly adjacent to the road or rail sources may require acoustic fencing, potentially up to 2.1 m tall to achieve the aspirational target of 55 dB  $L_{Aeq,16hr}$ .

## 6.0 School Noise Control Strategy

6.1 A similar approach has been undertaken for assessing noise to the proposed primary school, based on noise breaking into a standard classroom space.

### Glazing

6.2 For the purposes of this indicative assessment, one acoustically enhanced glazing type has been used in the calculations, as shown in **Table 4**.

**Table 4** Acoustic performance of glazing elements, dB

Code	Typical Construction	Index	Minimum Apparent Sound Reduction Index, dB at Octave Band Centred Frequency, Hz					
			125	250	500	1k	2k	4k
G4	6 mm glass, 16 mm air space, 4 mm glass	$R'$	17	22	22	28	39	39
G5	4 mm glass, 16 mm air space, 4 mm glass	$R_w$	Good quality standard thermal double glazing achieving an acoustic performance of $R_w$ 30 dB					

6.3 The typical glazing configuration is quoted for guidance only and an alternative may be utilised, in any case acoustic performance of the system proposed must be demonstrated to the satisfaction of the appointed acoustic consultant. The sound reduction performances quoted above must be achieved by the glazing systems taken as a whole, in their installed condition.

6.4 The performance specifications therefore apply to the glazing, frames and all seals on any openable parts of the systems and any required ventilation or condensation control mechanisms. This list is not exhaustive: no part of the glazing system shall cause the above figures not to be achieved. The glazing supplier should be expected to prove that the above sound reduction figures can be achieved by the system being proposed.

#### Ventilation

6.5 One passive ventilator has been used in the calculations, and as with glazing types, are to provide an indication of the mitigation necessary rather than to serve as a restricting factor. The required performance is as follows:

**Table 5** Acoustic performance of ventilator elements

Code	Example Product	Index	Element Normalised Level Difference, dB at Octave Band Centred Frequency, Hz					
			125	250	500	1k	2k	4k
V3	<i>Passivent</i> Aircool 265 mm deep internal louvre with 40% free area	$D_{n,e}$	18	21	24	32	40	42

#### Internal Noise

6.6 The important principle here is that the mitigation measures proposed are by no means the only solution to adequately control noise but represent an example of how the means of mitigation could be approached.

6.7 If teaching spaces were to be located at **10 m from Bicester Road**, it would be necessary to utilise Glazing Type G4 and Vent Type V3 on any façades with a view of the noise source.

6.8 If a buffer zone strategy were to be selected, Glazing Type G5 and Vent Type V3 would suffice on all façades if the teaching spaces were **15 m from Bicester Road**.

## 7.0 Conclusions

7.1 Planning permission is sought for mixed use development to include up to 3,100 residential dwellings, a primary school and commercial spaces on a broad area of land to the northwest of Bicester.

7.2 Suono have undertaken an updated noise survey at the site and a subsequent assessment to advise as to any design constraints on the site, and to provide an initial acoustic mitigation strategy to help guide the development of a layout.

7.3 Generally, the development behind the first line of building fronting the A4095 and Bicester Road, will require only the use of standard thermal double glazing and non-acoustic trickle ventilators will be an acceptable noise mitigation strategy.

7.4 As a general principle, external amenity areas adjacent to either road or railway noise sources should be provided with screening either by their adjoining dwelling or by suitable acoustic fencing. The exact requirements of this can be determined at detailed design stage.

7.5 It is recommended that the school building is not positioned closer than 10 metres from Bicester Road. If the school is positioned at least 35 metres from Bicester Road, the use of standard thermal double glazing and wall mounted ventilators will be an acceptable noise mitigation strategy.

7.6 In principle therefore, the site is suitable for residential and school development providing suitable mitigation measures are put in place, where appropriate.



# Annex A: Planning Policy and Guidance

## National Policy

### National Planning Policy Framework

The NPPF is the relevant document for defining the national policy toward noise sensitive development. The document was originally published in March 2012 and most recently updated in December 2024.

Paragraph 135 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...”*

Further to this and on the subject of noise, paragraph 180 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”*

Paragraph 198 of the 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;”*

Clause “a)” in paragraph 198 makes reference the Noise Policy Statement for England which is discussed in the following section.

The 'agent of change' principle is discussed in paragraph 193 of the NPPF. 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.”*

## Noise Policy Statement for England

The NPSE (March 2010) also 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 mitigation factors need to be considered.

Instead, the NPSE sets out the principle of “SOAEL, LOAEL and NOEL” which are defined as follows:

**Significant Observed Adverse Effect Level (SOAEL):** This is the level [of noise exposure<sup>2</sup>] above which significant adverse effects on health and quality of life occur.

**Lowest Observed Adverse Effect Level (LOAEL):** This is the level [of noise exposure<sup>2</sup>] above which adverse effects on health and quality of life can be detected.

**No Observed Effect Level (NOEL):** This is the level [of noise exposure<sup>2</sup>] 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.

Given the overall thrust of the NPSE, the SOAEL is an important assessment threshold although the NPSE also comments in section 2.22 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.”*

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 again in respect of the NPPF that the overall objective is to avoid or minimise significant adverse impacts; some degree of impact is acceptable, and it is not necessary or reasonable to seek to achieve no impact at all.

In addition to the principles set out above, the NPSE sets out three key 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.”*

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<sup>2</sup> Additional text drawn from the Planning Practice Guidance Definition

Paragraph 2.24 of the NPSE 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.

Each development site must be judged on its ability to deliver on each of these aims, and while rating the prevailing noise against predefined thresholds is no longer necessary, defining the prevailing noise levels is an essential first step in assessing a given site under the current regime.

## Planning Practice Guidance (PPG)

In March 2014 the Department for Communities and Local Government (DCLG) launched the national Planning Practice Guidance (PPG) web-based resource. The PPG on Noise (last updated in July 2019) 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. The PPG includes a section on noise, paragraph 003 of the 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.”*

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 the relevant SOAEL, LOAEL and, by inference, the NOEL. Definitions for these thresholds are provided again with the PPG, which differ very slightly in wording to the NPSE, but are taken to be identical in their meaning.

In relation to the SOAEL, LOAEL and NOEL, the PPG makes the following important statement:

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

The guidance then presents a table, which is reproduced in the following table. The implication of the final line of the table is that only the 'present 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.

On that basis, noise levels deemed to be below the SOAEL can be considered acceptable providing noise has been mitigated and reduced to a minimum.

**Table 6** Planning Practice Guidance summary of noise exposure hierarchy.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect	No specific measures required
<b>NOEL - No Observed Effect Level</b>			
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
<b>LOAEL - Lowest Observed Adverse Effect Level</b>			
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
<b>SOAEL - Significant Observed Adverse Effect Level</b>			
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

It is noteworthy that the PPG states that:

*“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).

## Guidance Documents

### The ProPG and BS 8233:2014

The Professional Practice Guidance on Planning & Noise – New Residential Development, 2017 (ProPG) was prepared by the Institute of Acoustics, the Chartered Institute of Environmental Health and the Association of Noise Consultants.

In relation to residential development, the ProPG builds on the principles and criteria set out BS 8233:2014 – Guidance on sound insulation and noise reduction for buildings (BS 8233).

While the ProPG it is helpful in many ways, it must be noted that the guidance and supplementary documents “does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy on which users should take their own advice as appropriate”.

Section 2.27 of the ProPG states:

*“It is considered that suitable guidance on internal noise levels can be found in “BS8233:2014: Guidance on sound insulation and noise reduction for buildings”. Table 4 in Section 7.7.2 of the standard suggests indoor ambient noise levels for dwellings (when unoccupied) and states that “in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values”. The standard states (Section 7.7.1) that “occupants are usually more tolerant of noise without a specific character” and only noise without such character is considered in Table 4 of the standard.”*

Indeed, ProPG expands on the advice and notes of BS 8233 Table 4, with relevant sections presented below:

**Table 7** BS8233/ProPG internal noise criteria

Activity	Location	Internal Ambient Noise Level	
		Daytime (0700-2300)	Night time (2300-0700)
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 $L_{Amax,f}$ (Note 4)

Note 4

*“... 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 5

*“... 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 and, in this scenario, the internal  $L_{Aeq}$  target levels should not normally be exceeded subject to the further advice in Note 7.”*

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.”*

With respect to external amenity spaces, ProPG again points to BS 8233 that 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  $L_{Aeq,16hr}$ ...”*

*“...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.”*

The above thresholds (adjust as necessary taking into account the relevant notes) are taken to correspond to LOAELs, when considered in relation to the PPG and NPSE.

The ProPG sets out the principle of the “Acoustic Design Statement” (ADS) in which noise is quantified and assessed, and mitigation measures determined in line with the methodology set out therein. The preparation of an ADS is not relevant or appropriate for all sites, however many of the principles are those which would typically be adopted when preparing noise assessment for planning submissions etc.

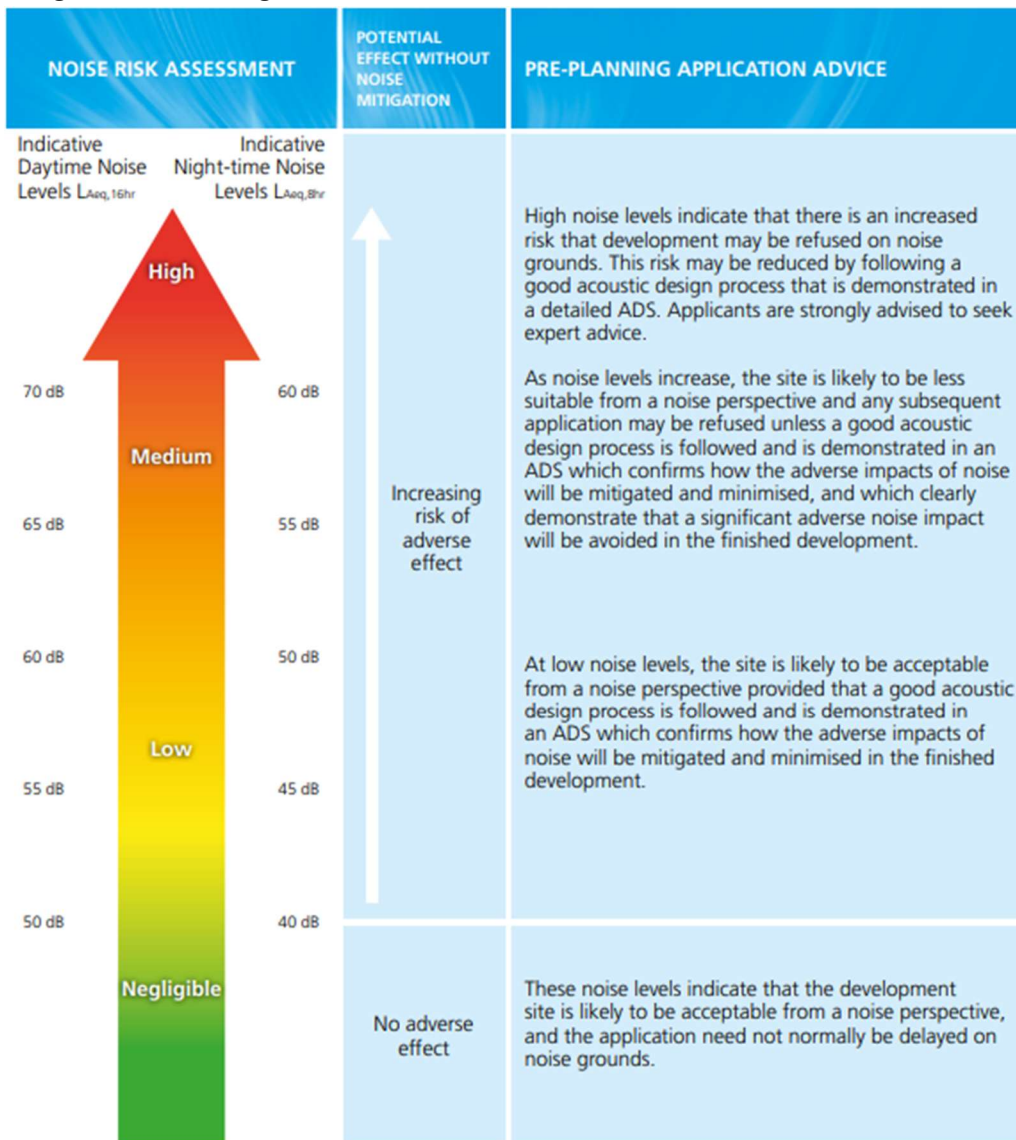
Features which may be included within an ADS comprise:

- An initial site noise risk assessment;
- A description of external site noise levels before and after mitigation measures;
- Demonstrations of good acoustic design principles;

- Details of how internal noise guidelines will be achieved;
- Assessment of the impact of  $L_{Amax,F}$  noise levels where guidelines values are exceeded;
- An aim to achieve internal noise guidelines with windows open where practical, noting this approach will not necessarily be possible. Due consideration should be given to ventilation and thermal comfort with windows closed;
- Acoustic design to achieve good living conditions where internal noise guidelines can only be achieved with windows closed (noting the guidelines are not applicable when windows are open to provide purge ventilation);
- Information regarding the steps taken to minimise overheating where this is relevant to noise;
- A consideration of noise to external amenity areas;
- A presentation of the findings of the assessment, resulting noise impacts and any mitigation measures that may be required.

With regard to the initial site noise risk assessment, the ProPG sets out the following table. It is important to understand that a site with external noise levels categories as high risk does not mean that site is necessary unsuitable for development. Instead, it means that a good acoustic design process must be followed to ensure suitable conditions are provided to future occupants.

**Image 1: ProPG Stage 1 Initial Site Risk Assessment**



**Figure 1 Notes:**

- a. Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- b. Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".
- c.  $L_{Aeq,16hr}$  is for daytime 0700 – 2300,  $L_{Aeq,8hr}$  is for night-time 2300 – 0700.
- d. 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 negligible risk.

As neither the ProPG of BS 8233 form statutory guidance or regulations, it falls to the acoustics practitioner (or other similar party) to determine how the documents should be interpreted and how their contents are applied to any given scheme.

**Building Regulations Approved Document O: Overheating**

The Building Regulations Approved Document O (ADO) on overheating was published In December 2021. It sets out requirements to ensure that overheating (and related effects) within new residential buildings are suitably controlled.

ADO took effect on 15 June 2022 in England but does not apply to work subject to a building notice, full plans application or initial notice submitted before that date, provided the work for each building was started before 15 June 2023.

The statutory, legal requirements of ADO are replicated below, with particular attention drawn to part O1(2)(a):

## Requirement O1(2)(a)

This section deals with requirement O1(2)(a) of Schedule 1 to the Building Regulations 2010.

Requirement	
<i>Requirement</i>	<i>Limits on application</i>
<b>O1 Overheating mitigation</b>	
(1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel ("residences") to—	
(a) limit unwanted solar gains in summer;	
(b) provide an adequate means to remove heat from the indoor environment.	
(2) <b>In meeting the obligations in paragraph (1)—</b>	
(a) <b>account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and</b>	
(b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.	

## Intention

In the Secretary of State's view, requirement O1(2)(a) is met in a new residential building if the building's overheating mitigation strategy for use by occupants takes account of all of the following.

- a. Noise at night – paragraphs 3.2 to 3.4.
- b. Pollution – paragraph 3.5.
- c. Security – paragraphs 3.6 and 3.7.
- d. Protection from falling – paragraphs 3.8 to 3.10.
- e. Protection from entrapment – paragraph 3.11.

It can be seen that accounting for potential noise effects at night is an important consideration when addressing the requirements of part O1(2)(a), in relation to ensuring the "reasonable enjoyment of the residence".

Section 3.2-3.4 of ADO sets out the following guidance with respect to noise. This does not form part of the statutory requirement but serves as guidance for how, in the Secretary of State's view, noise should be addressed when considering overheating:

## Noise

- 3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).
- 3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.
- 40dB  $L_{Aeq,T}$  averaged over 8 hours (between 11pm and 7am).
  - 55dB  $L_{AFmax}$  more than 10 times a night (between 11pm and 7am).
- 3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' *Measurement of Sound Levels in Buildings* with the overheating mitigation strategy in use.

**NOTE:** Guidance on reducing the passage of external noise into buildings can be found in the *National Model Design Code: Part 2 – Guidance Notes* (MHCLG, 2021) and the Association of Noise Consultants' *Acoustics, Ventilation and Overheating: Residential Design Guide* (2020).

The language of the text preceding the “limits” in section 3.3 suggest that these could be taken as guideline figures to assist the designer in identifying where noise issues may arise. The guidance does not state that noise levels must not exceed the “limits”, or that windows would always be shut where the above thresholds are exceeded, only that “windows are likely to be closed during sleeping hours” under such noise conditions.

At time of writing draft acoustics industry guidance on the interpretation of the ADO is subject to consultation (discussed in the following section). It may therefore be necessary to revise the approach regarding how overheating is considered in the context of noise.

It is important to note that in the context of ADO, the use of mechanical ventilation (e.g. MVHR) is considered a “passive means” of cooling a building. As per the requirements of ADO, “mechanical cooling” such as air conditioning may only be considered where all other passive methods of cooling are found to be insufficient.

### Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O, July 2022 (Draft for Consultation)

The above-titled guide provides guidance for practitioners when implementing the requirements of Approved Document O. It is stated as being designed to assist the industry in the understanding of what is published in the regulation and provides interpretation and clarification on the content of the published regulation. The guidance set out within the document must however be given an appropriate weight in relation to its draft status and may be subject to change.

The following external noise thresholds are set out in table 1 of the guidance, which relate to high and moderate overheating risk areas (as described within ADO):

**Table 1 External Noise Levels Above Which the Simplified Method Cannot Be Used**

Parameter	High Risk Location	Moderate Risk Location
$L_{Aeq,8hr}$ averaged over 8 hours (between 11pm and 7am)	44 dB	49 dB
$L_{AFmax}$ more than 10 times a night (between 11pm and 7am)	59 dB	64 dB

Note: Several assumptions have been used to determine the outside-to-inside level difference. These are: 2.4m bedroom height, 0.5s bedroom RT, simple hole in the facade of area sufficient to provide the required equivalent area, no sound transmission other than via the opening. Calculation according to Equation G.1 of BS 8233:2014 [Ref. 7].

The table sets external noise thresholds based on achieved the 40 dB  $L_{Aeq,8hour}$  level set out in ADO, but with a 4 dB reduction in noise offered by an open window in high overheating risk areas (based on an approximation of extended open areas) or a 9 dB reduction in moderate-risk locations.

As the site falls outside of London (and the other areas identified in Appendix C of the ADO), it is classed as a having a “moderate” overheating risk when considered in accordance with the simplified method set out within the ADO. Therefore, external level of 49 dB  $L_{Aeq,8hour}$  and 64 dB  $L_{AFmax}$  can be taken as a pessimistic thresholds to identify where open windows could not be used to control overheating effects. This is on the basis that windows would be circa 30° open.

Appendix A of the guide provides a method for calculating the potential loss through a partially open window where further detailed assessment is required. The calculation method is replicated below:

To estimate the internal noise level from the predicted acoustic open area, Equation G.1 of BS 8233:2014 can be used, reduced for a single element as follows:

#### Equation 1

$$L_2 = L_{1,ff} - R + 10 \log \left( \frac{ST}{V} \right) + 11$$

Where:

- $L_2$  is the internal level
- $L_{1,ff}$  is the free-field external level (i.e. assumed to be 3 dB lower than a level 1m away from the façade according to BS 8233)
- R is the sound reduction index, assumed to be zero for the open area, S (m<sup>2</sup>)
- T is the reverberation time, 0.5 seconds for the standardised internal level
- V is the room volume (m<sup>3</sup>). Consider as the floor area x room height.
- S, open area as a fraction of floor area, e.g. 0.05 x floor area.

The floor areas cancel, and for 5 % of the floor area to be open and a room height of 2.4 m:

#### Equation 2

$$L_{1,ff} - L_2 = 0 - 10 \cdot \log \left( \frac{0.05 \times 0.5}{2.4} \right) - 11 = 9 \text{ dB}$$

## AVO Residential Design Guide, 2020

The Acoustics, Ventilation and Overheating Residential Design (AVO) Guide, prepared by the Association of Noise Consultants was written to provide guidance on the control of noise in the context of overheating control. It is noteworthy that this guidance was published before both the ADO and ANC guidance set out in the previous section and therefore has to a large degree been superseded. It is still however useful reference and a helpful guide for context.

A key principle of the AVO is that internal noise in excess of the normal criteria set out within the ProPG and BS 8233:2014 are acceptable during the overheating condition, when open windows are used to provide a cooling effect. The amount by which internal noise conditions may be elevated is related to the duration over which overheating occurs and the guidance recommends the numerous methods to control overheating (beyond simple open windows).

Where external noise levels are equal to or fall below circa 53 dB  $L_{Aeq,16hour}$  or 48 dB  $L_{Aeq,8hour}$  the use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect. Above these thresholds, it is for the acoustics practitioner to determine the potential for adverse effect.

Where external noise levels are high (above approximately 65 dB  $L_{Aeq,16hour}$  or 55 dB  $L_{Aeq,8hour}$ ) a “Level 2 assessment” is recommended, where the internal noise levels in the above BS 8223 table are effectively taken as the LOAEL.

Interpreted values of the AVO guide Table 3-3 (for Level 2 assessment) are repeated below with reference to the PPG thresholds for clarity.

**Table 8** Summary of AVO Criteria

Bedroom Internal Ambient Noise Level (with windows open)			Action
Daytime $L_{Aeq,16hour}$	Night $L_{Aeq,8hour}$	Night $L_{Amax,F}$	
<b>NOAEL – No Observed Adverse Effect Level</b>			
≤ 35 dB	≤ 30 dB	Not normally exceeding 45 dB more than 10 times per night	No specific measures required
<b>LOAEL - Lowest Observed Adverse Effect Level</b>			
35 dB	30 dB	Exceeding 45 dB more than 10 times per night but not exceeding 65 dB	Mitigate and reduce to a minimum
<b>SOAEL - Significant Observed Adverse Effect Level</b>			
50 dB	42 dB	Normally exceeds 65 dB	Avoid / Prevent

The implication is that for circumstances where additional ventilation is necessary for cooling, but internal noise levels with windows open are between the LOAEL and a SOAEL, means to reduce noise should be introduced where possible but it is not necessary to achieve the BS 8233 levels.

### British Standard BS 4142

British Standard 4142:2014+A1:2019 (Methods for rating and assessing industrial and commercial sound) states in section 1.1:

*“This British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:*

- a) sound from industrial and manufacturing processes;*
- b) sound from fixed installations which comprise mechanical and electrical plant and equipment;*
- c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and*
- d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from fork-lift trucks, or that from train or ship movements on or around an industrial and/or commercial site.*

*The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.”*

The standard states its applications as,

*“This standard is applicable to the determination of the following levels at outdoor locations:*

- a) rating levels for sources of sound of an industrial and/or commercial nature; and*
- b) ambient, background and residual sound levels,*

for the purposes of:

- 1) investigating complaints;
- 2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and
- 3) assessing sound at proposed new dwellings or premises used for residential purposes.”

BS 4142 sets out a daytime assessment period of 1 hour and night time period of 15 minutes. The assessment methodology requires that a “specific level” from a given noise source is determined considering these time periods. Character corrections should be added if the noise has tonality, impulsivity, intermittency or other such characteristics; this gives the “rating level” of a given noise source. The level of the correction is based upon how the noise is perceived, as set out in the standard.

The rating level of noise,  $L_{Ar, Tr}$ , for the relevant assessment period is the calculated noise level at the nearest receiver location, adjusted to take into account the acoustic characteristic of the noise. Acoustic feature corrections can be made to account for tonality, impulsivity, intermittency and other characteristics present in the resultant sound at the receiver position. The magnitude or appropriateness of any correction will depend both on the type of noise source and the context in which it is perceived. Similarly, in accordance with BS 4142, the period of time for which an individual noise source is active during the relevant reference time period will also be considered in establishing the rating level.

It will also be necessary to consider the existing noise climate and what sound sources contribute to it. For example, where a noise generating activity is proposed adjacent to an existing similar noise generating site, the impact of the new noise source would be less than if it were to be planned in a location where its character and type is different to and more noticeable than any existing noise source nearby.

With regard to the background sound level against which the rating level is compared, the standard states the following:

*“In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.”*

The periods of interest over a 24 hour day are usually related to day time activities (07:00-23:00h) and night time (23:00-07:00h). However the standard makes the following statement:

*“Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes. Furthermore, in this general context it can also be necessary to separately assess weekends and weekday periods.”*

Therefore, the periods of time which can be considered as ‘waking up’ and ‘falling asleep’ stages, for example 06:00h to 07:00h and 23:00h to 24:00h, may need to be considered independently. Alternative periods may also be identified where breakdown beyond the standard day and night time analysis will be necessary, for example where background sound levels are shown to be regularly elevated.

Similarly, both weekend and weekday periods may need to be considered separately, with criteria set for both. The requirement to analyse specific time periods should be considered for each site individually.

Once the rating level at each receptor has been calculated, reference can be made to the following commentary in BS 4142 in relation to conducting an initial assessment of the impact, based on the difference between the rating level of the noise source and the pre-existing background sound level.

*“Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9), and consider the following.*

*NOTE 1 More than one assessment might be appropriate.*

*a) Typically, the greater this difference [between industrial site noise rating level and baseline background level], the greater the magnitude of the impact.*

*b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

*c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*

*d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

*NOTE 2 Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.”*

In situations where background sound levels are low, it is important to again consider context, rather than simply basing an assessment of impact on a difference in noise level, as suggested above. With regards to context in relation to absolute noise levels, the standard states the following:

*“1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

*Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.*

*Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.”*

British Standard BS 4142:2014 does not set out guidance for what constitutes low background noise levels. Instead, it can be inferred from the World Health Organisation Night Guidelines for Europe (2009) that a noise level of  $\geq 30$  dB  $L_{\text{night, outside}}$  is not likely to give rise to any substantial observed noise effects.

Although the above criterion relates to an 8-hour period between 23:00 and 07:00 (i.e. the night time), the application of the criterion to any given 15 minute period during the night time (or one hour if applied to the daytime) effectively makes the criterion more stringent.

Taking into account the above therefore, it is suggested that noise limits for mechanical services plant equipment should be set with a lower threshold of 30 dB  $L_{Ar,Tr}$ . Noise levels equal to or below this threshold figure would not be expected to give rise to substantial observed effects (i.e. the impact would be low).

From the above, it can be concluded that ensuring noise emissions from a given site or activity do not exceed noise limits set at a level 5 dB above the representative background noise levels (or at the 30 dB  $L_{Ar,Tr}$  threshold where background sound level are low) at a given receptors will provide an indication that noise adverse effect will **not** occur. Such a limit would therefore represent the LOAEL in relation to the thresholds set out within the PPG.

