

REPORT TITLE:

South Holland Extra Care Unit:

Noise Survey and Assessment

CLIENT DETAILS:

Willmott Dixon Construction Limited.

DATE:

11th October 2024

REPORT REFERENCE:

PC-24-0203-RP1

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Document Status and Revision Schedule

Issue/Revision	Description/Comments	Date	Prepared by	Approved by
-	Checked & Authorised	11/10/24	JCB	MJ

1 Executive Summary

The prevalent noise levels at the site of the proposed South Holland Extra Care Unit have been measured over a working day period to assess the impact of the existing noise sources. The potential impacts of the proposed development on surrounding areas are also considered.

The site is affected mainly by low levels of traffic noise and sporadic aircraft noise.

It is considered that using guidelines from the *World Health Organisation* alongside levels provided in *BS8233* for noise conditions within residential dwellings, and *HTM (Health Technical Memorandum: Acoustics)* recommended internal noise levels in ward single person will ensure that 'significant adverse impacts on health and quality of life' are avoided as required by the Noise Policy Statement for England.

Consequently, an adequate level of noise mitigation measures will be required to ensure that future residents of the site are protected from the existing ambient noise.

If mitigation measures are included to achieve the specified internal noise levels, future residents of the proposed development will be protected from the dominant noise sources. Mitigation measures should include the use of appropriate glazing coupled with trickle ventilation.

2 Introduction

Pace Consult was commissioned by Willmott Dixon Construction Limited to undertake an assessment of the noise impact associated with the proposed development name South Holland Extra Care Unit.

There is a potential for road traffic noise, and sporadic aircraft noise to have an impact on the proposed development. Therefore, the impact of the existing noise levels has been considered in assessing the site's suitability for residential use.

The assessment was undertaken in accordance with national standards and guidelines for residential dwellings.

3 The Site

3.1 Location and Description

The site is surrounded by residential dwellings to the north and eastern elevations, commercial units and a car park to the southern elevation, and an open plan recreational ground to the western elevation.

The site is affected mainly by low noise emission from Pinchbeck Rd, and the adjacent car park.

3.2 Proposed Development

The proposal is to build a four-storey residential block containing residential units (1 and 2 bed apartments), and staff rooms. The image overleaf shows the level 00 for indicative purposes.



Figure 1. Proposed development level 00.

4 Assessment Methodology

4.1 National Planning Policy Framework and the Noise Policy Statement for England

National Planning Policy Framework and the Noise Policy Statement for England

The National Planning Policy Framework (NPPF) sets out the general requirements for gaining planning permission. Comments regarding noise found within the document are as follows.

Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.

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.

The NPPF references the Noise Policy Statement for England (NPSE) which in turn references two concepts used by the World Health Organisation (WHO) which can be used

to ascertain relevant noise levels for individual sites. The concepts are LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level).

The NPPF then gives three aims to adhere to:

Aim 1 – 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.

Aim 2 – 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.

Aim 3 – 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.

In the context of assessing noise impact from the site, acceptable amenity levels for gardens are discussed within WHO Guidelines for Community noise, these criteria are also taken up by BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings.

4.2 British Standard BS8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings

The scope of BS8233 is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate.

BS8233 suggests suitable internal noise levels within different types of buildings, including residential dwellings. It suggests an internal noise level of 35 dB $L_{Aeq,T}$ during day time, and 30 dB $L_{Aeq,T}$ during night time within bedrooms. In the daytime, the standard recommends 35 dB $L_{Aeq,T}$ in living rooms and in 40 dB $L_{Aeq,T}$ dining rooms. Table 4 below is extracted from this document.

BS8233:2014 Excerpt:

7.7.2 Internal ambient noise levels for dwellings

In general, for steady external noise sources, it is **desirable** that the internal ambient noise level does not exceed the guideline values in Table 4.

Table 4 Indoor ambient noise levels for dwellings

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

Figure 2. BS8233:2014 recommended indoor ambient noise levels in residential areas.

NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

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.

4.3 World Health Organisation (WHO) ‘Guidelines for Community Noise’

This document states that, in dwellings, the critical effects of noise are on sleep, annoyance and speech interference. According to this document, to protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq} .

To avoid any possibility of sleep disturbance, indoor guideline values for bedrooms are 30 dB L_{Aeq} for continuous noise and 45 dB L_{Amax} for single sound events. These indoor noise levels correspond to sound pressure levels at the outside façades of the living spaces of 45 dB L_{Aeq} and 60 dB L_{Amax} . These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.

4.4 BS4142:2014 + A1: 2019 Methods for rating and assessing industrial and commercial sound

This standard sets out a methodology for the assessment of whether noise from factories, industrial premises or fixed installations and sources of an industrial/commercial nature.

The procedure contained in BS4142 for assessing the impact is to compare the measured or predicted noise level from the source in question, the ‘specific noise level’, at the assessment position with the correct background noise level for the worst case time of operation.

Where the noise contains a ‘distinguishable, discreet, continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks or clatters), or if the

noise is irregular enough to attract attention' then a range of correction factors can be added to the specific noise level as appropriate to obtain the 'rating level'.

As this is a prescriptive report prior to plant installation, overall rating noise levels will be specified for the new installation. Compliance with the rating value will be necessary to provide evidence that significant adverse impact has been avoided as required by the NPSE.

To assess the impact, the measured background noise level is subtracted from the rating noise level. BS4142 states:

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessment and arriving at decisions, therefore, it is essential to place the sound in context.

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.

- a) Typically the greater the difference, the greater the magnitude of the impact.*
- b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- c) A difference of around 5dB 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.*

Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including 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.

- 2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*

- 3) *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as;*
- i) *Façade sound insulation treatment*
 - ii) *Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and Acoustic screening.*

4.5 ProPG: Planning & Noise Professional Practice Guidance on Planning & Noise.

This document encourages improvements in the consistency and quality of planmaking and decision-taking in relation to acoustic matters. The context is primarily development control, although some of the content is relevant to strategic planning. The preparation of this ProPG acknowledges and reflects the Government's overarching Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance (including PPG-Noise), as well as other authoritative sources of guidance. This ProPG provides advice for Local Planning Authorities (LPAs) and developers, and their respective professional advisers.

The primary goal of this ProPG is to assist the delivery of sustainable development by promoting good health and wellbeing through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise.

The recommended approach is also considered suitable where some industrial or commercial noise contributes to the acoustic environment provided that it is "not dominant".

This ProPG advocates a systematic, proportionate, risk based, 2-stage, approach.

Stage 1 – *an initial noise risk assessment of the proposed development site; and*

Stage 2 – *a systematic consideration of four key elements.*

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- *Element 1 – demonstrating a "Good Acoustic Design Process";*
- *Element 2 – observing internal "Noise Level Guidelines";*
- *Element 3 – undertaking an "External Amenity Area Noise Assessment"; and*
- *Element 4 – consideration of "Other Relevant Issues".*

The two stages are described below:

Stage 1:

This section illustrates how an initial noise risk assessment is linked with an increasing risk of adverse effect from noise and how this in turn is broadly associated with indicative noise levels derived from current guidance and experience. The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site and should be interpreted flexibly having regard to the locality, the project and the wider context. The figure 1 is included below.

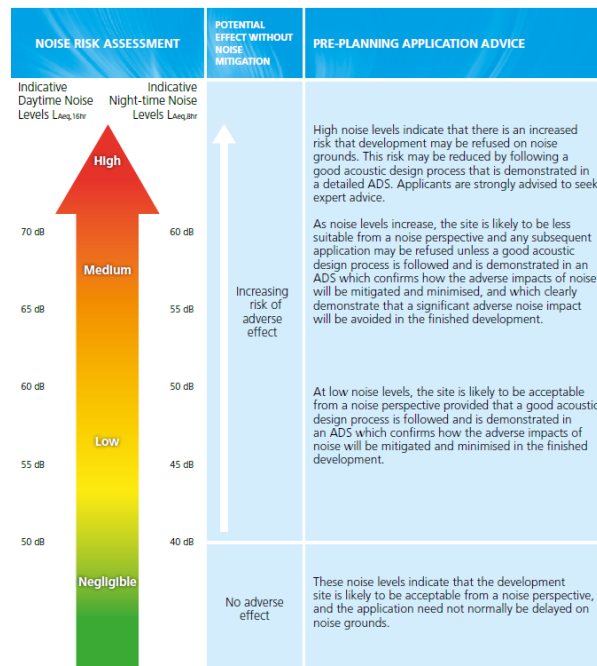


Figure 3. Noise risk assessment.

Figure notes.

- Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- 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”.
- LAeq,16hr is for daytime 0700 – 2300, LAeq,8hr is for night-time 2300 – 0700.
- 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.

Stage 2: The four key elements.

Stage 2: Element 1 – Good Acoustic design Process.

Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements.

Stage 2: Element 2 – Internal Noise Levels Guidelines.

The recommended ProPG internal noise level guidelines are included below.

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB LAeq,16 hr	-
Dining	Dining room/area	40 dB LAeq,16 hr	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16 hr	30 dB LAeq,8 hr 45 dB L _{max,F} (Note 4)

Figure 4. Recommended internal noise levels.

NOTE 1 The Table provides recommended internal LAeq target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources.

NOTE 2 The internal LAeq target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise.

NOTE 3 These internal LAeq target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

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_{max,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_{max,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).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. 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 LAeq target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal LAeq target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal LAeq levels start to exceed the internal LAeq 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 LAeq 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).

Stage 2. Element 3 – External Amenity Area Noise Assessment.

The ProPG external amenity area noise assessment reflects and extends the advice contained in BS8233:2014 and the current Government guidance in PPGNoise as detailed in the Element 3 box below.

3(i) "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".

3(ii) "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 LAeq,16hr."

3(iii) "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."

3(iv) Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.

3(v) Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or
- a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or
- 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, publically accessible, external 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 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.

Stage 2: Element 4 – Assessment of Other Relevant Issues.

This element seeks to build upon relevant national and local planning and noise policies (item 4(i)) to provide a systematic list of recommendations for the issues that should be considered before making a judgement about the noise aspects of a particular planning proposal for new residential development. The recommended relevant issues are included below.

4(i) compliance with relevant national and local policy

4(ii) magnitude and extent of compliance with ProPG

4(iii) likely occupants of the development

4(iv) acoustic design v unintended adverse consequences

4(v) acoustic design v wider planning objectives

4.6 Acoustic ventilation and overheating. Residential design guide.

This acoustic design guide provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed.

This guide is intended for the consideration of new residential development that will be exposed predominantly to airborne sound from transport sources, and to sound from mechanical services that are serving the dwelling in question.

Basically, the recommended indoor ambient noise levels is related to the duration for which the “overheating condition” occurs. The figures below include an example of the recommended indoor ambient sound levels during day/night-time based on the duration of the overheating conditions.

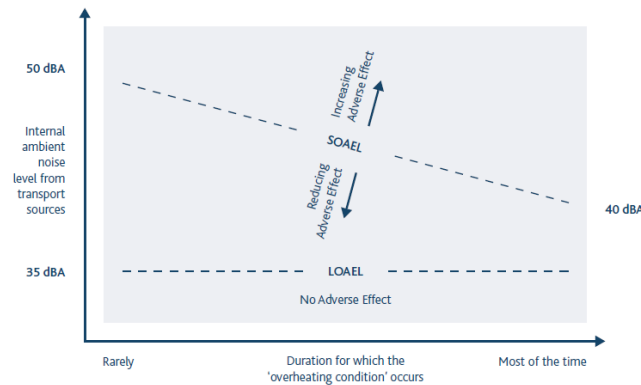


Figure 5. Daytime conditions.

As can be seen from the figure above, if the overheating condition occurs most of the time, the recommended indoor ambient noise levels should not exceed 40 dBA during daytime (bedrooms/living rooms areas). However, If the overheating occurs rarely, the indoor ambient sound levels should not exceed 50 dBA in order to avoid adverse noise effect.

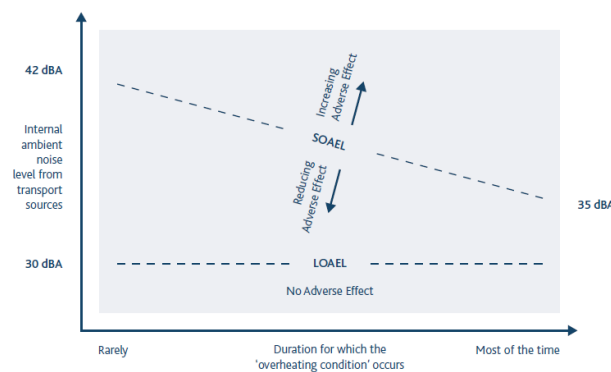


Figure 6. Night time conditions.

During night time conditions, the indoor ambient sound levels in bedrooms should not exceed 35 dBA, when the overheating condition occurs most of the time, and 42 dBA when the overheating occurs rarely. Living rooms noise criteria is not considered during night-time conditions.

4.7 Overheating Approved Document O.

Section 3 of this document includes the minimum internal noise levels in bedrooms during night time. sections 3.2,3.3, and 3.4 are included below for reference.

Noise

3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).

b. 55dB LAFmax, 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).

4.8 Health Technical Memorandum. 08-01: Acoustics.

This guidance recommends the internal noise levels in different spaces within healthcare centres. Table 1 of this guidelines sets out recommended criteria for noise intrusion for the completed building (including normal furniture). Table 1 extracted from HTM is included below.

Room type	Example	Criteria for noise intrusion to be met inside the spaces from external sources (dB)
Ward – single person	Single-bed ward, single-bed recovery areas and on-call room, relatives' overnight stay	40 $L_{Aeq, 1hr}$ daytime 35 $L_{Aeq, 1hr}$ night 45 $L_{Amax, f}$ night
Ward – multi-bed	Multi-bed wards, recovery areas	45 $L_{Aeq, 1hr}$ daytime 35 $L_{Aeq, 1hr}$ night 45 $L_{Amax, f}$ night
Small office-type spaces	Private offices, small treatment rooms, interview rooms, consulting rooms	40 $L_{Aeq, 1hr}$
Open clinical areas	A&E	45 $L_{Aeq, 1hr}$
Circulation spaces	Corridors, hospital street, atria	55 $L_{Aeq, 1hr}$
Public areas	Dining areas, waiting areas, playrooms	50 $L_{Aeq, 1hr}$
Personal hygiene (en-suite)	Toilets, showers	45 $L_{Aeq, 1hr}$
Personal hygiene (public and staff)	Toilets, showers	55 $L_{Aeq, 1hr}$
Small food-preparation areas	Ward kitchens	50 $L_{Aeq, 1hr}$
Large food-preparation areas	Main kitchens	55 $L_{Aeq, 1hr}$
Large meeting rooms (>35 m ² floor area)	Lecture theatres, meeting rooms, board rooms, seminar rooms, classrooms	35 $L_{Aeq, 1hr}$
Small meeting rooms (≤35 m ² floor area)	Meeting rooms, seminar rooms, classrooms, board rooms	40 $L_{Aeq, 1hr}$
Operating theatres	Operating theatres	40 $L_{Aeq, 1hr}$ 50 $L_{Amax, f}$
Laboratories	Laboratories	45 $L_{Aeq, 1hr}$

Table 7. Criteria for noise intrusion from external sources.

Notes. Night is defined as the hours between 23.00 and 07.00. A $L_{Amax, fast}$ dB limit for short-term events is included for sleeping areas and operating theatres.

The intrusive noise criteria do not include plant noise from adjacent hospital buildings.

5 Survey Method and Equipment

5.1 Survey

The noise survey was carried out between Tuesday 8th and Wednesday 9th to measure representative noise levels at the site of the proposed development during a typical weekday period.

The noise survey comprised of one unattended and three attended monitoring locations on site which are described in detail below.

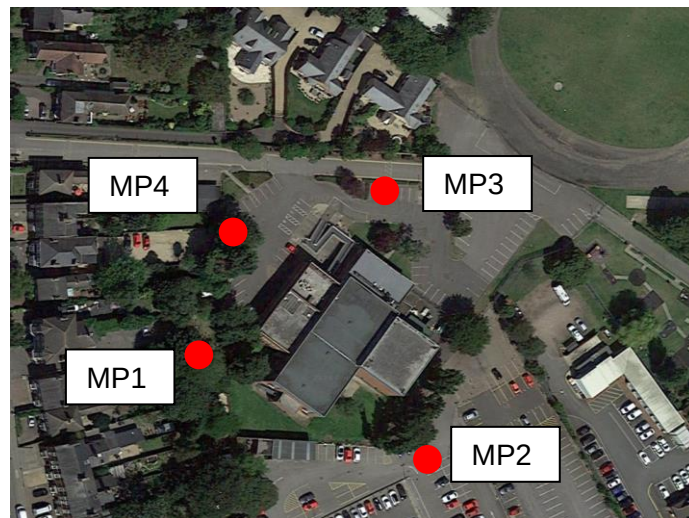


Figure 8. Noise survey locations.

- Western boundary (MP1): Unattended continuous monitoring position recorded the noise levels at the Western boundary of the proposed development. The sound level meter was positioned 3.5 m from any reflective surface, and 1.5 m above ground floor. The figure below shows the measurement location.



Figure 9. Noise measurement position MP1.

- Southern boundary (MP2): Attended monitoring position recorded the noise levels at the Southern boundary of the proposed development. The sound level meter was positioned at 3.5 m from any reflective surface, and 1.5 m above ground floor. The figure below shows the measurement location.

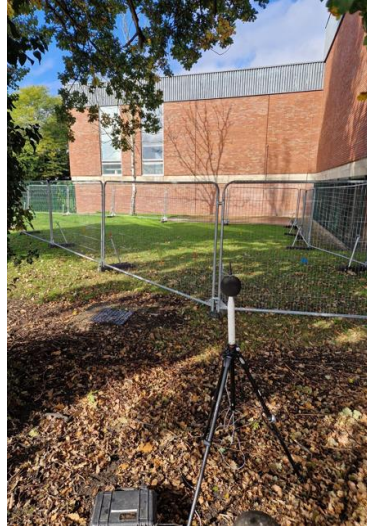


Figure 10. Noise measurement position MP2.

- Eastern boundary (MP3): Attended monitoring position recorded the noise levels at the Eastern boundary of the proposed development. The sound level meter was positioned at 3.5 m from any reflective surface, and 1.5 m above ground floor. The figure below shows the measurement location.



Figure 11. Noise measurement position MP3.

- Northern boundary (MP4): Attended monitoring position recorded the noise levels at the Northern boundary of the proposed development. The sound level meter was positioned at 3.5 m from any reflective surface, and 1.5 m above ground floor. The figure overleaf shows the measurement location.



Figure 12. Noise measurement position MP3.

Noise measurements were made with calibrated precision grade sound level meters which achieve the requirements of BS EN 61672:2013. The survey was carried out in accordance with the principles of BS 7445 Parts 1-3, '*Description and Measurement of Environmental Noise*', *British Standard* BS4142: 2014: + A1:2019 *Methods for rating and assessing industrial and commercial sound*.

5.2 Equipment

- Svantek 971 precision grade sound level meters. Serial numbers 34927, and 34937.
- Norsonic Sound Calibrator 1251. Serial number 32199.
- Environmental wind shields

The sound level meters were calibrated before and after the survey. No significant drift was noted between the two reference checks.

5.3 Weather

In order to evaluate the weather conditions, three e weather check measurements were undertaken on site. During the weather checks, it was noted that the climatic conditions were stable during the whole measurement period. Period of light rain was detected during Wednesday early morning.

Table 1. Weather condition.				
	°C	Wind speed m/s	Relative Humidity %	Wind direction
(12:30) Tuesday	17	1.0	45	E
(21:30) Tuesday	9	0.8	69	N
(10:00) Wednesday	14	0.9	85	N

The weather condition was taken using a Pocket weather tracker KESTREL 4500.

Conditions were considered conducive to environmental noise measurement.

6 Survey Results

The measurement survey at all monitoring locations comprised of consecutive measurement periods in terms of the most relevant standards and guidelines.

The tables below include the results of the noise survey.

Table 2. Measured continuous noise level at MP1			
Time	L _{Aeq} , T dB	L _{Amax} (fast), T dB 95th Percentile	L _{A90} , T dB Typical Background. Statistic mode
Day (07:00 – 23:00)	49	N/A	41
Night (23:00 -07:00)	37	55	32

The table below includes the center frequency of the L_{Aeq} and L_{Amax}(fast) at MP1

Table 3. Centre frequency L _{Aeq} , and L _{Amax} (fast) MP1								
Time	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	dBA
L _{Aeq} Day (07:00 – 23:00)	58	53	52	48	43	38	35	49
L _{Aeq} Night (07:00 – 23:00)	49	42	35	32	32	25	26	37
L _{Amax} (fast) Night (07:00 – 23:00)	67	60	57	53	47	43	37	55

The table below shows the noise levels recorded at MP2

Table 4. Measured continuous noise level at MP2			
Time	L _{Aeq} , T dB	L _{Amax} (fast), T dB 95th Percentile	L _{A90} , T dB Typical Background. Statistic mode
Day (11:00 – 12:00)	48	N/A	44

The table below includes the center frequency of the L_{Aeq} metric at MP2

Table 5. Centre frequency L_{Aeq} , and $L_{Amax(fast)}$ MP2								
Time	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	dBA
L_{Aeq} Day (11:00 – 12:00)	56	52	49	44	43	39	35	48

The table below shows the noise levels recorded at MP3

Table 4. Measured continuous noise level at MP3			
Time	$L_{Aeq, T}$ dB	$L_{Amax(fast), T}$ dB 95th Percentile	$L_{A90, T}$ dB Typical Background. Statistic mode
Day (12:00 – 13:00)	51	N/A	42

The table below includes the center frequency of the L_{Aeq} metric at MP3

Table 5. Centre frequency L_{Aeq} , and $L_{Amax(fast)}$ MP3								
Time	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	dBA
L_{Aeq} Day (12:00 – 13:00)	54	52	55	49	42	38	35	51

The table below shows the noise levels recorded at MP4

Table 4. Measured continuous noise level at MP4			
Time	$L_{Aeq, T}$ dB	$L_{Amax(fast), T}$ dB 95th Percentile	$L_{A90, T}$ dB Typical Background. Statistic mode
Day (13:00 – 14:00)	54	N/A	45

The table below includes the center frequency of the L_{Aeq} metric at MP4

Table 5. Centre frequency L_{Aeq} , and $L_{Amax(fast)}$ MP2								
Time	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	dBA
L_{Aeq} Day (13:00 – 14:00)	60	57	53	51	48	45	43	54

The figure below shows the recorded noise levels in five minutes period during the entire noise survey at MP1.

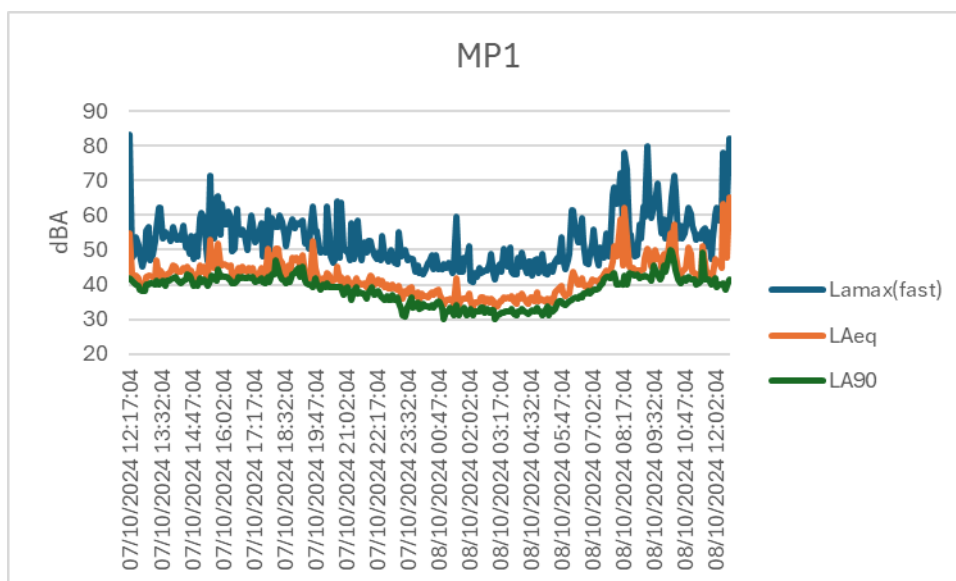


Figure 13. Measured noise level at MP1

7 Site Suitability for Residential Development

7.1 Noise Risk Assessment

The noise risk assessment is completed according to the methodology described within pro PG. Therefore, based on the measured noise levels during day and nighttime, the noise risk assessment affecting the proposed development is considered low.

ProPG states the following when developments are affected by low noise levels:

At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.

The following section includes the recommended acoustic building envelope to minimise/reduce the impact of noise as recommended by ProPG. Also, the recommended building envelope provides sufficient levels of sound reduction to meet the internal noise criteria recommended by the relevant acoustic guidelines such as BS8233:2014, WHO, and HTM.

7.2 Building Envelope Sound Insulation

The table below includes the recommended sound reduction of the building envelope.

Table 10 – Specification for the building envelope.								
Freq. Hz	63	125	250	500	1 k	2 k	4 k	Average
Roof	43	46	44	46	54	62	68	52 dB R_w
External Walls	34	47	55	61	64	64	68	63 dB R_w
Windows bedrooms/living rooms	15	18	23	30	35	27	32	31 dB R_w
Trickle Vent	30	36	38	36	32	37	39	35 Dn,e,w

The example wall specification used in the calculations was a cavity brick construction and Dryliner (12.5 mm soundbloc plasterboard). The example roof specifications are concrete roof. Various other construction types may be acceptable; however, these should be calculated if necessary.

It should be noted that the sound rating of the windows includes the glazing and the entire window frame. The windows provider should show evidence that the entire windows provide the recommended acoustic rating.

The windows and trickle vent in the staff rooms should have similar levels of sound reduction that those included in the above table.

By employing the above attenuating measures, it will be possible to attain the internal noise levels within dwellings recommended in British Standard BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, and HTM.

Night-time noise levels resulting from single sound events are not expected to regularly exceed the recommended internal noise level of 45 dB $L_{Amax(fast)}$ in bedrooms, and L_{Aeq} 35 dB in living rooms during day time.

Detailed noise intrusion assessment is included in the Annex.

The expected external noise levels at the proposed residential amenities areas are in line with the levels recommended by the relevant acoustic guidelines ($\leq 55 L_{Aeq,dB}$).

7.3 Noise and Overheating assessment.

The internal noise levels recommended by Overheating Approved Document O during night time period is 40 L_{Aeq} dB, and 55dB L_{AFmax} , more than 10 times at night for individual noise events.

The measured noise levels affecting the proposed development are low, and therefore the expected internal noise levels due to a partially open windows to control overheating conditions will be fully compliant with the internal noise criteria recommended by Overheating approved document O.

8 Noise from Fixed Installations and Mechanical Plant

Noise levels generated by mechanical plant and experienced by local receptors depends upon several variables, the most significant of which are considered to be as follows:

- Noise generated by plant or equipment used on site, generally expressed as sound power levels (SWL).
- Distance between the noise source and the receptor.
- Attenuation due to ground absorption, atmospheric and barrier effects.
- Periods of operation of the plant on the site, known as its “on-time”.

It is possible that the proposal will include installations of ventilation and mechanical plant. However, at this stage, no information is available with regards to the fixed installations and mechanical plants that are to be installed as part of the proposed development.

Consequently, it is not possible to present an inclusive assessment of the noise effects of such plant. However, in order to ensure that background noise levels at the nearest noise sensitive receptors do not increase significantly as a result of the development, design noise limits for electrical and mechanical plant have been provided.

The noise limits have been based on achieving 10 dB below the preexisting typical background noise level recorded during the noise survey.

Table 11 : Noise Limit for Fixed Installations of Mechanical Plant, $L_{A,Tf}$ (dB)	
Daytime	Night-time
31	22

If fixed installations and mechanical plant are designed to achieve the above-mentioned noise limits at the nearest residential receivers' complaints will be minimised.

There are several measures that can be introduced to control noise from the mechanical and fixed plant installation associated with the proposed development. Consideration should be given to reducing noise at point of generation (e.g. by selecting quieter plant) or containment of noise generated (e.g. by insulating buildings which house machinery and/or providing purpose-built barriers around the site).

9 Construction noise.

In order to evaluate the noise impact during the construction of the residential buildings, the guidance outlined by BS5228: *Code of practice for noise control on construction and open sites (part 1 and 2)*: 2009 should be implemented.

This British Standard BS5228: 2009 states a practical method of construction noise monitoring, which is the ABC sound levels categories. This suggests that the significance of construction noise impact should be limited by introducing thresholds which are considered appropriate through the consideration of the pre-existing ambient noise conditions in the area.

BS5228-1 Table E.1 Example threshold of significant effect at dwellings			
Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A ^{A)}	Category B ^{B)}	Category C ^{C)}
Night-time (23.00–07.00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75
NOTE 1:	A significant effect has been deemed to occur if the total L _{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.		
NOTE 2:	If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L _{Aeq} noise level for the period increases by more than 3 dB due to construction activity.		
NOTE 3:	Applied to residential receptors only.		
A)	Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.		
B)	Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values		
C)	Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values		
D)	19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.		

Annex E of BS5228 details the ABC Method which shows an example of the threshold of significant effect (SOAEL) at dwellings when the total noise level, rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the total noise level, including construction. If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur.

Based on the existing noise climate affecting the nearby residential properties, the threshold value should be set up as an L_{Aeq} of 65 dB.

BS5228 also provides guidance on method of measuring vibration and assessing its effects on the environment. It provides guidance on human response to vibration and response limits of building to ground-borne vibration which are detailed below.

BS5228: 2009 (Part 2) Vibration Criteria is included below for reference.

0.14mm.s ⁻¹	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies people are less sensitive to vibration.
0.3 mm.s ⁻¹	Vibration might be just perceptible in residential environments
1.0 mm.s ⁻¹	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm.s ⁻¹	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

BS5228-2 Table B.2 Transient vibration guide values for cosmetic damage		
Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures	50 mm/s at 4 Hz and above	50mm/s at 4 Hz and above
Industrial and heavy commercial buildings		
Unreinforced or light framed structures	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Residential or light commercial buildings		

Based on the above criteria, it is recommended that the vibration levels during construction will not be above 0.3 mm.s⁻¹

It is recommended to implement the following best practice in order to minimise as much as possible the noise and vibration during construction.

Control of Pollution Act 1974, section 61 consent.

Section 61 is an agreement between the contractor completing the construction works and the Local Authority. An application under this section shall contain particulars of the works, and the method by which they are to be carried out; and the steps proposed to be taken to minimise noise resulting from the works. If the Local Authority agrees with this section and the works are completed by the contractor with the terms which have been agreed, the contractor will be protected under Section 60 of the Control of Pollution Act 1974, or most recently the section 80 of the Environmental Protection Act 1990.

Best Practicable Means.

The Best Practicable Means is included within Section 72 of the Control of Pollution Act 1974 and Section 79 of the Environmental Protection Act 1990, these measures are included below.

- (a) 'practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;
- (b) the means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures.

In order to provide the BPM, the recommendations included within the BS5228:2009 should be implemented by the main contractor.

Based on the above requirements, the following steps should be implemented to mitigate the noise/vibration.

- Noisy machinery/items should be surrounded by temporary noise barriers.

The figure below shows a typical temporary barrier.



<http://www.echobarrier.co.uk/product/genset-noise-barrier/>

Figure 14. Example of Temporary Acoustic Barrier.

- Noisy activities or equipment's such as compressors should be enclosed in a temporary enclosure as shown below.

Table B.3 Sound-absorbing materials for lining covers and enclosures

Material	Thickness mm	Average absorption coefficient between 125 Hz and 4 000 Hz
Mineral wool	50	0.7 to 0.8
Straw slabs	50	0.4
Woodwool slabs	50	0.6

Figure B.1 Example of machine enclosure

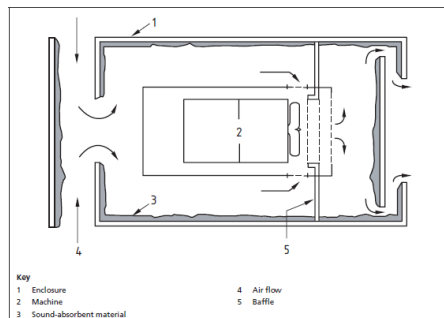


Figure B.2 Typical acoustic shed

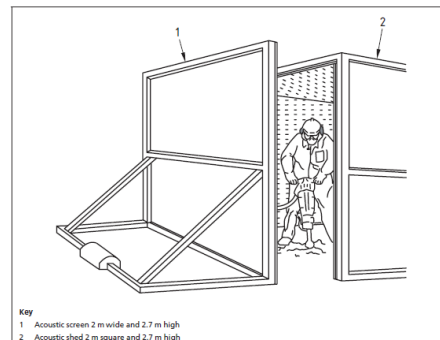


Figure 15. Example of temporary enclosures.

<https://www.echobarrier.co.uk/demolition-barriers/>

<http://www.soundexsolutions.com/>

<https://www.heras-mobile.co.uk/fencing/noise-reduction>

- The vibration and noise levels during pilling can be mitigated by using continuous flight auger (CFA). This pilling method is used in a densely populated areas where the noise and vibration should be contained to a minimum.
- Implementation of a construction management plan. The management plan should include the following recommendations:
 - ✓ Procedures for minimising the noise from construction related traffic on the existing road network, i.e. spacing the van and lorries deliveries along the working time.
 - ✓ Procedures for ensuring that all works are carried out according to the principle of 'Best Practicable Means' as defined in the Control of Pollution Act 1974.
 - ✓ General induction training for site operatives and specific training for staff having responsibility for particular aspects of controlling noise and vibration from the site, making them aware of the need to minimise impact to the surrounding neighbours etc.
 - ✓ A monitoring / auditing programme, particularly during any demolition operations and construction of access roads or phases particularly close to neighbouring noise sensitive boundaries.
 - ✓ A commitment to on-going liaison with the Local Authority and the community.

The last point is particularly important due to people will generally accept high noise levels if they know that they will only last for a certain duration. It is recommended that the nearest residential is informed when particularly noisy works and duration are to be carried out. It is well established that people's attitudes to noise can be influenced by their attitudes to the source, activity or operator itself. Noise from a site will tend to be accepted more readily by local residents, if they consider that the contractor is taking all possible measures to avoid unnecessary noise.

- ✓ The adoption of 'Best Practicable Means' is usually the most effective means of controlling noise from construction sites, such as:
 - ✓ Consideration of off-site fabrication to reduce the need for noisy assembly on site.
 - ✓ Keeping construction access roads well maintained to reduce noise and vibration from construction traffic.

- ✓ Minimising drop height into hoppers, lorries, etc.
- ✓ Where possible and safe to do so, mains electric powered plant should be used rather than diesel or petrol driven plant.

Implemented best practice during downloading/loading operations such as Stimulate quiet behaviour, Electric drive or electric hybrid drive, make sure all equipment is in good working order and maintained to minimise noise while in operation, reversing alarms should be modified for white noise (or qualified banksman can be used instead of reversing alarm), staff should be briefed about the necessity in reducing noise levels, when possible avoid situations in which more than one vehicle will be operating at the same time.

- ✓ HGV lorries unloading and loading. The loading/unloading operations should be reduced as much as possible. Contact between hard surfaces should be minimised, particularly metal on metal, using rubber matting, the driver should switch off the engine when not manoeuvring, the driver should try to minimise the start-ups.
- ✓ Noise control targets for normal daytime operation should be considered in terms of a regular noise monitoring programme. A record of noise levels recorded at agreed monitoring locations can then be stored on site by the main contractor or presented to the local residents as part of an on-going arrangement.
- ✓ In order to control the noise emission from the site, one monitoring station measuring continually the noise levels from the site can be located closest to the residential properties located at the southern boundary. The monitoring station can send a warning alarm once the noise levels of the site achieve an establish noise criteria. This will guarantee that the site is compliant with the acoustic requirements recommended by the relevant acoustic guidelines.

10 Conclusions

The impact of noise associated with the proposed developments at has been assessed during a typical working day.

Throughout, the assessment has been undertaken with reference to British Standards and national and international guidance on noise impacts.

The noise levels have been assessed with consideration to the National Planning Policy Framework and the Noise Policy Note for England. Following these policies, figures from the WHO's '*Guidelines for Community Noise*', BS8233 '*Sound Insulation and Noise Reduction for Buildings*' and HTM (Health Technical Memorandum 08-01:Acoustics) have been used to assure that 'significant adverse impacts on health and quality of life' are avoided. To achieve these internal noise levels envelope constructions have been suggested.

By designing the development using the acoustic specifications set out by this report, the internal noise level in residential accommodations will be in line with those recommended by the relevant acoustic guidelines

Appendix 1 – Noise Intrusion Assessment.

The noise intrusion in residential habitable spaces is calculated according to the methodology recommended by BS8233:2014 section G.2 Typical design problems: More rigorous calculation.

The table below includes the noise intrusion calculation in bedrooms exposed to the highest noise levels ($L_{Amax, fast}$ dB) during night-time. The calculation is based on the measured noise levels and the sound reduction provided by the recommended building envelope.

BS8233:2014 Calculation of Sound transmission into a building							
Project:					Date:		
Client:					Consultant:		
Building elements & Areas				Total M ²			
S _{ew} - External Wall Area				9.00			
S _{wi} - Area of Windows within Room				1.00			
S _{ir} - Area of Ceiling within Room				12.00			
Total Façade Area:				10.00			
Total Area of transmitting elements:				22.00			
				Constants			
				A0		10	
				A (0.16√T)		10.752	
				No. Vents		1	
		W	L	H	V	Rt (s)	
Room Data		4	3	2.8	33.6	0.5	
Constructions & Performance Data:							
Construction	63	125	250	500	1K	2K	4K
Window: Double glazing	15	18	23	30	35	27	32
Vent:	30	36	38	36	32	37	39
Wall:Cavity Block + Drylining	34	47	55	61	64	64	68
Ceiling	43	46	44	46	54	62	68
Source Noise & Element Contributions							
	63	125	250	500	1K	2K	4K
Source Lp	67	60	57	53	47	43	37
Window	-28.4	-31.4	-36.4	-43.4	-48.4	-40.4	-45.4
Vent	-33.4	-39.4	-41.4	-39.4	-35.4	-40.4	-42.4
Wall	-37.9	-50.9	-58.9	-64.9	-67.9	-67.9	-71.9
Ceiling	-45.6	-48.6	-46.6	-48.6	-56.6	-64.6	-70.6
Cumulative SRI	-26.8	-30.7	-34.9	-37.6	-35.2	-37.4	-40.7
Plus 10log S/A	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Façade Effect	3	3	3	3	3	3	3
RESULT	46.3	35.4	28.2	21.5	17.9	11.7	2.4
A weighted Internal Level					26.7		

As can be seen from the above table, the calculated internal noise levels are 27 $L_{Amax(fast)}$ dB which is 18 dB below, and therefore fully compliant with the criteria recommended by the relevant acoustic guideline (WHO and HTM recommendations ≤ 45 $L_{Amax(fast)}$ dB for individual noise events in bedrooms during night time).

Appendix 5 – ANC membership.

The author is a corporate member of the Institute of Acoustics (IOA) which satisfies the experience and qualification requirements for a 'suitably qualified acoustician'. Pace Consult are also full member of the Association of Noise Consultants.

