Hawkins environmental

Noise Assessment: 80 Guilford Street, Bloomsbury

Russell Building and Developments Limited

3rd December 2013

Report Details:

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Client	Russell Building and Developments Limited
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V01	3rd December 2013	Original Issue	Nick Hawkins MIOA MIAQM	Nick Hawkins MIOA MIAQM

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1. INTRODUCTION

Hawkins Environmental Limited has been instructed by Russell Building and Developments Limited to undertake a noise assessment for the redevelopment of 80 Guilford Street, Bloomsbury, situated within the London Borough of Camden. The site currently comprises a five storey terraced property containing sixteen bedsitting rooms. The proposals will see the conversion of the existing building structure into five self-contained apartments.

During the planning process, it has been identified that the site may require a noise assessment to determine whether the site is suitable for residential use, due to its location close to a busy road, and whether additional sound insulation will be required to ensure a good level of internal amenity. Consequently, the purpose of the study is primarily to determine, through on-site noise measurements and prediction, the noise climate of the site with the proposed layout. Recommendations for mitigation are also made where appropriate, in order to achieve reasonable internal noise levels.

2. THE NATURE, MEASUREMENT AND EFFECT OF ROAD TRAFFIC NOISE

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to measure the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB(A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels from say 60 dB(A) to 70 dB(A) would represent a doubling in 'loudness'. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) would represent a halving in 'loudness'. A change of 3 dB(A) is generally considered to be just perceptible[1]. **Table 2.1** details typical noise levels.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

[1] Communities & Local Government (1994). Planning Policy Guidance 24: Planning & Noise.

3. NOISE CRITERIA

3.1. The National Planning Policy Framework

In March 2012, the National Planning Policy Framework (NPPF) was published to replace the thousands of pages of national planning policy guidance, including guidance on noise. The intention was to let councils decide their own priorities though their Local Plans and reduce the amount of "red tape" to enable growth and development. Amongst hundreds of other documents, the NPPF replaces the 1994 document *Planning Policy Guidance Note 24 (PPG 24) 'Planning and Noise'* published by the then Department of Environment, which is now officially withdrawn as official government guidance.

The NPPF includes 12 core planning principles which include:

- *"Always seek to secure high quality design and a good standard of amenity for all existing and future occupants of buildings;*
- *Take account of the different roles and character of different areas, promoting the vitality of the main urban areas, protecting the Green Belts around them, recognising the intrinsic beauty of the countryside; and*
- *Contribute to conserving and enhancing the natural environmental and reducing pollution"*

It also states that the planning system "*should contribute to enhance the natural environment, by... preventing both new and existing development from contributing to or being put at risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution…To prevent unacceptable risks from pollution, planning policies and decisions should ensure that new development is appropriate for its location*".

The NPPF talks specifically about noise stating that *"Planning policies and decisions should aim to:*

- *Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *Recognise that development will often create some noise and existing businesses wanting to development in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

The purpose of the NPPF is for Local Planning Authorities to determine for itself whether a "*new development is appropriate for its location"* or how to determine what constitutes "*a good standard of amenity for all…future occupants of buildings"*. Prior to March 2012, Local Planning Authorities almost exclusively utilised PPG 24 to determine site suitability in terms of noise and used PPG 24 in conjunction with BS 8233 to determine whether the property will retain a good level of amenity based on the noise climate of the site. Whilst the withdrawal of PPG 24 and the advent of the NPPF will enable Local Planning Authorities to determine their own

methodologies and even determine whether noise is a priority, in the absence of any other local guidance or policy, any other nationally adopted guidance, or any informal guidance, it is anticipated that the withdrawn PPG 24 document will still be utilised as a method for determining site suitability. Furthermore, the vast majority of Local Planning Authorities still reference PPG 24 as the guidance to use in relation to noise; therefore, whilst officially withdrawn, the document currently remains in common usage.

3.2. Planning Policy Guidance Note 24 'Planning and Noise'

In September 1994 the then Department of Environment published the *Planning Policy Guidance Note 24 'Planning and Noise'*. The document (PPG 24) was intended to be used by Local Planning Authorities as guidelines in determining the acceptability of proposed development sites that may be affected by noise.

The PPG 24 states:

"*Noise Exposure Categories for Dwellings*

When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories (NEC's) the proposed site falls, taking account of both day and night-time noise levels. Local planning authorities should have regard to the advice in the appropriate NEC, as shown in ***Table 3.1*** *below:*

Table 3.1: PPG 24 Noise Exposure Categories

Noise Exposure Category	*Planning Response*
A	*Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.*
B	*Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.*
C	*Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites, conditions should be imposed to ensure a commensurate level of protection against noise.*
D	*Planning permission should normally be refused.*

A recommended range of noise levels is given below for each of the NEC's for dwellings exposed to noise from road, rail, air and 'mixed sources'. Annex 2 (of the PPG) provides a detailed explanation of how the boundaries of each of the NEC's have been derived. Paragraph 9 of the main text explains that in some cases local planning authorities may be able to justify a range of NEC's of up to 3 dBA above or below those recommended."

The recommended noise guidelines are shown in **Table 3.2** below.

Table 3.2: Noise Levels Corresponding to the NECs for New Dwellings

Noise Levels Corresponding To The Noise Exposure Categories For New Dwellings $L_{Aeq\,T}$ dB				
Noise Source	**Noise Exposure Category**			
	A	B	C	D
Road Traffic				
0700-2300	<55	55-63	63-72	>72
2300-0700[1]	<45	45-57	57-66	>66
Rail Traffic				
0700-2300	<55	55-66	66-74	>74
2300-0700[1]	<45	45-59	59-66	>66
Air Traffic				
0700-2300	<57	57-66	66-72	>72
2300-0700[1]	<48	48-57	57-66	>66
Mixed Sources				
0700-2300	<55	55-63	63-72	>72
2300-0700[1]	<45	45-57	57-66	>66

Notes. 1. Night-time noise levels (2300-0700): sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any one hour should be treated as being in NEC C, regardless of the $L_{Aeq.8hr}$ (except where the $L_{Aeq.8hr}$ already puts the site in NEC D).

Local Authorities could adopt a flexible approach to the above criteria and could, depending on their areas and local requirements, adjust the criteria.

To "*ensure an adequate level of protection against noise"* it was common practice to ensure that a good standard of internal noise amenity can be obtained, using the guidance within BS 8233 and the WHO Guidelines.

PPG 24 was officially withdrawn in March 2012 with the publication of the NPPF.

3.3. WHO Guidelines and BS 8233

Guidance on absolute limits for noise inside and outside of buildings is provided in BS 8233:1999 'Sound insulation and noise reduction for buildings –Code of practice'. Similar guidance can also be found in the current World Health Organisation (WHO) "Guidelines on Community Noise". A summary of the noise criteria can be seen in **Table 3.3** and **Table 3.4.**

Table 3.3: Summary of Noise Criteria: BS8233

Criterion	Typical situations	Good Level $L_{Aeq,T}$	Reasonable Level $L_{Aeq,T}$	Reasonable Peak L_{Amax}
BS 8233 Reasonable resting/sleeping conditions	Living rooms	30	40	-
	Bedrooms	30	35	45

Whilst it is always good practice to endeavour to achieve the "good" level of BS 8233, the British Standard does state that in normal circumstances, only the "reasonable" level needs to be achieved.

Table 3.4: Summary of Noise Criteria: WHO

Residential Environment	Critical Health Effect(s)	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

3.4. The London Plan

The London Plan[2], published in July 2011, provides an overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. The Plan brings together the Mayor's strategies, including policy on a range on environmental issues, such as climate change, air quality, noise and waste. London boroughs' local plans need to be in general conformity with the London Plan, and its policies guide decisions on planning applications by councils and the Mayor.

Policy 7.1 specifically relates to noise and states:

"Development proposals should seek to reduce noise by:

a) minimise the existing and potential; adverse impacts of noise on, from, within, or in the vicinity of, development proposals;

b) separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation;

[2] The London Plan - Spatial Development Strategy for Greater London (July 2011), Mayor of London.

c) promoting new technologies and improving practices to reduce noise at source.

3.5. Local Policy

The London Borough of Camden's Development Policies 2010-2025[3] document states in Policy DP28 Noise and Vibration that *"The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for: a) development likely to generate noise pollution; or b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided. Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted."*

The policy document goes on to describe noise thresholds at which noise levels will be acceptable:

"Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted:

Noise description and location of measurement	***Period***	***Time***	***Sites adjoining roads***
Noise at 1 metre external to a sensitive façade	*Day*	*0700-1900*	*72 dB $L_{Aeq.12hr}$*
Noise at 1 metre external to a sensitive façade	*Evening*	*1900-2300*	*72 dB $L_{Aeq.4hr}$*
Noise at 1 metre external to a sensitive façade	*Night*	*2300-0700*	*66 dB $L_{Aeq.8hr}$*

Table B: Noise levels on residential sites adjoining railways and roads at and above which attenuation measures will be required:

Noise description and location of measurement	***Period***	***Time***	***Sites adjoining roads***
Noise at 1 metre external to a sensitive façade	*Day*	*0700-1900*	*62 dB $L_{Aeq.12hr}$*
Noise at 1 metre external to a sensitive façade	*Evening*	*1900-2300*	*57 dB $L_{Aeq.4hr}$*
Noise at 1 metre external to a sensitive façade	*Night*	*2300-0700*	*52 dB $L_{Aeq.8hr}$*
Individual noise events several times on one hour	*Night*	*2300-0700*	*>82dB L_{Amax} (S time weighting)*

[3] Camden Local Development Framework - Camden Development Policies - Adoption version 2010

4. NOISE MEASUREMENT STUDY

In order to determine the extent to which the site is affected by noise, a detailed noise measurement study has been carried out on the proposed development site. Noise measurements have been carried out in order to determine the overall $L_{Aeq.16hrs}$ and $L_{Aeq.8hrs}$ for the day and night time periods.

All noise monitoring was conducted using a Norsonic 140 sound level meter, which conforms to BS EN IEC 61672 as a Class 1 precision measurement system. A Norsonic 1251 field calibrator was used before and after the measurement periods in order to ensure that the equipment had remained within reasonable calibration limits (+/- 0.5 dB). All of the equipment used has current certificates of calibration. **Appendix 2** summarises the equipment used including serial numbers and calibration certificates.

All noise monitoring has been conducted in accordance with the guidance set out in BS 7445-2: 1991 *'Description and measurement of environmental noise Part 2: Guide to the acquisition of data pertinent to land use*'. This standard details information that should be recorded in addition to the actual measured levels such as meteorological data, and a description of the noise source itself. The following statistical parameters were recorded during survey: L_{Aeq}, L_{Amax}, L_{A10}, L_{A50}, L_{A90}.

The survey was conducted from around 2pm on the 27th September 2012 to around 2pm on 28th September 2012. The noise monitoring was conducted by Nick Hawkins of Hawkins Environmental Limited. Nick is a Member of the Institute of Acoustics and holds the Institute of Acoustic's Certificate of Competence in Environmental Noise Measurement.

Weather conditions were conducive to successful monitoring. **Table 4.1** summarises the weather conditions during the measurement period.

Table 4.1: Summary of Weather Conditions during the Noise Measurements

General Description	The measurement periods were mainly cloudy and overcast, with some sunshine on the 27th. Towards the end of the measurements period, there was some light rain.
Windspeed	During the day and night, average windspeeds of around 0.5 m/s were experienced, with gusts of up to 2 m/s.
Temperature	The temperature went down to around 8°C at night, with temperatures generally around 15-19 °C during the day.
Precipitation	The measurement period remained dry until around 1pm on the 28th, when some light drizzle began. The roads were only just becoming wet when the measurement equipment was decommissioned.

Noise measurements were carried out at the location identified in **Appendix 1** which is representative of the closest point of the proposed development to Guilford Road and is therefore considered to be a worst-case noise measurement location. The equipment was attached to a first floor window of No.77 Guilford Street in a

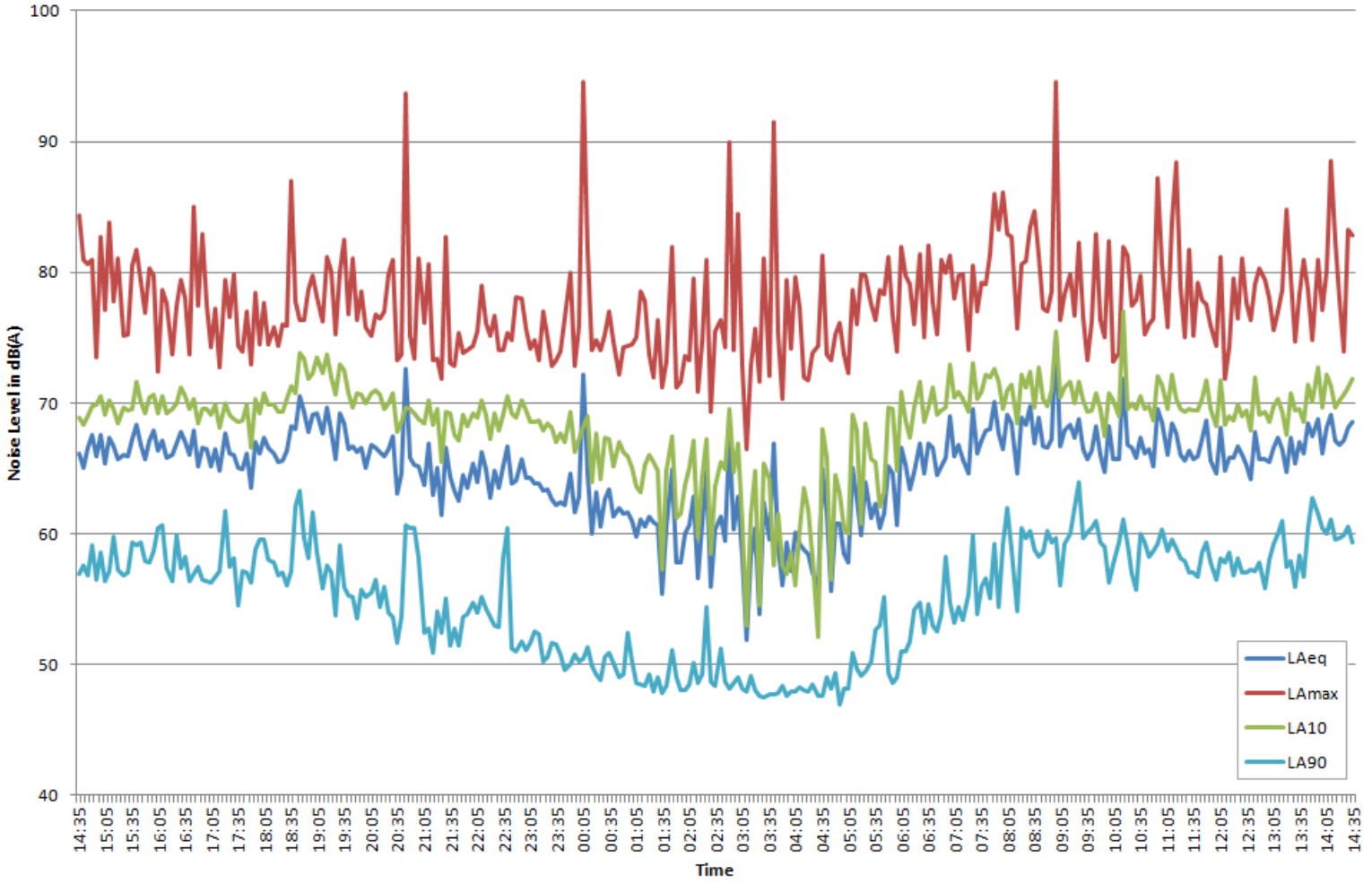
facade location. The noise measurements are considered to be representative of the front facade of No. 80 Guilford Street.

The noise measurement data is detailed in **Appendix 3** and summarised in **Table 4.2** below, with graphs displaying the noise level displayed in **Figure 4.1**. During the measurement periods, noise on site was mainly characterised by road traffic on Guilford Street, although traffic noise from surrounding roads was also clearly audible at times, especially traffic noise associated with emergency vehicles. Aircraft movements were also clearly audible at times.

Table 4.2: Summary of Noise Level Measurements

Period (hours)	Free-field Noise Level L_{Aeq} dB
07:00-19:00	64.2
19:00-23:00	63.3
23:00-07:00	59.8

Figure 4.1: Noise Measurements



5. NOISE ASSESSMENT

5.1. Evaluation of the Noise Survey Results

Table 5.1 shows that comparison of the measured noise levels against Camden's Noise Thresholds. The noise levels are less than the levels contained within Table A (see **Section 3.5**), but greater than the levels contained within Table B; this indicates that planning permission would not normally be refused on the basis of noise, but attenuation measures will be required. This is consistent with PPG 24, as the site is determined to be within Noise Exposure Category C, and PPG 24 suggests that if a property is in Noise Exposure Category C, noise needs to be taken into account when looking at the appropriateness of the building for residential purposes and "*conditions should be imposed to ensure a commensurate level of protection against noise.*"

Table 5.1: Measured Noise Levels and Comparison to Camden's Threshold Noise Levels

Period (hours)	Free-field Noise Level L_{Aeq} dB	Maximum Noise Threshold (Table A)	Attenuation Noise Threshold (Table B)	Action
07:00-19:00	64.2	72	62	Attenuation Required
19:00-23:00	63.3	72	57	Attenuation Required
23:00-07:00	59.8	66	52	Attenuation Required

5.2. Constraints and Mitigation Measures

The noise measurement survey indicates that attenuation is required and noise does need to be taken into account.

The Sound Reduction Index (SRI, sometimes noted as R_w) is the level of sound attenuation afforded by a particular material. It is possible to calculate the SRI of a particular facade to determine the internal noise level based upon the noise survey results. It is widely known that a masonry wall will have a SRI of at least 50 dB. sometimes as high as 55 to 60 dB. The SRI of individual glazing solutions will vary considerably. However, typical double glazed window systems will have a SRI of 31 to 33 dB.

Section 6.7 of BS 8233 provides a rigorous calculation method for determining the internal noise levels within a proposed development. **Figure 5.1** shows the published calculation procedure.

Figure 5.1: BS 8233:1999 External to Internal Noise Level Calculation Method

$$L_{eq,2} = L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3 \quad (1)$$

where

$L_{eq,ff}$ is the equivalent continuous sound pressure level outside the room elements under consideration;

NOTE It is the free-field sound level, measured or estimated at the intended position of the element under consideration. It is related to the level $L_{eq,1}$ measured within a few millimetres of the actual façade by the relation: $L_{eq,ff} = L_{eq,1} - 6$, and to the level $L_{eq,2M}$ measured 2 m away from the façade by the relation $L_{eq,ff} = L_{eq,1} - 3$.

A_0 is a reference absorption area of 10 m^2 and is independent of frequency;

S_f is the total façade area of the room in question in square metres (m^2);

S_{wi} is the area in square metres (m^2) of the windows of the room;

S_{ew} is the area in square metres (m^2) of the external wall of the room;

S_{rr} is the area in square metres (m^2) of the ceiling of the room;

S is the total area of elements through which sound enters the room in square metres (m^2), i.e. $S_f + S_{rr}$;

$D_{n,e}$ is the insulation of the trickle ventilator measured according to BS EN 20140-10;

R_{wi} is the sound reduction index (octave band value) of the window (see annex C);

R_{ew} is the sound reduction index (octave band value) of the external wall (see annex C);

R_{rr} is the sound reduction index (octave band values) of the roof/ceiling (see annex C);

A is the equivalent absorption area of the receiving room being considered (see annex C).

Using the above equation, it is possible to calculate the internal noise levels based on the proposed construction and layout of the development, providing that the existing noise levels are known in individual octave bands. At this particular site, octave data was collected and the day and night time noise levels are displayed in **Table 5.2** for 125 hertz to 2 kilohertz octave bands.

Table 5.2: Summary of Measured Noise Levels in Octave Bands

	Frequency in Hertz				
	125	**250**	**500**	**1K**	**2K**
07:00-23:00	63.0	60.4	58.4	62.0	58.6
23:00-07:00	57.1	55.6	53.8	55.4	53.1

Typical room dimensions were taken from plans associated with this planning application, for the rooms closest to the main road and would therefore likely to be the worst affected rooms. A number of assumptions have been made regarding the acoustic properties of the construction materials. **Table 5.3** shows the acoustic properties of the construction materials used in the calculations.

Table 5.3: Summary of Acoustic Properties of Construction Material Used in the Calculations

Material	**Frequency in Hertz**					**Notes**
	125	**250**	**500**	**1K**	**2K**	
Vent $D_{n,e}$	48	46	49	54	65	*1*
Window R_{wi}	24	21	32	37	42	*2*
Wall R_{ew}	41	45	45	54	58	*3*

Notes:

1 – Data for a Greenwood Airvac MA3051 passive acoustic wall vent, with a typical R_w of 55; manufacturer supplied data;

2 - Data for a typical 10-20-4 high performance double glazed window unit with a R_w of 35; data supplied by Pilkington Glass;

3 – Data for a typical brick and blockwork external wall with a R_w of 50, from BS 8233:1999 'Sound insulation and noise reduction for buildings –Code of practice':

Using the above data it has been possible to calculate the internal noise levels, within the worst affected rooms, with both the windows open and the windows closed. **Table 5.4** and **Table 5.5** summarise the internal noise level calculations.

Table 5.4: Summary of Internal Noise Levels (with windows closed)

	External	**Internal**	**BS 8233 Criteria**
Day	64.0	33.6	*"Reasonable"*
Night	59.8	28.5	*"Good"*

Table 5.5: Summary of Internal Noise Levels (with windows partially open)

	External	Internal	BS 8233 Criteria
Day	64.0	49.0	Ventilation Required
Night	59.8	44.8	Ventilation Required

Table 5.4 shows that in the worst affected rooms, closest to Guilford Street, the internal noise level within the bedrooms would be 33.6 dB(A) during the day and 28.5 dB(A) during the night time period, with a double glazed window unit with an overall Rw of 35, which is typical of a basic acoustic primary double glazed window systems. This shows that under BS 8233, the daytime noise levels are considered *"reasonable"*, with the night noise levels considered to be *"good"*.

Table 5.5 shows that in the worst affected rooms, closest to Guilford Street, the internal noise level within the bedrooms with the windows partially open would cause noise levels to be in excess of the *"reasonable"* level of BS 8233. As a consequence, to ensure that windows do not need to be opened, which will then compromise the acoustic integrity of the facade, it will be necessary to install ventilation to all habitable rooms within the proposed development. An acoustically treated passive ventilation system should be suitable to provide ventilation, yet do not let noise into the premises as well as fresh air. It should be noted that it is not recommended that windows should be sealed, rather that future occupants have the option as to whether they want to be open the windows for ventilation.

The detailed calculations above are for the worst affected facades and facades further from the main sources of noise may not require the same robust protection from noise. Predictions based on the likely facade effects of the building show those windows on the rear facades of the building should experience "good" internal noise levels with a standard double glazed window unit, typically with a R_w of 31 to 33 dB.

Table 5.5 shows that in the worst affected rooms, the internal noise level within the rooms with the windows partially open would cause noise levels to be in excess of the *"reasonable"* level of BS 8233. As a consequence, to ensure that windows do not need to be opened, which will then compromise the acoustic integrity of the facade, it will be necessary to install ventilation to all habitable rooms within the proposed development. An acoustically treated passive ventilation system should be suitable to provide ventilation, yet do not let noise into the premises as well as fresh air. An acoustic vent has been specified in **Table 5.3** and as with the windows, it is important to note that acoustic performance is frequency dependant and the minimum sound reductions in each octave band given in **Table 5.3** should be adhered to. Other vents may be suitable can be tested within the parameters of the BS 8233 methodology to determine suitability. It should be noted that it is not recommended that windows should be sealed, rather that future occupants have the option as to whether they want to be open the windows for ventilation.

6. OVERALL CONCLUSIONS AND RECOMMENDATIONS

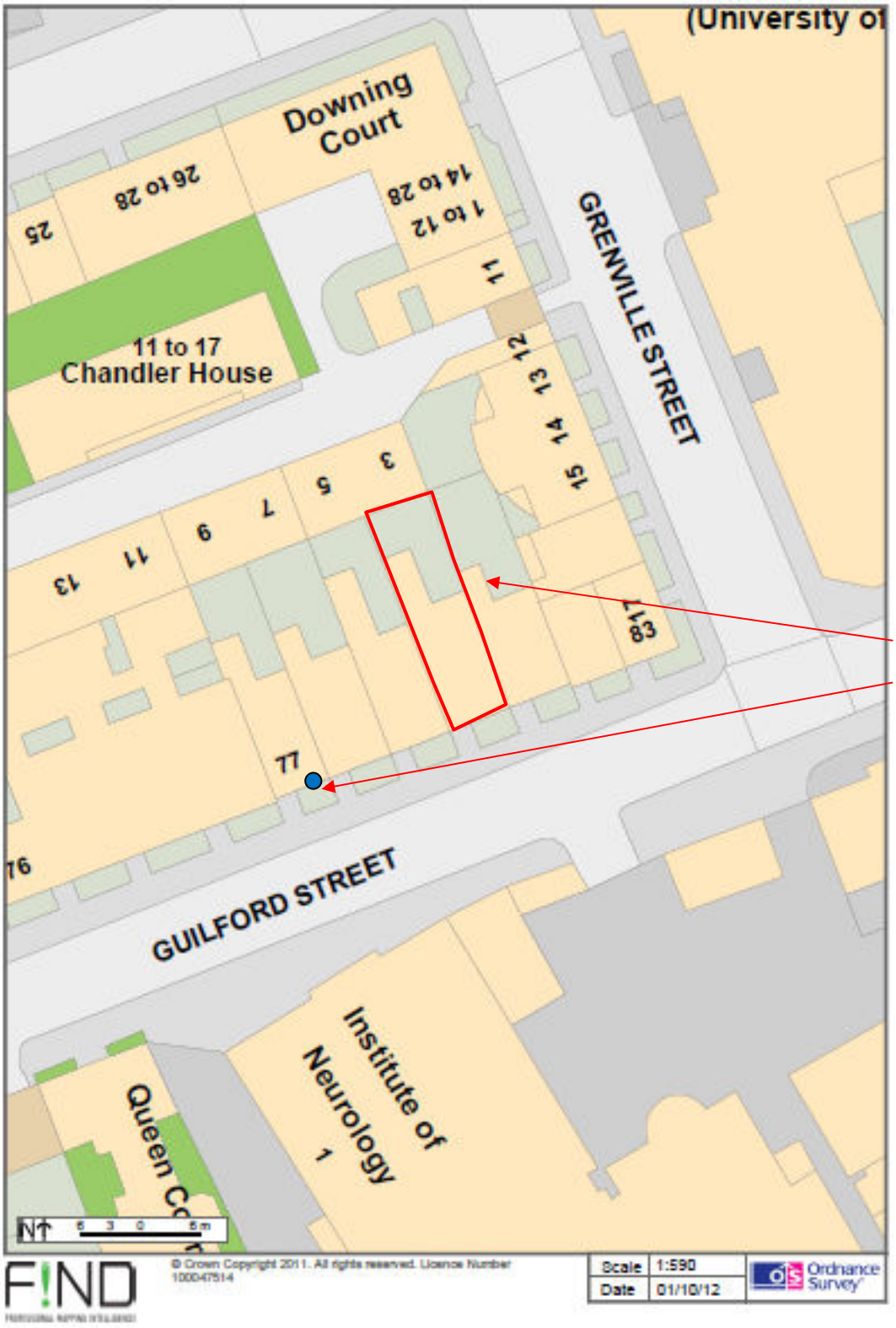
A detailed noise measurement study has been carried out at the site in order to determine whether as a result of noise, there are any significant constraints on developing the site for residential purposes.

The study has shown that based on noise from the adjacent road, if the site is to come forward for residential development, noise must be considered and attenuation must be provided.

However, it has been shown that, through the provision of a good quality window unit with a R_w of at least 35 dB, and the provision of passive ventilation, a *"reasonable"* internal noise environment can be achieved. Therefore, the noise environment of the site should not be a constraint on the proposed residential development.

Appendix 1
Site Plan

Appendix 1: Site Plan



Appendix 2
Schedule of Equipment

Appendix 2: Schedule of Equipment

Equipment Type	Manufacturer	Serial Number	Calibration Certification Number	Accreditation Body	Date of Last Calibration Check
Nor-140 Type 1 Sound Level Meter	Norsonic	1403056	11535	Campbell Associates	July 2012
Nor-1209 Pre-amplifier	Norsonic	12528	11535	Campbell Associates	July 2012
Nor-1225 Microphone	Norsonic	14360	11534	Campbell Associates	July 2012
Nor-1251 Sound Calibrator	Norsonic	32849	11533	Campbell Associates	July 2012
Nor-1284 Dehumidifier	Norsonic	222	Not Applicable		
Nor- 1212 Weather Protection Kit	Norsonic	Not Applicable			
Nor1408A/5 Extension Cable	Norsonic/Lemo	Not Applicable			

Calibration Report

Certificate No.:11535

Norsonic Type: 140 Serial no: 1403056

Customer: **Hawkins Environmental**
Address: **57 Verdi Close, Basingstoke, Hants. RG22 4JF.**
Contact Person: **Nick Hawkins.**

Instrument software version: V1.4.6238

Microphone :	Norsonic	Type: 1225	Serial no: 14360	Sens:-24.85dB
Preamplifier	Norsonic	Type: 1209	Serial no: 12528	
Calibrator:	Norsonic	Type: 1251	Serial no: 32849	Level:114.04dB
Wind screen	Norsonic	Type: Nor1451		

Measured with Preamplifier Mains adapter was included
Interface cable was included
This sound level meter has been calibrated as specified in BS 7580. PART 1: 1997.
Measurement Results:

Calibration of sound level meter - BS7580 Clause 5.4	Passed
Noise test - BS 7580 Clause 5.5.2	Passed
Level Linearity Test - BS 7580, Clause 5.5.3	Passed
Frequency weightings: A Network - BS 7580 Clause 5.5.4	Passed
Frequency weightings: C Network - BS 7580 Clause 5.5.4	Passed
Frequency weightings: Z Network - BS 7580 Clause 5.5.4	Passed
Time weightings F and S - BS7580 Clause 5.5.5	Passed
Peak response - BS7580 Clause 5.5.6	Passed
RMS accuracy - BS7580 Clause 5.5.7	Passed
Time weighting I - BS7580 Clause 5.5.8	Passed
Integrating Test : Time averaging - BS7580 Clause 5.5.9	Passed
Integrating Test : Pulse range - BS7580 Clause 5.5.10	Passed
Integrating Test : Sound exposure level - BS7580 Clause 5.5.11	Passed
Overload SPL Test - BS 7580 Clause 5.5.12	Passed
Overload Leq Test - BS 7580 Clause 5.5.12	Passed
Acoustic tests - BS 7580 Clause 5.4 and 5.6	Passed
Summation of acoustic tests - BS 7580 Clause 5.5.4	Passed

The sound level meter in the configuration tested conforms to the requirements of BS 7580 Part 1.

Comment:
Correct level with associated calibrator is 113.9dB(A). Results traceable to NPL London.

Measurement procedure: TP02

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
100.934 kPa	22.4 °C	53.0 %RH

Date of calibration: 02/07/2012
Date of issue: 02/07/2012
Supervisor: Darren Batten Tech IOA
Engineer

Michael Tickner.

Campbell Associates
www.campbell-associates.co.uk

Software version: 5.2e

Calibration Report

Certificate No.:11534

Manufacturer: Norsonic
Type: 1225
Serial no: 14360

Customer: Hawkins Environmental
Address: 57 Verdi Close, Basingstoke, Hants. RG22 4JF.
Contact Person: Nick Hawkins.

Measurement Results:

	Sensitivity: (dB re 1V/Pa)	Capacitance: (pF)
1:	-24.85	20.7
2:	-24.85	20.6
3:	-24.85	20.6
Result (Average):	**-24.85**	**20.7**
Expanded Uncertainty:	0.10	2.00
Degree of Freedom:	>100	>100
Coverage Factor:	2.00	2.00

The following correction factors have been applied during the measurement:
Pressure:-0.010 dB/kPa Temperature:-0.007 dB/°C Relative humidity:0.000 dB/%RH

Reference Calibrator: WSC1 - Nor1253-24269 Volume correction: 0.000 dB
Records:K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\2012\NOR1225_14360_M1.nmf
Measurement procedure: TP05 V3.4

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

Comment: Results traceable to NPL London.

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
100.932 ± 0.006 kPa	22.4 ± 1.2 °C	56.3 ± 2.5 %RH

Date of calibration: 02/07/2012
Date of issue: 02/07/2012

Supervisor : David Egan - Laboratory Manager
Engineer :

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Michael Tickner
Software version: 5.2g

Calibration Report

Certificate No.:11533

Manufacturer: Norsonic
Type: 1251
Serial no: 32849

Customer: Hawkins Environmental
Department:
Address: 57 Verdi Close, Basingstoke, Hants. RG22 4JF.
Order No:
Contact Person: Nick Hawkins.

Measurement Results:

	Level: (dB)	P. Stab : (dB)	Frequency: (Hz)	F. Stab : (%)	Distortion: (% TD)
1:	114.04	0.01	999.84	0.00	0.18
2:	114.04	0.01	999.83	0.00	0.18
3:	114.03	0.01	999.83	0.00	0.19
Result (Average):	**114.04**	**0.01**	**999.83**	**0.00**	**0.18**
Expanded Uncertainty:	0.10	0.02	1.00	0.01	0.10
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa.

The following correction factors have been applied during the measurement:
Pressure:0.0005 dB/kPa Temperature:0.003 dB/°C Relative humidity: None
Reference microphone: WSM2 - GRAS40AG-28653. Volume correction: -0.015 dB
Records:K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2012\NOR1251_32849_M1.nmf
Measurement procedure: TP01 v7.9

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

Results traceable to NPL London.

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
100.940 ± 0.003 kPa	22.3 ± 1.2 °C	57.9 ± 2.8 %RH

Date of calibration: 02/07/2012
Date of issue: 02/07/2012

Supervisor : Darren Batten TechIOA.
Engineer :

Michael Tickner
Software version: 5.2a

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Appendix 3
Summary of Noise Measurements

Appendix 3: Summary of Noise Measurements

Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A50}	L_{A90}
07:00	67.7	86.0	71.4	63.0	55.5
08:00	67.9	86.1	70.8	65.1	59.1
09:00	68.7	94.6	70.6	65.1	60.1
10:00	67.6	87.2	70.6	64.7	58.5
11:00	67.0	88.4	70.2	64.6	58.3
12:00	66.0	81.2	69.4	63.6	57.4
13:00	66.9	84.8	69.9	65.0	59.1
14:00	67.1	88.5	70.1	64.7	59.0
15:00	66.7	83.8	69.8	64.1	58.0
16:00	66.8	85.0	69.9	64.5	58.1
17:00	65.9	79.9	69.1	64.0	57.3
18:00	67.6	87.0	70.8	65.3	58.8
19:00	67.9	82.5	71.8	63.9	56.6
20:00	67.1	93.7	69.8	62.2	56.0
21:00	64.4	82.7	68.4	59.3	53.3
22:00	64.9	79.0	69.1	60.0	54.2
23:00	63.2	80.0	67.9	56.6	51.0
00:00	64.7	94.5	66.6	54.9	50.2
01:00	60.7	81.9	63.8	52.5	48.9
02:00	62.0	90.0	64.5	53.9	49.4
03:00	60.8	91.5	60.4	50.9	48.1
04:00	60.0	81.3	60.7	51.6	48.1
05:00	62.6	81.2	65.2	54.5	50.4
06:00	65.4	82.1	69.2	58.8	53.0
Day	**67.0**	**94.6**	**70.1**	**63.7**	**57.5**
Night	**62.8**	**94.5**	**64.8**	**54.2**	**49.9**