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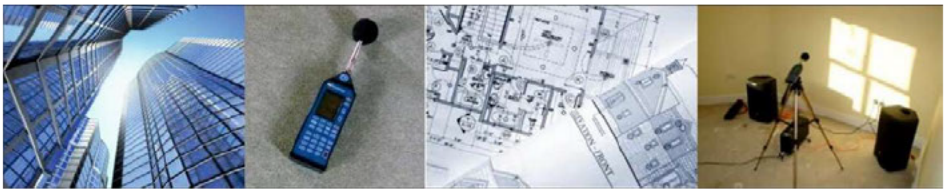

THAKEHAM TILES
ROCK ROAD
STORRINGTON
WEST SUSSEX
RH20 3AD

ENVIRONMENTAL NOISE ASSESSMENT

v.1

Client:
THAKEHAM TILES
Rock Road
Storrington
West Sussex
RH20 3AD

30th September 2025
Ref: M5739

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1. SUMMARY

1.1 An assessment of environmental noise has been undertaken at a proposed residential development at Thakeham Tiles, Rock Road, Storrington, West Sussex, RH20 3AD.

1.2 The objective of the exercise is to demonstrate that the proposed site is suitable for residential development and how, in principle, an acceptable level of acoustic amenity may be provided.

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

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

1.5 Means of attenuating the external noise levels have been submitted (Section 5), in the form of a specification for the façade glazing (Table 5.1).

1.6 In respect of external amenity spaces, noise levels within all areas will be within the relevant guidelines.

1.7 Consideration has then been given to the acoustic impact of an open window strategy to address ventilation issues. It has been shown that the predicted external noise levels exceed the limits set out in ADO Overheating for about 9% of the dwellings (see Appendix 3 for a full schedule).

1.8 In summary the plots that exceed the ADO criteria for an open window strategy are:

- Plots 99 – 108.

1.9 It is therefore recommended that all properties where predicted noise levels exceed the limits in ADO include a MVHR system (or equivalent, mechanical solution), designed to counter any overheating issues.

1.10 Overall, it is concluded that, with the recommended measures in place, occupants of new properties can be provided with an acceptable acoustic environment using very practicable methods of construction.

2. INTRODUCTION

2.1 An assessment of environmental noise has been undertaken at Thakeham Tiles, Storrington, West Sussex, RH20 3AD.

2.2 It is proposed to demolish the existing commercial buildings and erect 108 dwellings in their place. The site lies to the south of Rock Road and west of Steyning Grammar School, and is flanked by existing residential dwellings (Figure 1 – Site Location).

2.3 The objective of this exercise is to demonstrate the means by which occupiers of the dwellings may be guaranteed an acceptable level of acoustic amenity. This will be achieved through the consideration of an indicative site layout (Figure 2 – Proposed Site Layout).

2.4 It is recognised that the proposed development may be subject to levels of noise, predominantly from road traffic passing by on the Rock Road, as well as the ambient noise from the surrounding area.

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

(i) To determine the existing ambient noise climate in the vicinity of the development site.
(ii) To assess likely noise levels at the facades of any new buildings, and to specify a suitable façade construction to ensure acceptable conditions.
(iii) To consider the strategy for mitigating overheating issues in the properties, whilst sustaining the acoustic integrity of the façades.
(iv) To consider external noise levels and advise on any requirements for site screening.

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

3. SURVEY OF CURRENT NOISE LEVELS

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

3.2 A noise survey was undertaken from Tuesday 11th to Thursday 13th March 2025.

3.3 A Rion NL-52 Type 1 sound level meter was set up at the location shown below.

3.4 The microphone of the meters was attached to an extendable light stand and set approximately 4m away from Rock Road in a free-field position.

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

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

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

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

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

3.7 Weather conditions throughout the survey period are summarized in Table 3.1.

Date	Average Temperature (°C)	Rainfall (mm)	Average Wind Speed m/sec	Wind Direction
Tuesday 11/03	7	0.0	3.4 – 5.4	NNE
Wednesday 12/03	5	0.0	1.6 – 3.3	NW
Thursday 13/03	4	0.0	1.6 – 3.3	NNW

Table 3.1 – Summary of Weather Conditions

3.8 Figure 3 shows the variation in noise levels during the survey period, and Table 3.2 confirms the measured levels during each of the standard daytime and night-time periods.

Period		Day Time $L_{Aeq,\ 07.00 - 23.00}$	Night-Time $L_{Aeq,\ 23.00 - 07.00}$	Typical $L_{Amax,\ fast}$ Night
Tuesday 25/02	dB(A)	59.9*	52.5	79
Wednesday 26/02	dB(A)	61.3	51.4	77
Thursday 27/02	dB(A)	62.6*		
*Part measurements				

Table 3.2 – Summary of Measured Noise Levels

3.9 The L_{Amax} levels shown in the tables are the peak values based on the 90th percentile and may exclude exceptional 'one-off' events during the night.

3.10 Ian Sharland Limited has taken the source data acquired and developed a computer model of the site using the DGMR iNoise software. The calculations are based on the ISO 9613 and CNOSSOS-EU methods and the recommendations of the quality standard ISO.

3.11 The topography of the site has been created, and then the principal sources of noise (Rock Road) have been added, calibrated in strength to the survey results.

3.12 The new buildings have then been added to the model.

3.13 The software has then been used to create a schedule of predictions at each façade of each dwelling, for daytime and night-time periods.

3.14 Figures 4 & 5 provide the relevant daytime L_{Aeq} and night-time L_{Amax} noise maps across the site (Ground & 1st Floors).

3.15 Appendix 1 provides a table of the predicted daytime, night-time $L_{Aeq,8hrs}$ and L_{Amax} façade noise levels for each dwelling.

3.16 Section 5 of this report will discuss these noise levels, in respect of their suitability for residential building.

4. ASSESSMENT OF NOISE LEVELS

4.1 National Planning Policy Framework (December 2024)

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

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

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

4.1.4 Paragraphs 187, 198 & 200 of the NPPF states:

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

(a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan).

(b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland.

(c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate.

(d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures and incorporating features which support priority or threatened species such as swifts, bats and hedgehogs.

(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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

(f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

198. *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; and
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

200. *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.*

4.2 National Policy Statement for England (March 2010)

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

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

4.2.2 This vision should be achieved through the following Noise Policy Aims:

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

- *avoid significant adverse impacts on health and quality of life.*
- *mitigate and minimise adverse impacts on health and quality of life.*
- *and where possible, contribute to the improvement of health and quality of life".*

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

- **NOEL** - No Observed Effect Level
  This is the level below which no effect can be detected. In simple terms, below this level there is no detectable effect on health and quality of life due to the noise.

- **LOAEL** - Lowest Observed Adverse Effect Level
  This is the level above which adverse effects on health and quality of life can be detected. Where levels lie between the LOAEL and SOAEL, the Statement requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, as set out in the NPPF.

- **SOAEL** - Significant Observed Adverse Effect Level
  This is the level above which significant adverse effects on health and quality of life occur. It notes, however, that "it is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times".

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

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

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

> *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development.... This does not mean that such adverse effects cannot occur."*

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

4.3 Planning Practice Guide 'Noise' (July 2019)

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

When is noise relevant to planning?

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

What are the observed effect levels?

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

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

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

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

As the exposure increases further, it crosses the 'lowest observed adverse effect' level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration

needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

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

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

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

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

Table 4.1 – Noise Exposure Hierarchy

4.3.3 The guidance further advises:

What factors influence whether noise could be a concern?

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

These factors include:

- the source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if

they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.

- for a new noise making source, how the noise from it relates to the existing sound environment.
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- the spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features), and
- the local arrangement of buildings, surfaces and green infrastructure, and the extent to which it reflects or absorbs noise.

More specific factors to consider when relevant include:

- the cumulative impacts of more than one source of noise.
- whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations;
- In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.
- Noise Action Plans (where these exist), and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations should be taken into account. Defra's website has information on Noise Action Plans and Important Areas. Local authority environmental health departments will also be able to provide information about Important Areas.
- the effect of noise on wildlife. Noise can adversely affect wildlife and ecosystems. Particular consideration needs to be given to the potential effects of noisy development on international, national and locally designated sites of importance for biodiversity.
- where external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.
- some commercial developments including restaurants, hot food takeaways, night clubs and public houses can have particular impacts, not least because activities are often at their peak in the evening and late at night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the noise that may be made by customers in the vicinity.

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

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

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

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

4.3.4 The noise impact on residential developments may be partially off-set if the residents of those dwellings have access to:

- *a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;*
- *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 with increasing noise exposure and could be such that significant adverse effects occur, 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, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minute walking distance).*

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

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

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB(A) LAeq, 16 hr	-
Dining	Dining room/Area	40 dB(A) LAeq, 16 hr	-
Sleeping	Bedroom	35 dB(A) LAeq, 16 hr	30 dB(A) LAeq, 8 hr

Table 4.2 - BS8233 Indoor Guideline Values

4.4.2 It is usually considered that an open window will provide a reduction of some 10-15 dB(A)[1]. Therefore the 'good' internal standards quoted above would broadly equate to the following targets immediately outside the buildings:

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	48 dB(A) LAeq, 16 hr	-
Dining	Dining room/Area	53 dB(A) LAeq, 16 hr	-
Sleeping	Bedroom	48 dB(A) LAeq, 16 hr	43 dB(A) LAeq, 8 hr

Table 4.3 - BS8233 Derived Facade Guideline Values

4.4.3 BS8233 recognises that, where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB, and reasonable conditions will be achieved[2].

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

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

[1] Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)
[2] Note, the relaxation specified in BS8233 must be read in conjunction with parallel guidance set out in Approved Document O.

4.5 ProPG Planning & Noise (May 2017)

4.5.1 The Professional Practice Guidance on Planning & Noise (Institute of Acoustics (IOA), Association of Noise Consultants (ANC) and Chartered Institute of Environmental Health (CIEH), 2017) [1] for New Residential Development was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

4.5.2 The ProPG acknowledges and reflects the Government's overarching Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and the associated planning practice guidance on Noise, as well as other authoritative sources of guidance.

4.5.3 The two sequential stages of the overall approach are:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements.

4.5.4 Where sites are deemed to be *"negligible"* risk under Stage 1, there would not normally be a need for a Stage 2 assessment.

4.5.5 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"
- Element 4 – consideration of "Other Relevant Issues"

4.5.6 ProPG recommends that the details of the assessment(s) are presented in an Acoustic Design Statement (ADS). An ADS should not be necessary for a site assessed as negligible risk.

Stage 1: Initial Site Noise Risk Assessment

4.5.7 The noise risk assessment is intended to provide an indication of the likely risk of adverse effects from noise without any measures in place. It may be based on measurement or prediction (or a combination) as appropriate and should aim to describe noise levels over a *"typical worst case"* 24-hour day either now or in the foreseeable future.

4.5.8 The noise risk assessment categories are presented in Figure 1 of the ProPG, which is reproduced in Table 3.1 below. It 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.

4.5.9 The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site. Whilst it is noted that they *"…should be interpreted*

flexibly having regard to the locality, the project and the wider context…", there is considered to be no need to amend them for the purposes of this assessment.

4.5.10 In the final column, the initial noise risk assessment is aligned with pre-planning application guidance that highlights the increasing importance of good acoustic design as the noise risk increases.

NOISE RISK ASSESSMENT	POTENTIAL EFFECT WITHOUT NOISE MITIGATION	PRE-PLANNING APPLICATION ADVICE
Indicative Daytime Noise Levels $L_{Aeq,16hr}$ / Indicative Night-time Noise Levels $L_{Aeq,8hr}$ High 70 dB / 60 dB Medium 65 dB / 55 dB 60 dB / 50 dB Low 55 dB / 45 dB 50 dB / 40 dB Negligible	Increasing risk of adverse effect	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development. At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic 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.
	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.

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.

Table 4.2 – ProPG Stage 1 Initial Site Noise Risk Assessment

4.5.11 ProPG states that "It is important that the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker". Though, presumably, this would be acceptable for sites/noise levels deemed negligible risk (when a Stage 2 assessment or ADS would not normally be required).

4.5.12 It is noted that the categories do not necessarily correspond with a given threshold. This is perhaps understandable since these may vary in practice due to various acoustic and non-acoustic factors (which may vary from site to site); however, it is not helpful when it comes to consistently determining the degree of risk.

4.5.13 To determine thresholds for this purpose, it is logical in the first instance to take from the table above that 50 dB and 40 dB represent the thresholds between negligible and low for the day and night-time periods respectively. As discussed subsequently, the daytime level of 50dB is the bottom of the criteria range applied to external amenity areas, whilst the equivalent level inside a dwelling based on a window being partially open (providing 10-15 dB reduction) would be 35-40 dB, which is in keeping with the relevant criteria, also discussed subsequently.The same is broadly the case in terms of the night-time period; although, since the day and night internal criteria are only 5 dB apart (shown later), and the external thresholds are 10 dB apart, the external night threshold is more stringent relative to the daytime equivalent.

4.5.14 Applying a banding of 10 dB results in the following thresholds in Table 3.2, which correspond well with the table above.

Noise risk category	LAeq,16h (0700-2300)	LAeq,8h (2300-0700)	LAFmax (2300-0700)	Level 2 assessment?	Pre-planning application advice
High	>70 dB	>60 dB	> 10 events > 60 dB	Required	*"…an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process…"*
Medium	61 – 70 dB	51 – 60 dB			*"…application may be refused unless a good acoustic design process is followed and is demonstrated… how the adverse impacts of noise will be mitigated and minimised, and… a significant adverse noise impact will be avoided…"*
Low	51 – 60 dB	41 – 50 dB			*"…the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed…"*
Negligible	≤ 50 dB	≤ 40 dB	Less than the above	Not normally required	*"…the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds."*

Table 4.3 - Interpretation of the Level 1 initial site noise risk assessment thresholds

4.5.15 As noted above, the rating or categorisation at this stage is not to be taken as the final word on the site, but rather an initial guide as to the degree of measures likely to be required to achieve an acceptable development.

4.5.16 In achieving 'Good Acoustic Design' ProPG states: *"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".*

4.5.17 Note 7 states that *"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 5dB 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."*

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

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

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB(A) LAeq, 16 hr	-
Dining	Dining room/Area	40 dB(A) LAeq, 16 hr	-
Sleeping	Bedroom	35 dB(A) LAeq, 16 hr	30 dB(A) LAeq, 8 hr

Table 4.4 - BS8233 Indoor Guideline Values

4.6.2 It is usually considered that an open window will provide a reduction of some 10-15 dB(A)[3]. Therefore the 'good' internal standards quoted above would broadly equate to the following targets immediately outside the buildings:

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

Table 4.5 - BS8233 Derived Facade Guideline Values

4.6.3 BS8233 recognises that, where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB, and reasonable conditions will be achieved[4].

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

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

4.7 World Health Organisation Guidelines

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

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

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

[3] Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)
[4] Note, the relaxation specified in BS8233 must be read in conjunction with parallel guidance set out in Approved Document O.

4.8 Approved Document F Ventilation

4.8.1 Approved Document F (2021 edition, Volume 1 & 2) of the Building Regulations 2010 sets out the requirements for ventilation in dwellings. ADF describes three types of ventilation, summarised in the table below:

Type of Ventilation	Definition in ADF	Location/reason for ventilation	Required
Whole Dwelling Ventilation[5]	Whole building ventilation (general ventilation is normally continuous ventilation of rooms or spaces at a relatively low rate to dilute and remove pollutants and water vapour not removed by operation of extract ventilation, purge ventilation or infiltration, as well as supplying outdoor air into the building. For an individual dwelling this is referred to as 'whole dwelling ventilation'.	To provide fresh air to the building and to dilute and disperse residual water vapour not dealt with by extract ventilation as well as removing other pollutants which are released throughout the building	Continuously
Extract Ventilation	Extract ventilation is the removal of air directly from a space or spaces to the outside. Extract ventilation may be provided by natural means, e.g., by passive stack ventilation) or by mechanical means (e.g., by an extract fan or central system)	From rooms where most water vapour and/or pollutants are released, e.g., due to activities such as cooking or bathing. This is to minimise their spread to the rest of the building	Continuously or intermittently
Purge Ventilation	Purge ventilation is manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollution and/or water vapour. Purge ventilation may be provided by natural means (e.g., an openable window) or by a mechanical means (e.g., a fan)	Throughout the building to aid the removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental released such as smoke from burnt food or spillage of water	Occasionally

Table 4.6 – ADF Types of Ventilation

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

4.8.2 It is important to differentia between the need to provide 'purge ventilation' as required occasionally under ADF, against the provision of ventilation to help control overheating, which is now covered by Approved Document O Overheating. ADF states:

> *This document <ADF> sets minimum standards for purge ventilation for rapidly diluting indoor air pollutants and extracting water vapour where necessary in habitable rooms in dwellings. For domestic-type buildings, Part O may require a higher standard than the guidance given in this document for purge ventilation to remove excess heat. In this case, the higher of the two standards should be followed.*

4.8.3 There are various types of ventilation described in ADF, including:

Ventilation System	Provision with ADF System / Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
Background ventilation and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate. Trickle vents to provide inlet air	Continuous mechanical extract – minimum high rates. Trickle vents to provide inlet air	Typically provided by opening windows
Continuous mechanical supply and extract with heat recovery (MVHR)	Continuous mechanical supply and extract – minimum low rate	Continuous mechanical supply and extract – minimum high rate	Typically provided by opening windows

Table 4.7 – ADF Template Systems

4.8.4 With regard to the provision of purge ventilation within habitable rooms, the approved document notes that there may be practical difficulties in achieving this (e.g., if unable to open a window due to excessive noise from outside).

4.8.5 Whilst ADF does give advisory residential noise limits during normal conditions (not boost)[6], it does not itself confirm limits for noise during purge ventilation.

[6] In line with BS8233 guidance.

4.9 Approved Document O – Overheating

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

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

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

Table 4.8 – ADO Scope

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

a. 40dB $L_{Aeq,t}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB $L_{Amax,f}$ more than 10 times a night (between 11pm and 7am).

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

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

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

4.10.2 When providing design targets inside the dwellings, the AVOG document advises that the internal noise standard of BS8233:2014 (as copied here in Table 4.2) should be achieved when providing adequate ventilation as defined in ADF. However, the document continues to propose that it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

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

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

4.10.5 BS8233:2014 states that, if internal noise levels are no more than 5 dB greater than the levels shown here in Table 4.9, this would be a 'reasonable' standard. Therefore, if external noise levels do not exceed the following values when windows are open, conditions should be considered wholly acceptable, and therefore the threshold between No and Low Observed Adverse Effect Levels:

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

Table 4.9 – Proposed LOAEL Façade Noise Levels with Windows Open

4.10.6 To consider the upper limit, beyond which internal conditions should not be deemed acceptable, reference is made to issue of speech interference. With reference to the numerical values in BS8233 (see Table 4.5 above), the AVOG document adopts an internal daytime limit of 50 dB(A), which would then equate to an external limit of 63 dB(A) when windows are open.

4.10.7 At night, reference is made to the WHO Night Noise Guidelines, which developed the original WHO Guidelines for Community Noise report. This states that if external noise levels exceed 55 dB(A) L_{Aeq}, 'adverse health effects occur frequency and a sizeable proportion of the population is highly annoyed and sleep disturbed'.

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

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

Table 4.10 – Proposed SOAEL Threshold Façade Noise Levels with Windows Open

5. RECOMMENDATIONS FOR NOISE ATTENUATION MEASURES

INTERNAL NOISE LEVELS

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

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

Living Rooms:	35 dB(A) $L_{Aeq,\ 07.00 – 23.00}$
Bedrooms:	30 dB(A) $L_{Aeq,\ 23.00 – 07.00}$, and also
	45 dB(A) $L_{Amax,\ 23.00 – 07.00}$

5.3 Appendix 1 confirms the predicted external façade noise levels, dB(A) across the site. These values are based on the data acquired during the site survey (Para 3.8), and a computer model of the site, developed using the iNoise V2024.2 predictive software. The calculations are based on the ISO 9613:2024 methodology and the recommendations of the new quality standard ISO 17534. The range of values across the site varies as follows:

$L_{Aeq,\ 0700 – 2300}$	$L_{Aeq\ 2300 – 0700}$	Typical $L_{Amax\ 2300 - 0700}$
<30 – 55 dB(A)	<30 – 46 dB(A)	<35 - 72 dB(A)

Table 5.1 – Range of Façade Noise Levels across the Site

5.4 A review of the data against the suggested threshold values of the ProPG document suggest the site would be considered a low risk, with the comment *"…the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed…".*

5.5 The following paragraphs will consider how the noise may be mitigated across the site, in line with Stage 2 of the ProPG guidance.

5.6 The external façade construction has not been confirmed but a likely construction would be,

- Brick outer skin,
- Notional 100mm partially insulated cavity,
- Inner leaf of timber frame or masonry.

5.7 Table 5.2 confirms the single glazing requirement for the site, based on the predicted façade noise levels and the facade construction stated in Para 5.6. Calculations in Appendix 2 confirm compliance based on the highest predicted façade noise level affecting any building:

	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							Overall Rating & Possible Configuration
	63	125	250	500	1K	2K	4K	
All Dwellings	21	21	18	26	37	42	33	27 dB Rw + Ctr 4 / 16 / 4

Table 5.2 – Possible Glazing Configurations

EXTERNAL AMENITY SPACE

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

5.9 The predicted noise levels within all amenity areas ranges from 15 – 47 dB(A) and therefore would meet the WHO criteria.

5.10 The predictions are based on 1.8m high close boarded timber fences, as shown on the indicative site plan.

6. ASSESSMENT OF OVERHEATING MITIGATION

6.1 The preferred means of countering overheating issues is usually to rely on open windows to provide the necessary ventilation.

6.2 Open windows do have an adverse impact on the acoustic integrity of the building construction, however, and ADO has therefore confirmed the maximum acceptable internal noise levels when windows are opened for this specific purpose.

6.3 To repeat Para.4.7.3 above, the acceptable levels are:

a. 40dB $L_{Aeq,t}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB $L_{Amax,f}$ more than 10 times a night (between 11pm and 7am).

6.4 A review of the 8-hour average noise levels and the typical peak noise levels affecting the site confirms that the former represents the more onerous criteria.

6.5 The question is then how the internal target of 55dB $L_{Amax,f}$ equates to an external 'façade noise level', when the windows are open for the purposes of overheating.

6.6 At this point, it is necessary to explain the difference between free-field and façade noise levels. The former represents the sound level which would be recorded at a particular position, with no buildings (or other reflecting surfaces) nearby. The latter represents the sound level which would be recorded directly in front of a building. As such, it will include acoustic energy which passes the microphone and is then reflected back off the building, past the microphone again. The correction between two equivalent measurements is normally taken to be 3 dB (the façade value being the louder).

6.7 It is then necessary to consider the likely acoustic loss through the open window. Approved Document O provides a simplified estimate of 9 dB. This replates to properties in a 'medium risk' area for overheating, as would be the case here. The loss is based on windows being set to an open area which is 4% of the floor area of the bedroom.

6.8 It is noted that this loss relates to the difference between the free-field noise level at the location and the resulting internal noise level. The difference between the façade noise level and resulting internal noise level would be some 7 dB.

6.9 This value is lower than the guidance provided in PPG24 'Planning and Noise', which advised that a partially open window would provide a reduction between 10 and 15 dB(A).

6.10 The value quoted in Approved Document O is offered in a conservative manner, to allow for a safe, simplified assessment of conditions. The Document does allow for a more detailed assessment of acoustic loss.

6.11 In the first instance, reference is made here to the work by Napier University, and their much-referenced report on the acoustic performance of windows, NANR116: 'Open/Closed Window Research - Sound Insulation Through Ventilated Domestic Windows', April 2007

6.12 To counter overheating, the windows require an open area of at least 4% of the floor area. A review of the floor plans indicates that bedrooms have floor areas approximately 14m^2. This indicates that the open area of the windows would need to be 0.56m^2.

6.13 Assuming a side hung casement window, the Napier Report would indicate that the acoustic loss from outside (façade level) to inside would be 12 – 15 dB(A), for the openings here.

6.14 The final approach is to consider a 'first-principles ' calculation of the loss through the window. This would reflect the open area, the sound reduction of the opening (zero) and the acoustic absorption of the room into which the sound is travelling.

6.15 Table 6.1 provides this calculation and indicates an acoustic loss from outside (façade level) to inside of 13 dB(A).

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Reference facade SPL, outside	dB	105	102	98	96	96	93	87	82	**100**
SRI open Window	dB	0	0	0	0	0	0	0	0	
Reflection Loss, 0.56m2	dB	-4	-2	0	0	0	0	0	0	
Area correction, 0.56m2	dB	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	
Absorption in room	m2	11.27	11.27	11.27	11.27	11.27	11.27	11.27	11.27	
Absorption Loss	dB	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	
Net SPL	dB	88	87	85	83	83	80	74	69	**87**
Difference	dB	17	15	13	13	13	13	13	13	

Table 6.1 – Calculation of loss through an open window

6.16 The table below summarises the various results:

Source	Difference between façade sound level (road traffic) and resulting internal noise level
ADO Simplified	9 dB(A)
PPG24	10 – 15 dB(A)
Napier University NANR116 Study	12 – 15 dB(A)
First Principles Calculation	13 dB(A)

Table 6.2 – Acoustic Loss for Traffic Noise through 0.56m^2 opening.

6.17 It is therefore concluded that a reduction of 13 dB(A) would be a reasonable, safe prediction of the acoustic loss across this development, and the criteria of ADO would therefore equate to external facade noise limits of,

Bedrooms – 53 dB $L_{Aeq,2300 - 0700}$
Bedrooms – 68 dB $L_{AFmax, 2300 - 0700}$

6.18 Appendix 3 confirms the predicted internal noise level with a suitably open window and confirms whether or not the situation would be considered compliant with the limits of ADO.

6.19 The facades highlighted in 'red' in the following excerpt of the site plan show the areas of the development where open windows are **NOT** a suitable solution and where an alternative approach is appropriate.

Figure 6.1 – Bedrooms where Open Window Overheating Strategy is NOT Suitable

6.20 For any bedrooms with windows solely on these elevations, the energy and mechanical consultants will need to develop an alternative strategy. This is likely to be a mechanical solution, but could adopt a passive solution, such as marketed by TEK Limited (et al).

7. CONCLUSION

7.1 The foregoing assessment has looked at the levels of ambient noise within the vicinity of a proposed new residential development at Thakeham Tiles, Rock Road, Storrington, West Sussex, RH20 3AD, on behalf of SLR Consulting Ltd.

7.2 It has been concluded that, by specifying appropriate glazing and facade construction along with acoustically treated means of ventilation, it will be possible to ensure that an acceptable internal environment can be provided within new dwellings.

7.3 It has been shown that noise levels within a minority of the amenity areas can meet the WHO's guideline figure of 55 dB L_{Aeq}, to protect the majority of people from being seriously annoyed during the daytime, for a steady, continuous noise.

FIGURE 1 – SITE LOCATION

FIGURE 2 – PROPOSED SITE PLAN

FIGURE 3 – VARIATION OF MEASURED NOISE LEVELS

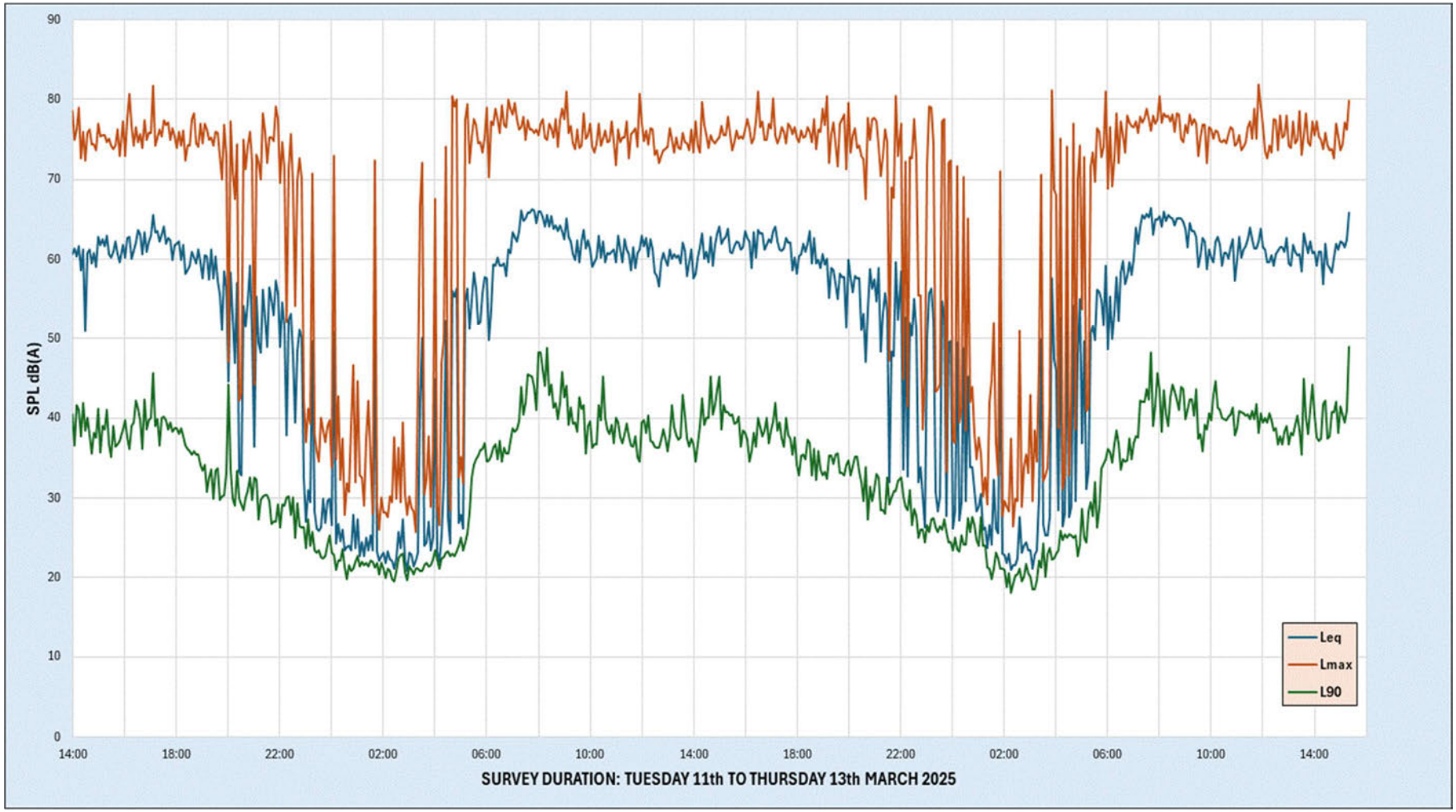


FIGURE 4 – DAYTIME L_{Aeq} GF NOISE MAP

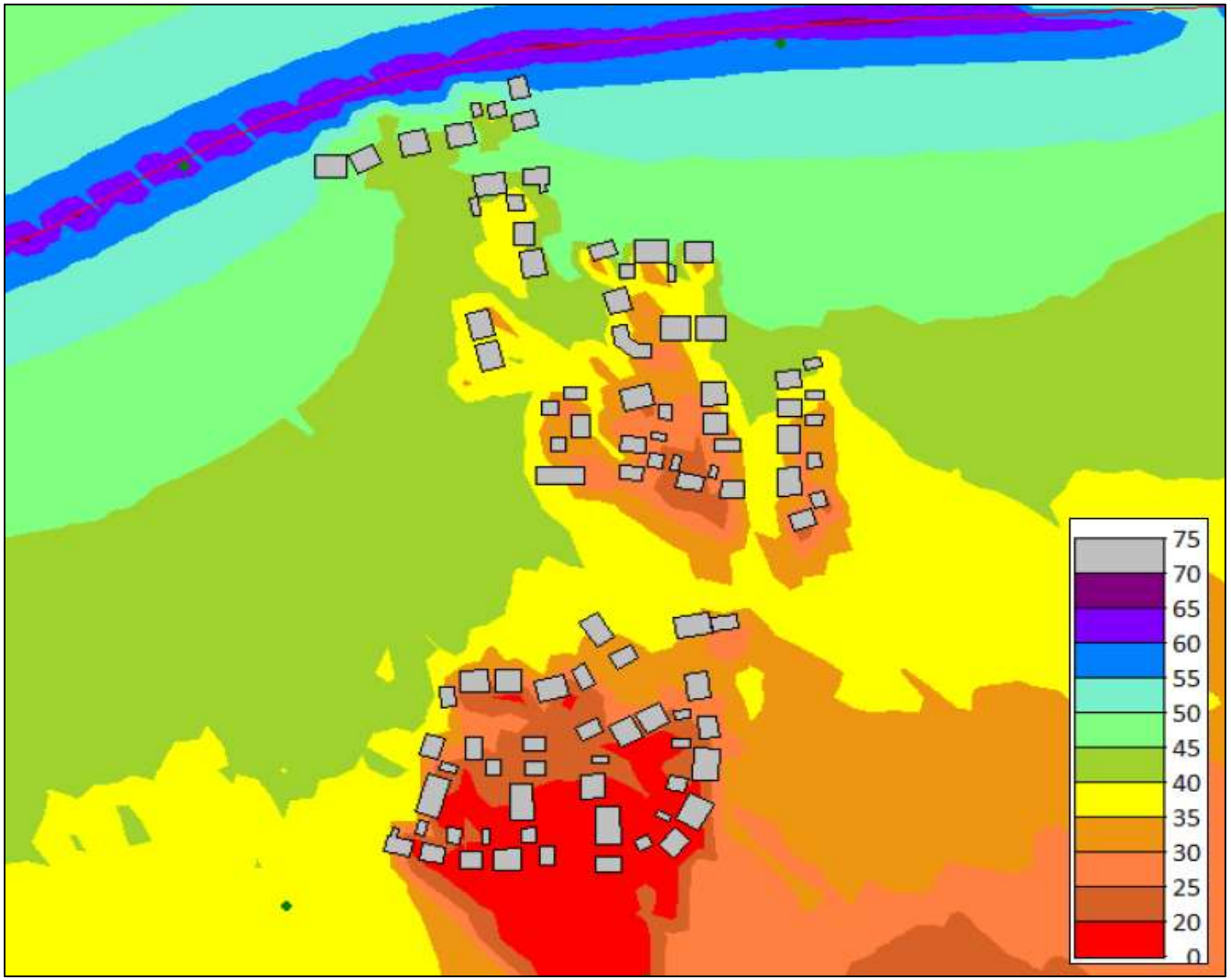
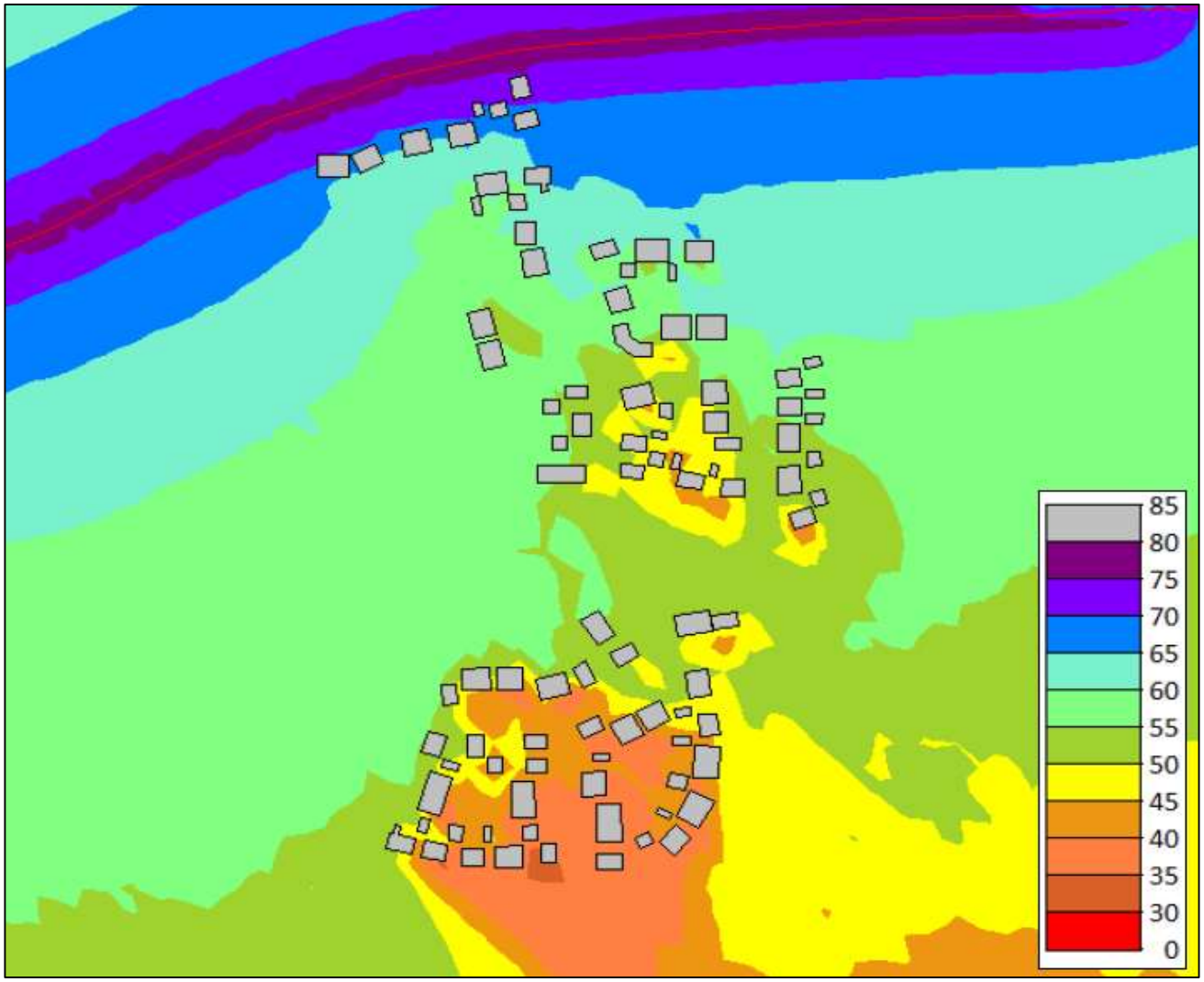


FIGURE 5 – NIGHT-TIME L_{Amax} 1F NOISE MAP



APPENDIX 1 – PREDICTED FAÇADE NOISE LEVELS

PLOT	DAYTIME L_{Aeq} dB(A)		NIGHT-TIME L_{Aeq} dB(A)		NIGHT-TIME L_{Amax} dB(A)	
	FRONT	REAR	FRONT	REAR	FRONT	REAR
1	49	36	39	29	65	55
2	49	34	39	29	65	55
3	49	31	39	27	65	54
4	48	29	39	25	65	51
5	48	30	38	25	65	51
6	42	31	31	30	57	56
7	41	29	31	30	57	56
8	40	33	29	27	56	54
9	38	35	28	30	54	56
10	34	39	24	33	50	59
11	37	40	26	34	52	60
12	35	40	24	34	51	61
13	31	45	21	35	47	61
14	41	36	30	32	57	58
15	39	29	28	28	54	54
16	37	27	27	27	53	53
17	39	31	30	29	56	55
18	33	28	25	26	51	52
19	37	26	27	27	53	54
20	27	24	20	28	46	54
21	17	19	7	14	33	40
22	17	22	8	16	34	42
23	29	18	19	15	46	40
24	31	21	21	20	47	46
25	34	18	24	12	50	38
26	26	19	19	16	45	42
27	31	27	22	25	49	51
28	29	22	21	19	47	45
29	31	18	25	9	52	35
30	32	17	26	9	52	35
31	29	17	21	9	47	34
32	30	17	21	9	47	35
33	28	18	20	8	46	34
34	20	18	15	11	41	37
35	19	19	15	13	41	39
36	18	18	10	10	36	36
37	19	18	12	10	38	36
38	18	19	10	12	36	38
39	18	19	10	12	36	37

PLOT	DAYTIME L_{Aeq} dB(A)		NIGHT-TIME L_{Aeq} dB(A)		NIGHT-TIME L_{Amax} dB(A)	
	FRONT	REAR	FRONT	REAR	FRONT	REAR
40	23	30	13	26	39	52
41	19	21	9	23	35	49
42	16	18	7	16	33	42
43	16	17	6	12	32	37
44	16	18	6	12	32	38
45	17	19	9	12	35	37
46	20	18	14	12	39	38
47	17	19	9	14	35	40
48	17	19	8	16	34	42
49	22	20	16	17	42	43
50	21	23	15	21	41	47
51	35	18	26	12	52	38
52	39	19	28	14	55	40
53	39	18	28	13	55	39
54	37	18	27	11	53	36
55	38	18	27	10	53	35
56	28	38	19	29	44	56
57	28	38	18	30	45	56
58	19	36	12	29	38	55
59	19	37	10	31	36	57
60	18	36	9	31	35	57
61	18	36	9	29	35	56
62	18	34	9	28	35	54
63	18	34	9	28	35	55
64	18	33	10	27	36	53
65	35	32	26	27	52	53
66	35	31	26	28	52	55
67	38	38	28	28	54	54
68 - 71	37	38	28	28	54	55
72	19	38	10	28	36	54
73	21	29	13	25	39	51
74	22	29	14	22	40	48
75	38	24	27	18	53	44
76	44	29	33	22	59	48
77	43	25	32	20	58	46
78	44	31	33	26	59	52
79	43	33	32	25	58	52
80	34	23	26	17	52	43
81	34	24	25	21	51	47

PLOT	DAYTIME L_{Aeq} dB(A)		NIGHT-TIME L_{Aeq} dB(A)		NIGHT-TIME L_{Amax} dB(A)	
	FRONT	REAR	FRONT	REAR	FRONT	REAR
82	26	25	21	20	48	46
83	34	24	27	20	53	46
84	30	35	20	30	47	56
85	27	32	20	30	45	56
86	36	33	26	29	52	55
87	40	37	31	30	57	57
88	33	39	24	32	50	58
89	32	38	23	31	49	58
90	33	38	24	31	50	57
91	31	38	22	32	48	58
92	46	37	36	31	62	57
93	46	39	36	31	62	58
94	45	39	36	31	62	58
95	45	38	36	32	63	58
96	50	32	40	27	66	53
97	48	33	38	31	64	57
98	47	36	37	32	64	59
99	47	49	37	46	63	72
100	45	47	36	45	62	71
101	39	45	30	44	56	70
102	36	47	30	44	56	70
103	39	48	29	45	56	72
104	39	46	29	45	55	71
105	41	47	32	45	58	71
106	40	46	32	44	58	70
107	52	40	43	39	69	65
108	55	49	46	46	72	72

APPENDIX 2 – OUTSIDE TO INSIDE CALCULATIONS

PLOTS 99, 103 & 108 - BEDROOMS										
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
External Noise Level LAmax	**dB**	68	57	62	64	70	65	55	43	**72**
Glazing Specified: 4 / 16 / 4	dB	21	21	18	26	37	42	33	46	
Area of Window	dB	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
Area Correction	dB	4	4	4	4	4	4	4	4	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	11	11	11	11	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	40	29	37	31	26	16	15	-10	**33**
External Wall	dB	43	45	45	49	57	65	70	70	
Area of Wall	dB	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	
Area Correction	dB	9	9	9	9	9	9	9	9	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	11	11	11	
Absorption Correction	dB	10	10	10	11	11	10	10	10	
Net SPL Inside	dB	23	10	15	13	11	-2	-17	-29	**15**
Combined Level from elements	dB	41	29	37	31	27	17	15	-10	**33**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	**dB**	**44**	**32**	**40**	**34**	**30**	**20**	**18**	**-7**	**36**

PLOT 96 - BEDROOM										
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
External Noise Level LAmax	**dB**	62	51	54	58	64	59	48	37	**66**
Glazing Specified: 4 / 16 / 4	dB	21	21	18	26	37	42	33	46	
Area of Window	dB	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
Area Correction	dB	4	4	4	4	4	4	4	4	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	11	11	11	
Absorption Correction	dB	10	10	10	11	11	10	10	10	
Net SPL Inside	dB	34	23	29	25	20	10	8	-16	**26**
External Wall	dB	43	45	45	49	57	65	70	70	
Area of Wall	dB	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	
Area Correction	dB	9	9	9	9	9	9	9	9	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	11	11	11	
Absorption Correction	dB	10	10	10	11	11	10	10	10	
Net SPL Inside	dB	17	4	7	7	5	-8	-24	-35	**8**
Dn,e Vents	dB	30	41	41	38	45	50	50	50	
10logN (number of vents)	dB	3	3	3	3	3	3	3	3	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	11	11	11	
Absorption Correction	dB	0	0	0	1	1	0	0	0	
Net SPL inside via vent	dB	35	13	16	22	21	12	1	-10	**24**
Combined Level from elements	dB	38	24	30	27	24	14	9	-9	**28**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	**dB**	**41**	**27**	**33**	**30**	**27**	**17**	**12**	**-6**	**31**

LIVING ROOMS										
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
External Noise Level LAeq	**dB**	52	44	45	47	53	48	37	25	**55**
Glazing Specified: 4 / 16 / 4	dB	21	21	18	26	37	42	33	46	
Area of Window	dB	8	8	8	8	8	8	8	8	
Area Correction	dB	9	9	9	9	9	9	9	9	
Likely RT in Room	sec	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Room Volume	m3	50	50	50	50	50	50	50	50	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	29	21	25	19	14	4	2	-23	**20**
External Wall	dB	43	45	45	49	57	65	70	70	
Area of Wall	dB	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	
Area Correction	dB	9	9	9	9	9	9	9	9	
Likely RT in Room	sec	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Room Volume	m3	50	50	50	50	50	50	50	50	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	7	-3	-2	-4	-6	-19	-35	-47	**-3**
Dn,e Vents	dB	30	41	41	38	45	50	50	50	
10logN (number of vents)	dB	3	3	3	3	3	3	3	3	
Likely RT in Room	sec	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Room Volume	m3	50	50	50	50	50	50	50	50	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	1	1	1	1	1	1	1	1	
Net SPL inside via vent	dB	24	5	6	11	10	0	-11	-23	**13**
Combined Level from elements	dB	30	21	25	19	15	5	2	-20	**21**
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	**dB**	**33**	**24**	**28**	**22**	**18**	**8**	**5**	**-17**	**24**

APPENDIX 3 – ASSESSMENT OF ADO COMPLIANCE FOR BEDROOMS (LAmax)

PLOT	PREDICTED EXTERNAL NOISE LEVEL dB(A)	ADO REQUIREMENT dB(A)	OVERHEATING STRATEGY
1	65	68	Open Windows
2	65	68	Open Windows
3	65	68	Open Windows
4	65	68	Open Windows
5	65	68	Open Windows
6	57	68	Open Windows
7	57	68	Open Windows
8	56	68	Open Windows
9	56	68	Open Windows
10	59	68	Open Windows
11	60	68	Open Windows
12	61	68	Open Windows
13	61	68	Open Windows
14	58	68	Open Windows
15	54	68	Open Windows
16	53	68	Open Windows
17	56	68	Open Windows
18	52	68	Open Windows
19	54	68	Open Windows
20	54	68	Open Windows
21	40	68	Open Windows
22	42	68	Open Windows
23	46	68	Open Windows
24	47	68	Open Windows
25	50	68	Open Windows
26	45	68	Open Windows
27	51	68	Open Windows
28	47	68	Open Windows
29	52	68	Open Windows
30	52	68	Open Windows
31	47	68	Open Windows
32	47	68	Open Windows
33	46	68	Open Windows
34	41	68	Open Windows
35	41	68	Open Windows
36	36	68	Open Windows
37	38	68	Open Windows
38	38	68	Open Windows
39	37	68	Open Windows
40	52	68	Open Windows

PLOT	PREDICTED EXTERNAL NOISE LEVEL dB(A)	ADO REQUIREMENT dB(A)	OVERHEATING STRATEGY
41	49	68	Open Windows
42	42	68	Open Windows
43	37	68	Open Windows
44	38	68	Open Windows
45	37	68	Open Windows
46	39	68	Open Windows
47	40	68	Open Windows
48	42	68	Open Windows
49	43	68	Open Windows
50	47	68	Open Windows
51	52	68	Open Windows
52	55	68	Open Windows
53	55	68	Open Windows
54	53	68	Open Windows
55	53	68	Open Windows
56	56	68	Open Windows
57	56	68	Open Windows
58	55	68	Open Windows
59	57	68	Open Windows
60	57	68	Open Windows
61	56	68	Open Windows
62	54	68	Open Windows
63	55	68	Open Windows
64	53	68	Open Windows
65	53	68	Open Windows
66	55	68	Open Windows
67	54	68	Open Windows
68 - 71	55	68	Open Windows
72	54	68	Open Windows
73	51	68	Open Windows
74	48	68	Open Windows
75	53	68	Open Windows
76	59	68	Open Windows
77	58	68	Open Windows
78	59	68	Open Windows
79	58	68	Open Windows
80	52	68	Open Windows
81	51	68	Open Windows
82	48	68	Open Windows
83	53	68	Open Windows
84	56	68	Open Windows
85	56	68	Open Windows

PLOT	PREDICTED EXTERNAL NOISE LEVEL dB(A)	ADO REQUIREMENT dB(A)	OVERHEATING STRATEGY
86	55	68	Open Windows
87	57	68	Open Windows
88	58	68	Open Windows
89	58	68	Open Windows
90	57	68	Open Windows
91	58	68	Open Windows
92	62	68	Open Windows
93	62	68	Open Windows
94	62	68	Open Windows
95	63	68	Open Windows
96	66	68	Open Windows
97	64	68	Open Windows
98	64	68	Open Windows
99	72	68	Mechanical Ventilation
100	71	68	Mechanical Ventilation
101	70	68	Mechanical Ventilation
102	70	68	Mechanical Ventilation
103	72	68	Mechanical Ventilation
104	71	68	Mechanical Ventilation
105	71	68	Mechanical Ventilation
106	70	68	Mechanical Ventilation
107	69	68	Mechanical Ventilation
108	72	68	Mechanical Ventilation

APPENDIX 4 - TERMINOLOGY RELATING TO NOISE

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