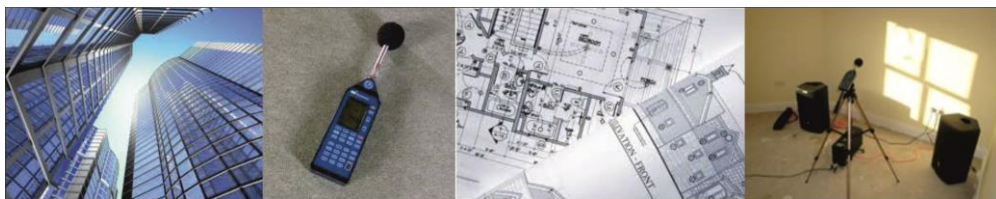


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**553 OXFORD ROAD
READING
BERKSHIRE
RG30 1HJ**

ENVIRONMENTAL NOISE ASSESSMENT

v.2

Client:

CPL ARCHITECTS

A3

Chaucer Business Park
Dittons Road
Polegate
BN26 6QH

29th August 2018

Ref: M3956

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Project Reference	M3956
Issue No.	2
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1. SUMMARY

- 1.1 An assessment of ambient noise has been undertaken at a proposed residential / community centre development at 553 Oxford Road, Reading, Berkshire, RG30 1HJ.
- 1.2 It is proposed to demolish the existing church and develop the land with a community centre on the ground floor and residential dwellings on the upper two floors.
- 1.3 The existing ambient noise climate affecting the site has been established (Section 3), and the survey has confirmed a typical variation in day time and night time levels.
- 1.4 An outline assessment of the site's suitability for residential development has been provided (Section 4).
- 1.5 Means of attenuating the external noise levels have been submitted (Section 5.4 - 5.7), in the form of a specification for the façade glazing and means of acoustically ventilating the building.
- 1.6 An assessment of noise in external amenity areas confirms that all of the balcony areas will meet the threshold values described in the WHO guidelines.
- 1.7 A design criteria has been established (Section 6) for noise associated with mechanical services equipment.
- 1.8 A design criteria has been established (Section 7) for noise transmission from the community centre to the flats above
- 1.9 It is concluded that, with these measures in place, the occupants of the new properties can be provided with an acceptable acoustic environment.

2. INTRODUCTION

- 2.1 An assessment of environmental noise has been undertaken at 553 Oxford Road, Reading, Berkshire, RG30 1HJ, on behalf of CPL Architects.
- 2.2 The site is situated southeast to the junction of Oxford Road and Wilson Road, (see Figure 1 – Site Location).
- 2.3 It is proposed to build the following;
- 10no flats spread over two floors (1st to 2nd);
 - 3no meeting halls on the ground floor, one with a kitchen;
 - A kitchen within the main foyer;
 - 2no staff rooms and manager's office.
- (see Figures 2 – 4: Proposed Site Plans).
- 2.4 It is recognised that the proposed development may be subject to noise predominantly from road traffic passing by on Oxford Road, and minor disturbance from traffic passing by on Wilson Road.
- 2.5 Given the nature of the surrounding acoustic environment, it will be necessary to ensure the scheme provides sufficient protection for any prospective occupants of new residential buildings.
- 2.6 Formally, the objectives of the current exercise may be summarised as follows:
- (i) To determine the existing ambient noise climate within 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 external noise levels and advise on any requirements for site screening;
 - (iv) To provide noise criteria for any mechanical services plant.
- 2.7 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 EXISTING 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 Given the security of the site, a long-term noise survey was not possible. An attended survey was therefore carried out in accordance with the short-survey technique described in the Calculation of Road Traffic Noise document, published by the Department of Transport (Welsh Office). This survey was undertaken on Friday 9th June 2017, between 11.30 and 14.30pm.
- 3.3 Two Rion NL-52 Type 1 sound level meters were set up around the site (see Figure 3 – Sound Level Meter Locations).
- P1 – Oxford Road (1m from existing church façade);
 - P2 – Wilson Road (2m from rear of church and 3m from road).
- 3.4 The microphones of the meters were attached to extendable light stands and set up at 1.5m above the ground.
- 3.5 The equipment was configured to measure 5 minute samples of the following acoustic parameters:
- | | |
|-------------------|---|
| LAeq | 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. |
| LAm _{ax} | The A-weighted maximum sound pressure level recorded during each sample period (as measured on fast response). |
| LA ₁₀ | A statistical parameter representing the A-Weighted noise level exceeded for 10% of each sample period. This is commonly used to describe road traffic noise levels. |
| LA ₉₀ | A statistical parameter, representing the A-weighted noise level exceeded for 90% of each sample period. This gives a measure of the underlying noise, and is commonly used to describe the ambient background noise. |

3.6 Weather conditions throughout the survey period are summarized in the following table;

Date	Average Temperature (°C)	Rainfall (mm)	Average Wind Speed m/sec	Wind Direction
Friday 9 th June	14	0.0	5.0	WSW

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

3.8 Figures 5 & 6 show the variation in noise levels during the survey period at each measurement location, and the following tables confirms the measured levels during each of the hourly periods;

P1 – Oxford Road				
Period		L _{Aeq, 1hr}	L _{A10,1hr}	L _{Amax, fast}
11.30 – 12.30	dB(A)	67.9	70.7	86
12.30 – 13.30	dB(A)	73.9	70.5	86
13.30 – 14.30	dB(A)	67.6	70.7	84

P2 – Wilson Road				
Period		L _{Aeq, 1hr}	L _{A10,1hr}	L _{Amax, fast}
11.30 – 12.30	dB(A)	54.0	57.0	73
12.30 – 13.30	dB(A)	56.5	57.1	73
13.30 – 14.30	dB(A)	54.7	57.6	72

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 that may have occurred.

3.10 The CRTN document provides a formula for converting the 1-hour values of L_{A10} into a day time 18-hour L_{A10} value. The result of this calculation is as follows:

L _{A10, 18hr}	
Oxford Road	69.6 dB(A)
Wilson Road	56.2 dB(A)

- 3.11 In fact, assessments of road traffic noise are now more commonly based on the L_{Aeq} parameter, rather than the L_{A10} parameter. It is therefore necessary to convert the 18-hour L_{A10} into the more usual 16-hour day time L_{Aeq} and the 8-hour night time L_{Aeq} .
- 3.12 The TRL Project Report PR/SE/451/02¹ provides formulae for making the necessary adjustment, and using these relationships, the figures of the $L_{A10, 18hrs}$ equates to the following:

	Day Time L_{Aeq} (07.00 – 23.00 Hrs)	Night Time L_{Aeq} (23.00 – 07.00 Hrs)
Oxford Road	67.0 dB(A)	58.9 dB(A)
Wilson Road	54.3 dB(A)	46.8 dB(A)

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

¹ TRL Project Report PR/SE/451/02 CONVERTING THE UK TRAFFIC NOISE INDEX $L_{A10,18h}$ TO EU NOISE INDICES FOR NOISE MAPPING
Prepared for DEFRA 2002

4. ASSESSMENT OF NOISE LEVELS

4.1 National Planning Policy Framework (July 2018)

- 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 taken into account 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 Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):
- a) an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
 - b) a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
 - c) an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

- 4.1.5 These objectives should be delivered through the preparation and implementation of plans and the application of the policies in this Framework; they are not criteria against which every decision can or should be judged. Planning policies and decisions should play an active role in guiding development towards sustainable solutions, but in doing so should take local circumstances into account, to reflect the character, needs and opportunities of each area.
- 4.1.6 So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development
- 4.1.7 Paragraph 180 of the NPPF states:

180. 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 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 life²*
- 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.*

- 4.1.8 The Framework continues:

182. 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.

183. The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

² Refers here to the NPSE, discussed in Section 4.2 of this report.

4.2 Noise 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."

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".

- 4.2.2 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".

- 4.2.3 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 particular policy, development or other activity may not have been given adequate weight when assessing the noise implications".

- 4.2.4 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 as a whole.
- 4.2.5 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 taking into account the guiding principles of sustainable development... .. This does not mean that such adverse effects cannot occur."*
- 4.2.6 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 DCLG Guidance Note, 2013 - 'Noise'

- 4.3.1 The Department of Communities and Local Government provided further guidance to support the NPPF. The section, Noise, published in August 2013 advises:

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Noise may override other planning concerns in certain circumstances, neither the Noise Policy Statement for England nor the National Planning Policy Framework (which reflects the Noise Policy Statement) expects noise to be considered in isolation, separately from the economic, social and other environmental dimensions of proposed development.

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*

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

This would include identifying whether the overall effect of the noise exposure is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

At the lowest extreme, when noise is not noticeable, there is by definition no effect. As the noise exposure increases, it will cross the no observed effect level as it becomes noticeable. However, the noise has no adverse effect so long as the exposure is such that it does not cause any change in behaviour or attitude. The noise can slightly affect the acoustic character of an area but not to the extent there is a perceived 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 above this level the planning process should be used to avoid this effect occurring, by use of appropriate mitigation such as by altering the design and layout. Such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused.

At the highest extreme, noise exposure would cause extensive and sustained changes in behaviour without an ability to mitigate the effect of 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 prevented from occurring.

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

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 1 - Impact Assessment Criteria

4.3.3 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 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). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.*

4.3.4 The adverse effects of noise may be mitigated in one of the four broad approaches:

- *engineering;*
- *layout;*
- *using planning conditions/obligations to restrict activities; and*
- *mitigating the impact on areas likely to be affected by noise.*

4.3.5 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 publicly 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 minutes walking distance).*

4.4 Reading Borough Council

Core Strategy Document (2008 & altered 2015): Policy CS34

- 4.4.1 Proposals for development that are sensitive to the effects of air, noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution.

Sites and Detailed Policies Document (2012 & altered 2015): Policy DM4

- 4.4.2 Development will not cause a significant detrimental impact to the living environment of existing or new residential properties, in the terms of:
- Privacy and overlooking;
 - Access to sunlight and daylight;
 - Visual dominance and overbearing effects of the development;
 - Noise and disturbance;
 - Artificial lighting;
 - Vibration;
 - Dust and fumes;
 - Smell;
 - Crime and safety.
- 4.4.3 The position of habitable rooms, windows and outdoor living spaces will be particularly important. A back-to-back distance of 20m between dwellings is usually appropriate, although the circumstances on individual sites may enable dwellings to be closer without a detrimental effect on privacy.

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

- 4.5.1 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 2 - BS8233 Indoor Guideline Values

- 4.5.2 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) 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 3 - BS8233 Derived Facade Guideline Values

- 4.5.3 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.
- 4.5.4 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.
- 4.5.5 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.

³ Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)

4.6 BS 4142:2014: Methods for rating and assessing industrial and commercial sound

- 4.6.1 Any formal assessment of commercial noise affecting residential properties would in all likelihood be based upon the recommendations of British Standard 4142:2014 "Methods for rating and assessing industrial and commercial sound".
- 4.6.2 In brief, this rating method determines "specific sound level" generated by the new plant, assessed immediately outside the residential properties most likely to be affected. For daytime (07.00 – 23.00) only operation of the new plant, this would be the equivalent continuous noise level of the new noise, evaluated over a 1 hour sampling period, its $L_{Aeq,1hr}$. For plant operating during the night-time (23.00 – 07.00) only the reference time interval is 15 minutes.
- 4.6.3 Corrections of up to + 9 dB (A) are then made to this "specific sound level" if the new noise has certain acoustic features such as; tonality, impulsivity, intermittency and any other sound characteristics, to give the "rating level".
- 4.6.4 An assessment of the impact of the specific sound level can be determined by subtracting the measured background level from the rating level, and consider the following;
- a) Typically, the greater this difference, the greater the magnitude of the impact.
 - b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
 - c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
 - d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

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

- 4.6.5 It is likely that the Local Authority would seek to avoid marginal situations at the planning stage, and may try to ensure a positive likelihood that no complaints would be forthcoming. As such, they might recommend a noise target which limits the Rating Noise Level to a

maximum which is as low as 5 - 10 dB(A) below the minimum background level currently experienced.

- 4.6.6 However, there are limitations to BS4142 if noise levels are very low, and in such circumstances, it may not be necessary to follow the normal guidance in order to achieve this aim. Indeed, within the Scope of the Standard, it is stated:

"The method is not suitable for assessing the noise measured inside buildings or when the background and rating noise levels are both very low."

Note: for the purpose of this Standard, background noise levels below about 30 dB and rating noise level below about 35 dB are considered to be very low."

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.

5. RECOMMENDATIONS FOR NOISE ATTENUATION MEASURES

INTERNAL NOISE LEVELS

5.1 Section 4.5.1 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 Table 4 below defines the predicted external façade noise levels, dB(A) and overall performance targets required through each façade of the buildings. These figures are based initially on the targets of Para 5.2, the measured noise levels given in Para 3.8 and the calculated figures within Para 3.12.

Elevation	External Noise Level	Target Noise Level	Outside to inside level difference
North Façade			
Living Rooms	67 dB(A) $L_{Aeq,16hrs}$	35 dB(A) $L_{Aeq,16hrs}$	32 dB(A)
Bedrooms	59 dB(A) $L_{Aeq,8hrs}$ 86 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,8hrs}$ 45 dB(A) $L_{Amax,fast}$	41 dB(A)
South Façade			
Living Rooms	54 dB(A) $L_{Aeq,16hrs}$	35 dB(A) $L_{Aeq,16hrs}$	19 dB(A)
Bedrooms	47 dB(A) $L_{Aeq,8hrs}$ 73 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,8hrs}$ 45 dB(A) $L_{Amax,fast}$	28 dB(A)
West Façade			
Living Rooms	62 dB(A) $L_{Aeq,16hrs}$	35 dB(A) $L_{Aeq,16hrs}$	27 dB(A)
Bedrooms	54 dB(A) $L_{Aeq,8hrs}$ 78 dB(A) $L_{Amax,fast}$	30 dB(A) $L_{Aeq,8hrs}$ 45 dB(A) $L_{Amax,fast}$	33 dB(A)

Table 4 – Predicted Façade Noise Levels

5.5 Table 5 confirms the required glazing performance and recommendations of glazing configurations, and Appendix I shows calculations of the predicted outside to inside noise levels for the different possible glazing options, based on the information supplied by the client.

Façade	Room	Glazing Performance Target $R_w + C_{tr}$	Possible Configuration
North (Plots 3,4,5,8,9 & 10)	Living Rooms	33 dB	6 / 15 / 8.8A
North (Plots 3,4,8 & 9)	Bedrooms	46 dB	14.8A / 24 / 12.8A ⁴
West (Plots 3 & 8)	Living Rooms	33 dB	6 / 15 / 8.8A
West (Plots 1,2,6 & 7)	Living Rooms	29 dB	4 / 12 / 6
West (Plots 1,2,6 & 7)	Bedrooms	46 dB	14.8A / 24 / 12.8A ⁴
South	All rooms	27 dB	4 / 12 / 4

Table 5 – Glazing Performance Requirement

5.6 Whichever level of glazing is provided for these sensitive façades, it is of course the case that when the windows are opened, the acoustic performance of the windows will be irrelevant. It may therefore be necessary to provide alternative means by which habitable rooms may be ventilated whilst keeping the acoustic integrity of the façade. The options for achieving this include:

- (i) An acoustic trickle vent, such as the Passivent⁵ ALdB Acoustic Grille. This is an external grille providing a reduction of up to 42 dB $D_{n,e,w}$. This fits in conjunction with a standard internal trickle vent;
- (ii) A wall ventilation system, such as the Passivent Fresh 90 dB Wall Ventilator. An internal grill and external louver linked by 150mm diameter duct, providing 300mm² - 6000mm² ventilation;
- (iii) A Mechanical Ventilation Heat Recovery (MVHR) system for each apartment. This operates with a fresh air grill set into the external elevation, providing fresh air to the unit. The air is then ducted to one or more grills across the flat. Return air grills draw exhaust air back through the MVHR unit, which then discharges the air to atmosphere through a second grill in the outside wall or roof. Manufacturers do not provide sound transmission loss figures, but conservative calculations indicate that the outside to inside loss through a typical MVHR system will be in the order of 40 dB(A).

⁴ The glazing would only be acceptable if used in conjunction with a MVHR unit

⁵ Passivent, by Willan Building Services 0161 962 7113

EXTERNAL AMENITY SPACE

- 5.7 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} .
- 5.8 It is noted that, all of the plots are designed to have balcony areas, and taking into consideration the distance from source to receiver, height of the glazed balustrade and barrier effect, it is confirmed that the predicted noise levels within the balconies will be below the WHO guidelines.
- 5.9 It should be noted though that any gaps around the edges of the balustrade will have a detrimental effect to the predicted noise levels.
- 5.10 However, in the case where there is a residual excess, it is noted that BS8233:2014 does provide some clarification to this particular design criteria (Para 7.7.3.2):

However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies maybe included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to

protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.

6. DESIGN TARGET FOR NEW PLANT NOISE

- 6.1 It is understood that the development will use mechanical ventilation within the kitchens, which will exhaust through louvres within the external façade, however the exact locations of the louvres are unknown at present.
- 6.2 During the attended survey background noise levels (L_{A90}) were measured, and the typical daytime background noise level around the vicinity of the development was 47dB(A).
- 6.3 The nearest noise sensitive dwelling could be as close as 8m away from the development, and taking into consideration the requirements of BS4142, the following design target should be adopted on this project:

<i>Maximum Allowable Rating Noise Level at nearest noise sensitive receptors</i>		
<i>Time Period⁶</i>	<i>General Noise</i>	<i>Tonal or Intermittent Noise</i>
<i>07.00 – 23.00</i>	<i>37 dB(A) $L_{Aeq,1hr}$</i>	<i>32 dB(A) $L_{Aeq,1hr}$</i>

7. NOISE TRANSMISSION FROM COMMUNITY CENTRE

- 7.1 The development will include 3no meeting rooms and 2no kitchens on the ground floor, directly below private apartments, and it will therefore be necessary to demonstrate that noise within these areas will have no adverse impact on the amenity of adjacent residents.
- 7.2 The two sources of noise to be considered are those related to the customers and food preparation, and then any new fixed equipment or building services plant.
- 7.3 In respect of the former, assuming typical operational hours (0700 - 1900), it is suggested that noise transmission through the building can be controlled to an acceptable level in the flats above, providing the separating floor is designed to achieved 5 dB above the minimum airborne sound insulation requirements of the Building Regulations.
- 7.4 This assessment is based on noise levels in the meeting rooms or kitchen not exceeding 80 dB(A) - the level which represents people shouting at each other. Table 6 provides a

⁶ It is understood that mechanical ventilation noise associated with the kitchens will only be during daytime hours.

calculation of the noise transmission through a concrete floor slab designed to achieved 50 dB $D_{nT,w} + C_{tr}$, into a living rooms and bedrooms above.

	63	125	250	500	1000	2000	4000	8000	dB(A)
Community Centre to Living Rooms Above									
Internal Level	80	80	80	78	75	70	63	59	80
SRI of Party Floor	-34	-53	-52	-59	-66	-73	-78	-78	82
Area of Room Above 41m ²	+16	+16	+16	+16	+16	+16	+16	+16	
Room Correction	-15	-15	-15	-15	-15	-15	-15	-15	
Net SPL in Rooms Above	47	28	29	20	10	-2	-14	-18	25

	63	125	250	500	1000	2000	4000	8000	dB(A)
Community Centre to Bedrooms Above									
Internal Level	80	80	80	78	75	70	63	59	80
SRI of Party Floor	-34	-53	-52	-59	-66	-73	-78	-78	82
Area of Room Above 12m ²	+11	+11	+11	+11	+11	+11	+11	+11	
Room Correction	-10	-10	-10	-10	-10	-10	-10	-10	
Net SPL in Rooms Above	47	28	29	20	10	-2	-14	-18	25

Table 6 – Calculation of Room to Room Noise Transmission

7.5 For clarity, the calculation is based on a floor construction comprising

75mm sand/cement screed on a 10mm thick resilient layer
150mm concrete composite slab
MF ceiling grid, 100mm void, partially filled with 50mm insulation
1 x 12.5mm Wallboard plasterboard to the underside.

7.6 The result is a residual noise level of 25 dB(A), which is 10 dB(A) below the 'good ' standard indicated in BS8233 for day time accommodation, and 5 dB(A) below the night-time criteria.

8. CONCLUSION

- 8.1 The foregoing assessment has looked at the levels of ambient noise within the vicinity of a proposed new mixed development at 553 Oxford Road, Reading, Berkshire, RG30 1HJ, on behalf of CPL Architects.
- 8.2 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 within the proposed buildings will be met.
- 8.3 It has been shown that noise levels within the balcony areas will be within 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.
- 8.4 Criteria has been given to ensure noise levels from mechanical services plant will not have a detrimental effect on the nearby dwellings.
- 8.5 It has been shown that the proposed party floor construction between the ground floor community centre and 1st floor flats will provide a good level of sound insulation.

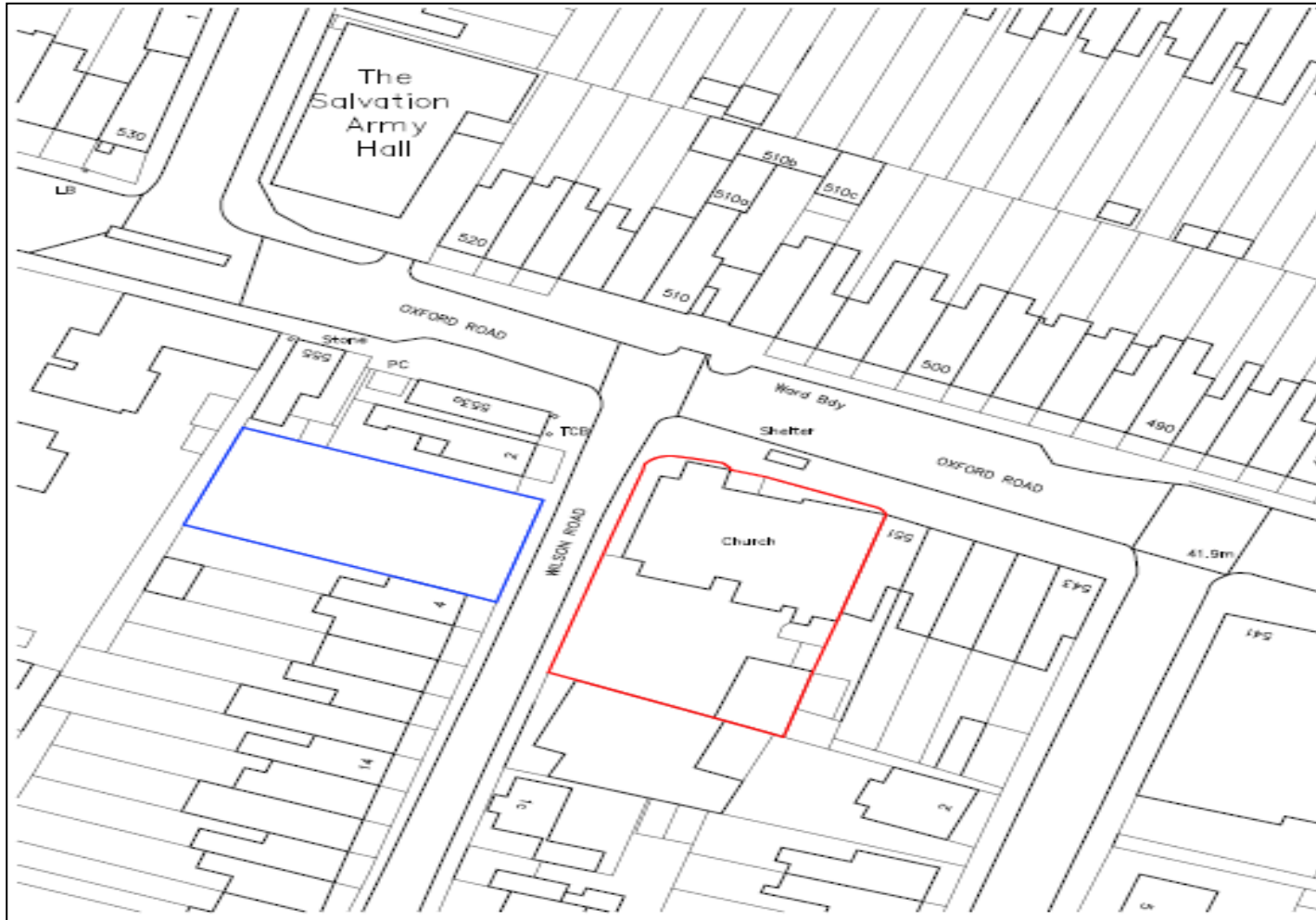


FIGURE 1: SITE LOCATION

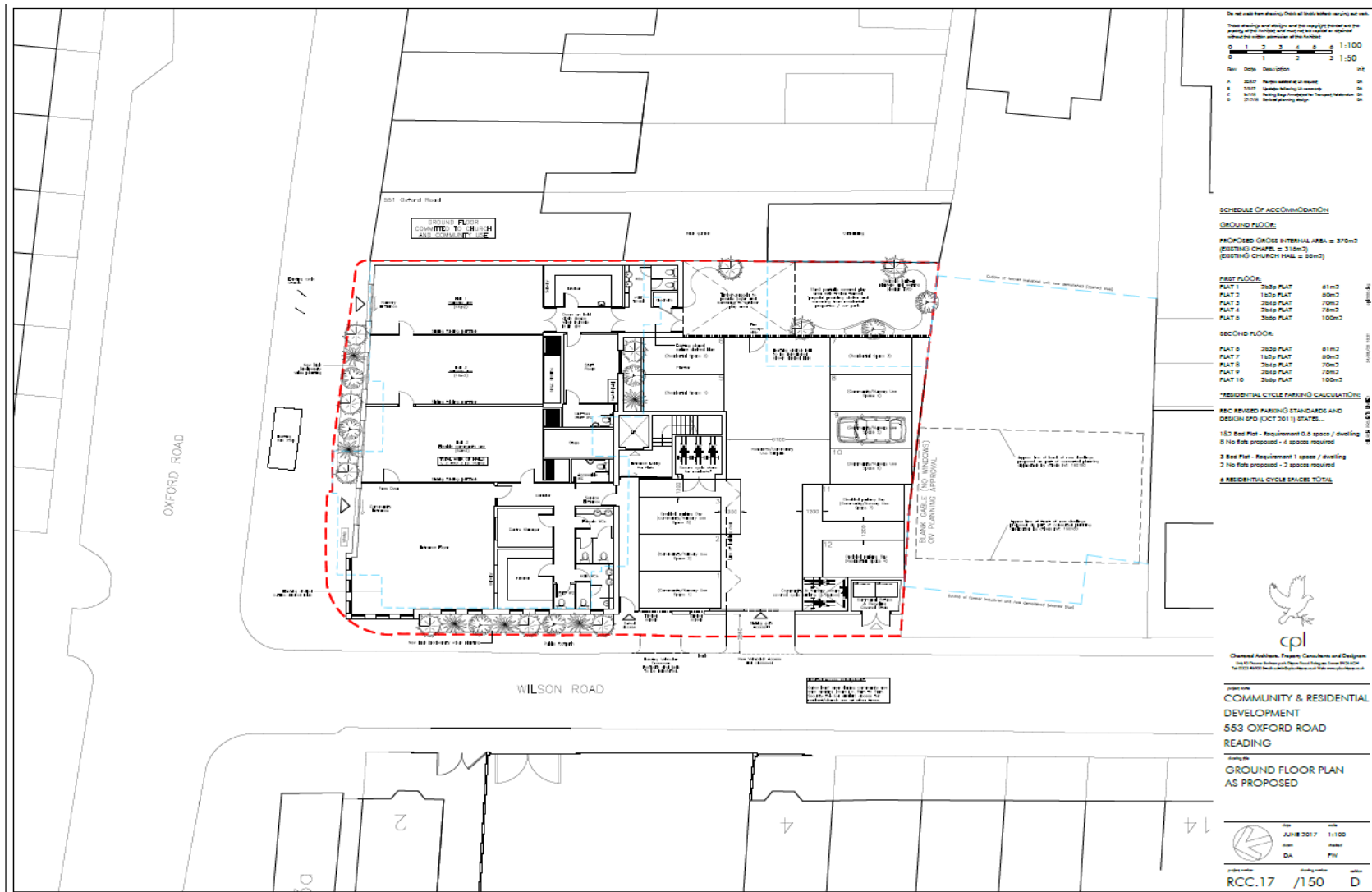


FIGURE 2: PROPOSED GROUND FLOOR PLAN

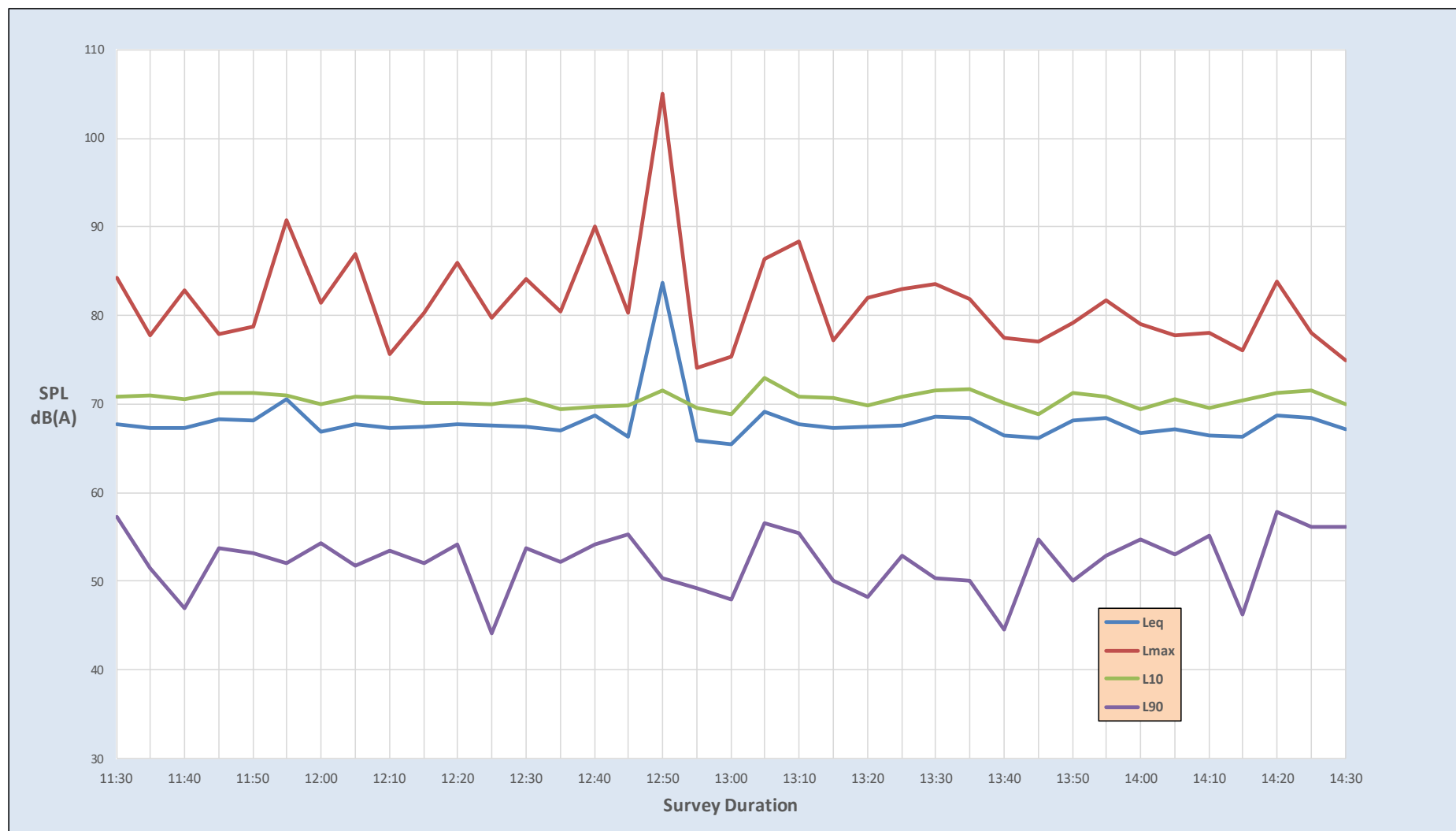


FIGURE 5: VARIATION OF MEASURED NOISE LEVELS – OXFORD RD

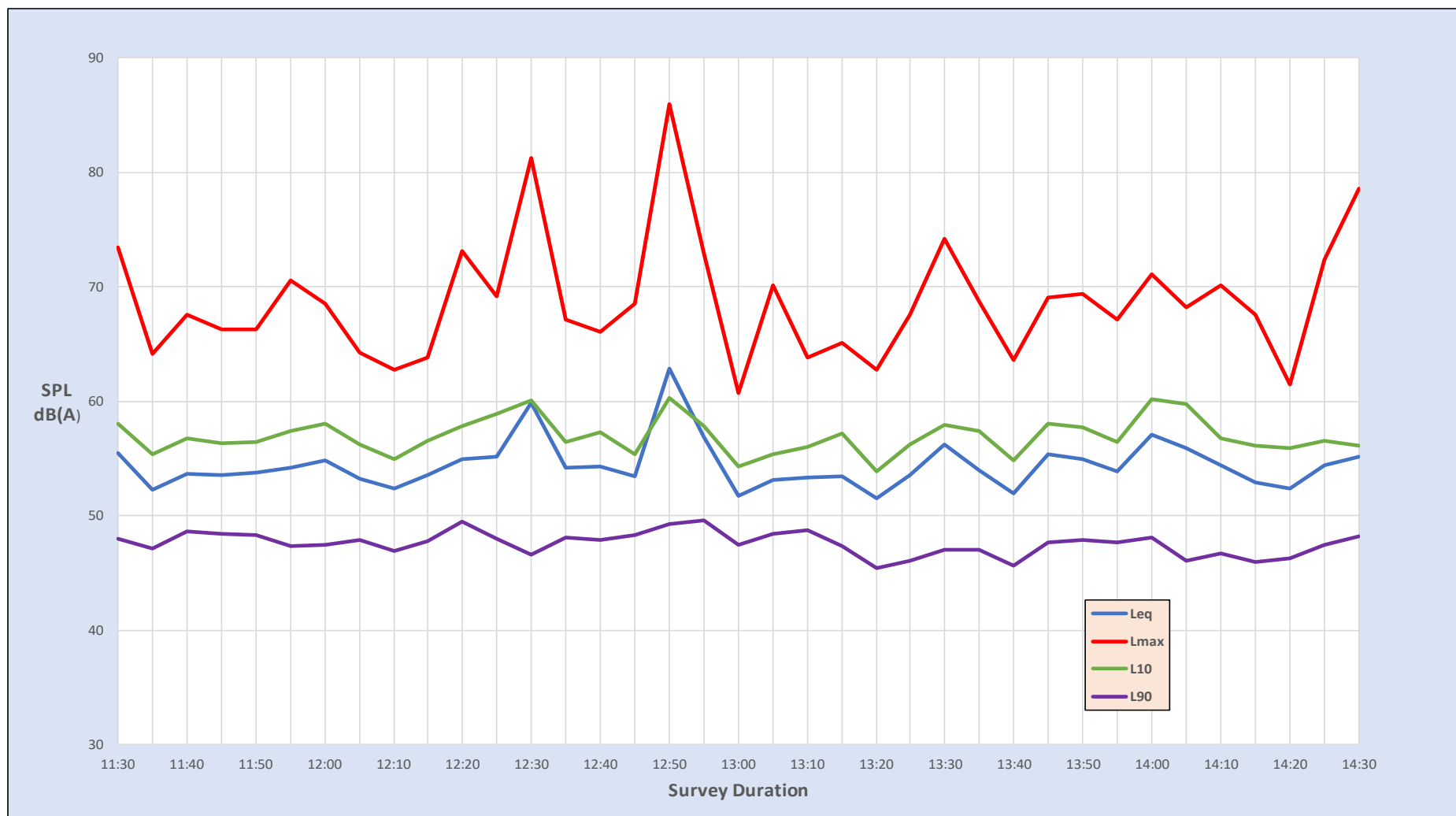


FIGURE 6: VARIATION OF MEASURED NOISE LEVELS – WILSON RD

APPENDIX I: CALCULATION OF OUTSIDE TO INSIDE NOISE (for each glazing type)

LIVING ROOMS PLOTS 5 & 10: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAeq	dB	76	66	68	62	64	59	51	43	67
Glazing Specified: 6 / 15 / 8.8A	dB	33	25	27	37	47	44	51	51	
Area of Window	dB	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	97	97	97	97	97	97	97	97	
Absorption		31	31	31	32	33	27	25	31	
Absorption Correction	dB	15	15	15	15	15	14	14	15	
Net SPL Inside	dB	35	33	33	17	9	8	-7	-16	26
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	97	97	97	97	97	97	97	97	
Absorption		31	31	31	32	33	27	25	31	
Absorption Correction	dB	15	15	15	15	15	14	14	15	
Net SPL Inside	dB	27	12	16	5	-3	-17	-35	-44	9
Combined Level from window and wall	dB	36	33	33	17	9	8	-7	-16	26
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	39	36	36	20	12	11	-4	-13	29

LIVING ROOMS PLOTS 4 & 9: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAeq	dB	76	66	68	62	64	59	51	43	67
Glazing Specified: 6 / 15 / 8.8A	dB	33	25	27	37	47	44	51	51	
Area of Window	dB	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	74	74	74	74	74	74	74	74	
Absorption		24	24	24	25	25	20	19	24	
Absorption Correction	dB	14	14	14	14	14	13	13	14	
Net SPL Inside	dB	36	34	34	18	10	9	-6	-15	27
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	
Area Correction	dB	5	5	5	5	5	5	5	5	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	74	74	74	74	74	74	74	74	
Absorption		24	24	24	25	25	20	19	24	
Absorption Correction	dB	14	14	14	14	14	13	13	14	
Net SPL Inside	dB	26	11	15	4	-4	-18	-36	-45	9
Combined Level from window and wall	dB	37	34	35	18	10	9	-6	-15	27
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	40	37	38	21	13	12	-3	-12	30

LIVING ROOMS PLOTS 3 & 8: WEST & NORTH ELEVATIONS										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAeq	dB	76	66	68	62	64	59	51	43	67
Glazing Specified: 6 / 15 / 8.8A	dB	33	25	27	37	47	44	51	51	
Area of Window	dB	14	14	14	14	14	14	14	14	
Area Correction	dB	11	11	11	11	11	11	11	11	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	72	72	72	72	72	72	72	72	
Absorption		23	23	23	24	25	20	19	23	
Absorption Correction	dB	14	14	14	14	14	13	13	14	
Net SPL Inside	dB	41	39	39	23	15	13	-1	-10	31
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	12	12	12	12	12	12	12	12	
Area Correction	dB	11	11	11	11	11	11	11	11	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	72	72	72	72	72	72	72	72	
Absorption		23	23	23	24	25	20	19	23	
Absorption Correction	dB	14	14	14	14	14	13	13	14	
Net SPL Inside	dB	32	17	21	10	2	-12	-30	-39	15
Combined Level from window and wall	dB	41	39	39	23	15	13	-1	-10	31
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	44	42	42	26	18	16	2	-7	34

LIVING ROOMS PLOTS 1, 2, 6 & 7: WEST ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAeq	dB	71	61	63	57	58	53	45	47	62
Glazing Specified: 4 / 12 / 6	dB	15	27	21	29	40	39	43	40	
Area of Window	dB	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	62	62	62	62	62	62	62	62	
Absorption		20	20	20	21	21	17	16	20	
Absorption Correction	dB	13	13	13	13	13	12	12	13	
Net SPL Inside	dB	50	28	36	22	12	9	-3	1	30
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
Area Correction	dB	5	5	5	5	5	5	5	5	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	62	62	62	62	62	62	62	62	
Absorption		20	20	20	21	21	17	16	20	
Absorption Correction	dB	13	13	13	13	13	12	12	13	
Net SPL Inside	dB	22	7	11	-1	-10	-24	-41	-40	4
Combined Level from window and wall	dB	50	28	36	22	12	9	-3	1	30
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	53	31	39	25	15	12	0	4	33

BEDROOM 1 PLOTS 4 & 9: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAmax	dB	91	88	88	87	75	72	68	59	86
Glazing Specified: 14.8A / 24 / 12.8A	dB	33	40	41	47	51	53	59	60	
Area of Window	dB	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	
Area Correction	dB	5	5	5	5	5	5	5	5	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	9	9	11	
Absorption Correction	dB	10	10	10	11	11	10	9	10	
Net SPL Inside	dB	53	43	42	35	19	15	5	-6	37
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	
Area Correction	dB	4	4	4	4	4	4	4	4	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	34	34	34	34	34	34	34	34	
Absorption		11	11	11	11	12	9	9	11	
Absorption Correction	dB	10	10	10	11	11	10	9	10	
Net SPL Inside	dB	44	36	38	32	10	-3	-16	-26	32
<i>Combined Level from window and wall</i>	dB	53	44	43	36	19	15	5	-6	38
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	56	47	46	39	22	18	8	-3	41

BEDROOM 2 PLOTS 4 & 9: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAmax	dB	91	88	88	87	75	72	68	59	86
Glazing Specified: 14.8A / 24 / 12.8A	dB	33	40	41	47	51	53	59	60	
Area of Window	dB	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	
Area Correction	dB	2	2	2	2	2	2	2	2	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	38	38	38	38	38	38	38	38	
Absorption		12	12	12	13	13	19	19	12	
Absorption Correction	dB	10	10	10	11	11	10	19	10	
Net SPL Inside	dB	59	49	49	35	19	15	2	-9	33
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	256	256	256	256	256	256	256	256	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	38	38	38	38	38	38	38	38	
Absorption		12	12	12	13	13	19	19	12	
Absorption Correction	dB	10	10	10	11	11	10	19	10	
Net SPL Inside	dB	46	38	48	32	10	-3	-16	-26	32
Combined Level from window and wall	dB	53	42	42	36	19	12	2	-9	38
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	56	43	45	39	20	18	8	-8	40

BEDROOM 1 PLOTS 3 & 8: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAmax	dB	91	88	88	87	75	72	68	59	86
Glazing Specified: 14.8A / 24 / 12.8A	dB	33	40	41	47	51	53	59	60	
Area of Window	dB	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	33	33	33	33	33	33	33	33	
Absorption		11	11	11	11	11	9	9	11	
Absorption Correction	dB	10	10	10	10	11	10	9	10	
Net SPL Inside	dB	55	45	44	37	21	17	7	-4	39
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
Area Correction	dB	5	5	5	5	5	5	5	5	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	33	33	33	33	33	33	33	33	
Absorption		11	11	11	11	11	9	9	11	
Absorption Correction	dB	10	10	10	10	11	10	9	10	
Net SPL Inside	dB	44	36	38	32	10	-2	-16	-26	33
<i>Combined Level from window and wall</i>	dB	55	46	45	38	21	17	7	-4	40
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	58	49	48	41	24	20	10	-1	43

BEDROOM 2 PLOTS 3 & 8: NORTH ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAmax	dB	91	88	88	87	75	72	68	59	86
Glazing Specified: 14.8A / 24 / 12.8A	dB	33	40	41	47	51	53	59	60	
Area of Window	dB	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	
Area Correction	dB	2	2	2	2	2	2	2	2	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	27	27	27	27	27	27	27	27	
Absorption		9	9	9	9	9	7	7	9	
Absorption Correction	dB	9	9	9	10	10	9	8	9	
Net SPL Inside	dB	51	41	40	33	17	13	3	-8	35
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	27	27	27	27	27	27	27	27	
Absorption		9	9	9	9	9	7	7	9	
Absorption Correction	dB	9	9	9	10	10	9	8	9	
Net SPL Inside	dB	48	40	42	35	13	1	-12	-22	36
<i>Combined Level from window and wall</i>	dB	53	43	44	37	18	13	3	-8	38
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	56	46	47	40	21	16	6	-5	41

BEDROOM 1 PLOTS 1, 2, 6 & 7: WEST ELEVATION										
Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
External Noise Level LAmax	dB	86	83	83	82	70	67	63	54	81
Glazing Specified: 12.8A / 15 / 12.8A	dB	24	29	38	44	52	49	64	60	
Area of Window	dB	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	
Area Correction	dB	2	2	2	2	2	2	2	2	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	29	29	29	29	29	29	29	29	
Absorption		9	9	9	10	10	8	7	9	
Absorption Correction	dB	10	10	10	10	10	9	9	10	
Net SPL Inside	dB	55	47	38	31	10	11	-7	-13	35
External Wall	dB	41	46	44	49	59	69	79	79	
Area of Wall	dB	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
Area Correction	dB	8	8	8	8	8	8	8	8	
Likely RT in Room	sec	0.5	0.5	0.5	0.48	0.47	0.58	0.62	0.5	
Room Volume	m3	29	29	29	29	29	29	29	29	
Absorption		9	9	9	10	10	8	7	9	
Absorption Correction	dB	10	10	10	10	10	9	9	10	
Net SPL Inside	dB	43	35	37	31	9	-3	-17	-27	31
<i>Combined Level from window and wall</i>	dB	55	47	40	34	13	12	-7	-13	37
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	58	50	43	37	16	15	-4	-10	40

APPENDIX II: 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 s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. 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.
L10,T	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic 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.