PO Box 1030, Warrington, Cheshire WA4 9FJ
t. 01925 723333 www.adcacoustics.co.uk

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25th March 2019

Sam Properties

Assessment of noise at the land at 79-85 Hathersage Rd, M13 0EW, for proposed commercial (hotel) development

Prepared for :-

Sam Properties
433 Wilmslow Road
Withington
Manchester
M20 4AF

Prepared by :-

Andrew Raymond

ADC Acoustics is a trading name of Acoustic Design & Control Limited
Registered Office: One City Place, Queens Road, Chester, CH1 3BQ Registered in England and Wales 5117653

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1.0 SUMMARY

Noise was dominated at all times by traffic on Hathersage Road.

The site is noisy on the façade overlooking Hathersage Road and a little less so for the façade overlooking Upper Brook St. BS 8233 criteria will only be achieved with closed windows and so ventilation will be required to make this a realistic option for occupants.

Fairly high spec acoustic vents will be required to Hathersage Road and Upper Brook St facades. Upgrading glazing will also be required, especially to Hathersage Road.

Note however that calculations and resulting specifications are based on ground floor noise measurements and at times likely to be the noisier times of day and night. Higher level rooms and different times are likely to be a little quieter.





A R Raymond

P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the above site with regards to its suitability for hotel development from a noise perspective.

This report begins by summarising assessment standards and, where appropriate, discusses alternative interpretations.

After a brief statement of survey details we discuss basic results and the resulting assessment, along with any mitigation which might be implied. We sum-up and conclude at the end, along with brief recommendations.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situation can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 180:-

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 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(footnote here refers to NPSE – see below);

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.

Paragraph 180 is also relevant:-

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.

The NPPF refers to the NPSE which sets out the following aims:-

1. avoid significant adverse impacts on health and quality of life;
2. mitigate and minimise adverse impacts on health and quality of life; and
3. where possible, contribute to the improvement of health and quality of life.

It also introduces the concepts of:

- NOEL – No Observed Effect Level. 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.
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided in a table as reproduced below.

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

It also makes the point that 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, including the level of the noise in absolute terms and how it might compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS4142, BS8233, etc.) and the potential impact on wildlife.

3.2 BS8233/WHO Guide

BS8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations. The criteria are very similar to those of the WHO Guide to Community Noise

Table 4 of BS8233 gives the desirable criteria for indoor ambient noise levels for dwellings as follows:-

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

Note that the standard accepts the widely used rule of thumb that, for a partly open window, the levels just outside will be 15dB higher than those just inside. This brings us to an external equivalent of the above table, as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	50 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	55 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	50 dB $L_{Aeq,16hour}$	45 dB $L_{Aeq,16hour}$

It goes on to state that, where necessary, the criteria can be relaxed by up to 5 dB and still achieve reasonable conditions. Note that the new version does not explicitly state criteria for bedroom noise in terms of dB L_{Amax}.

Garden area criteria are unchanged with 50 dB L_{Aeq} and 55 dB L_{Aeq} being considered desirable and reasonable respectively.

Note that the new version of BS8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 Local Authority

As far as we are aware no planning conditions have been proposed.

4.0 GUIDE TO MODELLING

Full details of calculations are given in Appendix 2. The basic approach is as follows.

1. The external noise break-in is based on the level of external noise just outside the façade(s), the area of the façade(s), the sound insulation properties of the façade(s) and the internal absorption of the room.

2. The first input to the calculation process is the area of the exposed façade. Where more than one façade is exposed, then they can all be entered. The room depth is also entered so as to derive the

room volume. Where the room is not a straight forward rectangular shape, an "effective depth" is sometimes entered so as to derive the approximate room volume. Judgement may occasionally be used if the room is not simple, such as a very unusual shape or a multi-use room such as a through-kitchen/dining room/living room, or studio-style area.

3. The reverberation time (RT) is entered. Usually this is a standardised 0.5 seconds and represents the absorption properties of the room.

4. Two corrections result from the above inputs. Firstly, we have the Area Correction. Put simply, the greater the exposed area, the more noise will break in. The correction is 10 x log(Effective Area) and is usually a positive number. Note that the "Effective Area" takes account of the method of modelling vents – see later. The Room Correction takes account of the room absorption (more absorption reduces the noise) and the room volume (a larger volume disperses, and so reduces, the noise). The correction is 10 x log(RT/0.163/Volume) and is usually a negative number.

5. These corrections, together with the sound insulation properties of the façade(s) give us the basic outside-to-inside level difference. The sound insulation properties of the façade(s), known as the Sound Reduction Index (SRI or just R) are effectively the sound insulation of $1m^2$ of material (apart from vents – see later). Of course, a façade is usually made up of more than one element – windows and walls for instance. The overall SRI or R is referred to as the Composite SRI or composite R and is related to the SRI or R or the individual elements and their respective areas. SRI or R figures are usually based on laboratory tests and therefore somewhat idealised.

6. An additional complication is that performance data for vents is generally standardised to $10m^2$. The area of a vent is therefore usually entered as $10m^2$, even though its actual area will usually be nowhere near that much.

7. So, the composite SRI or R, combined with the areas and room corrections gives us the basic level difference to be expected under perfect (laboratory) conditions. However, actual site conditions are affected by workmanship, which can never be guaranteed to be perfect, and flanking paths (noise paths other than straight through the façade(s)). We add a generous 5 dB allowance for this.

8. The process is repeated in octave bands across the frequency range to derive the predicted internal levels.

<u>Bedrooms</u>

Bedrooms (sleeping areas of the guest rooms) are a slightly unusual case here as they are not exposed to any windows. We have based the calculations on the noise in the living areas (as described in the

processes above) and the door between this area and the bedrooms being left fully open.

9. The steps above are repeated but with some slight alterations.

10. For the “external” noise we used calculated noise break-in to the living room area

11. Instead of an area of glazing, we used an open door, essentially an area of zero sound insulation

12. There are no external vents which have not already been accounted for in the above steps.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The measurements were carried out by Mark Pickering of ADC Acoustics.

Measurements were carried out on 11th March 2019 between approximately 16:00 hours and 18:00 hours to represent rush hour and between 2300 hours and 0100 hours, representing what was likely to be a noisier time of night.

5.2 Instrumentation

Instrumentation used was a Rion NL52. This is a precision grade sound level meter which holds a current calibration certificate and which was field-calibrated before and after the measurements with no drift noted. The meter was set up to measure 5 minute samples in terms of dB L_{eq}, dB L_{max} and dB L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in Appendix 1.

5.3 Measurement Positions

The main measurement positions were as shown on the following plan.



The microphone was 1.5 m above ground and well away from other reflecting surfaces.

5.4 Survey Conditions

We have no reason to believe that the conditions we found on the survey were anything other than representative of normal conditions.

Weather conditions were as follows :-

Rain	:	none, wet roads for night time
Cloud	:	100%
Temperature	:	8 to 11 Celsius
Wind	:	up to 3m/s from the SW

6.0 RESULTS AND DISCUSSIONS

Noise was dominated at all times by traffic on Hathersage Road.

6.1 Basic Results

Full details are given in Appendix 2. A summary of overall levels is as follows:-

Time	*Position*	*Index*	***dB(A)***
Overall Rush Hour	1	Leq	**62**
		Lmax	**77**
		L90	**53**
	2	Leq	**66**
		Lmax	**85**
		L90	**54**
Overall Early Night	1	Leq	**59**
		Lmax	**78**
		L90	**46**
	2	Leq	**63**
		Lmax	**82**
		L90	**49**

6.2 Assessments

The above results give the following assessments.

In terms of BS8233, we are mainly concerned with the dB(A) L_{eq} values, or the dB L_{Aeq} levels. See definition of Acoustic terms in Appendix 1. The new version of BS8233 no longer has night time criteria in terms of dB(A) L_{max} values, or dB L_{Amax} values, but some local authorities still like to see them presented.

The measured levels appear to suggest that sound insulation will need to be designed to control external noise break-in as follows:

Environment	*Position*	*Required Reductions*	
		Desirable	*Reasonable*
Living Areas	1	27 dB	22 dB
	2	31 dB	26 dB
Sleeping Areas	1	29 dB	24 dB
	2	33 dB	28 dB
Outdoor Living Areas	1	12 dB	7 dB
	2	16 dB	11 dB

Note, of course, that these assertions are based upon the assumption that night-time noise levels are represented by measurements around midnight and that daytime noise levels are represented by measurements around rush hour. They are also based on ground floor measurements. Higher floors can be expected to be less noisy. In other words, they should represent a worst-case.

6.3 Mitigation

Some rooms have balconies. These are given special consideration in BS 8233. The levels measured are significantly above criteria for outdoor living areas, but it clearly makes no sense to suggest that amenity would be improved by removing the balcony facilities.

A partly open window can be expected to provide about 15 dB reduction. This will be insufficient to achieve BS8233 criteria for “desirable” or “reasonable” conditions. The rest of this assessment is therefore based on an assumption of closed windows. This implies that ventilation will be required such that occupants have the realistic option of keeping windows shut. This can be achieved using active or passive ventilation which provides a suitable sound insulation. This could take the form of ventilation through acoustic or non-acoustic vents or a whole house-type system which does not require any wall or window vents.

Note that this assessment provides the specification for the acoustic performance of vents. Ventilation needs should be determined by others.

A summary of mitigation (or building elements assumed in our calculations) is as follows:-

Façade	*Room Type*	*Make-Up on Which Calculations are Based*
Upper Brook St Façade	Living Areas	Walls: Traditional Masonry Glazing: 33 dB Rw, eg. 8+16+4 Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450
	Sleeping Areas	Walls: Traditional Masonry Open Internal Door Vents: n/a
Hathersage Road Façade	Living Areas	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+12+6 Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450
	Sleeping Areas	Walls: Traditional Masonry Open Internal Door Vents: n/a

Note that the table provides the acoustic specifications (such as R_w for windows and $D_{n,e,w}$ for vents) to meet appropriate criteria. The glazing build-ups and vent models which are also shown are examples and many other options achieving the same acoustic performance are available.

Full calculation details are shown in Appendix 2 and a summary of predicted internal noise levels is as follows:-

Façade	*Room Type*	*Time*	*Index*	***dB(A)***
Upper Brook St Façade	Living Areas	Rush	Leq	**35**
	Sleeping Areas	Night	Leq	**24**
			Lmax	**42**
Hathersage Road Façade	Living Areas	Rush	Leq	**38**
	Sleeping Areas	Night	Leq	**26**
			Lmax	**42**

Of course, these assessments are very robust as they use what are likely to be the noisier times of day and night, assume all facades have a unrestricted lines of sight to the main sources and that the development itself will not provide any screening to its own properties.

7.0 CONCLUSIONS/RECOMMENDATIONS

Noise was dominated at all times by traffic on Hathersage Road.

The site is noisy on the façade overlooking Hathersage Road and a little less so for the façade overlooking Upper Brook St. BS 8233 criteria will only be achieved with closed windows and so ventilation will be required to make this a realistic option for occupants.

Fairly high spec acoustic vents will be required to Hathersage Road and Upper Brook St facades. Upgrading glazing will also be required, especially to Hathersage Road.

Note however that calculations and resulting specifications are based on ground floor noise measurements and at times likely to be the noisier times of day and night. Higher level rooms and different times are likely to be a little quieter.

Note that recommended glazing and vent specifications are given in terms of a required performance, along with *examples* what can be expected to achieve them. A planning condition requiring details to be submitted and approved would be an appropriate way for planners to control this through the detailed design stages.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but is really should be stated. The threshold of human hearing is a sound pressure of 20μPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20μPa). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to given an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

Equivalent Continuous Sound Level, L_{eq}

This is a kind of mean noise level.

The unit is dB L_{eq}. For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq}. The Noise at Work Regulations use $L_{eq(s)}$ which refers to a sample level.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max}. For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax}.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for n% of the measurement period.

The unit is dB L_n. For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An}.

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceed for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band form low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq}, L_{max}, L_n, etc. as defined above.

Appendix 2

Measurement and Calculation Details

Daytime Measurements

Position	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1	16:00	Leq	**62**	69	60	58	56	58	54	49	40
		Lmax	**75**	82	75	69	66	70	69	68	60
		L90	**54**	62	55	52	50	51	47	38	27
	16:05	Leq	**61**	69	60	58	57	59	53	45	37
		Lmax	**74**	80	73	70	69	69	62	68	60
		L90	**53**	63	55	50	49	49	46	38	29
	16:10	Leq	**61**	69	60	57	56	59	53	43	35
		Lmax	**74**	84	73	65	67	71	62	63	56
		L90	**53**	62	54	52	49	50	46	35	22
	16:32	Leq	**61**	67	62	57	55	58	53	45	37
		Lmax	**74**	78	72	65	66	71	66	60	57
		L90	**53**	62	56	52	49	50	46	36	23
	16:37	Leq	**61**	69	64	60	57	58	52	43	36
		Lmax	**78**	84	82	80	78	70	63	56	62
		L90	**54**	62	56	52	50	50	46	36	22
	16:42	Leq	**62**	69	68	57	56	59	55	47	36
		Lmax	**80**	91	93	67	72	72	73	65	61
		L90	**53**	61	55	51	49	50	46	36	23
	17:05	Leq	**62**	68	62	58	57	59	54	46	37
		Lmax	**77**	82	76	68	71	74	69	68	52
		L90	**54**	62	55	52	50	50	46	37	29
	17:10	Leq	**60**	66	63	57	55	57	53	43	37
		Lmax	**72**	77	80	70	67	68	61	60	64
		L90	**53**	61	55	52	49	49	45	35	22
	17:15	Leq	**64**	69	62	60	60	60	56	48	42
		Lmax	**80**	86	75	75	77	77	73	63	61
		L90	**54**	62	56	52	50	50	46	37	26
	17:38	Leq	**59**	66	62	57	54	56	51	43	38
		Lmax	**73**	86	80	74	70	65	62	58	65
		L90	**53**	59	54	51	48	50	45	36	26
	17:43	Leq	**63**	68	61	57	58	60	57	47	40
		Lmax	**81**	81	76	72	77	77	75	62	63
		L90	**52**	61	55	50	49	48	44	37	27
	17:48	Leq	**60**	66	60	57	55	58	52	44	44
		Lmax	**74**	80	76	69	70	69	63	56	70
		L90	**53**	59	52	50	48	49	45	37	28
2	16:16	Leq	**71**	72	72	69	67	68	60	51	44
		Lmax	**94**	87	93	93	91	91	80	73	66
		L90	**55**	62	58	53	51	52	47	40	29
	16:21	Leq	**66**	73	66	61	61	64	59	51	43
		Lmax	**86**	88	80	76	74	84	78	71	61
		L90	**54**	63	56	51	49	51	46	38	28
	16:26	Leq	**67**	73	65	61	61	64	59	50	44
		Lmax	**78**	88	79	75	74	73	69	59	70
		L90	**54**	64	57	51	50	50	45	40	29
	16:48	Leq	**67**	71	65	62	61	64	59	50	41
		Lmax	**78**	85	79	73	72	75	69	64	59
		L90	**55**	62	57	53	51	50	47	41	31
	16:53	Leq	**66**	73	67	63	61	62	58	51	44
		Lmax	**78**	86	80	79	74	72	71	65	60
		L90	**55**	64	57	53	51	50	47	41	30
	16:58	Leq	**66**	75	69	63	60	62	58	50	42
		Lmax	**78**	89	85	77	73	74	68	66	61
		L90	**54**	65	60	54	50	50	46	40	30
	17:22	Leq	**66**	72	65	61	61	63	58	53	44
		Lmax	**79**	86	79	75	74	73	71	73	62
		L90	**53**	64	55	51	49	50	46	39	30
	17:27	Leq	**67**	75	67	62	61	64	59	51	44
		Lmax	**79**	92	83	80	75	73	69	67	66
		L90	**55**	64	57	52	50	51	47	39	29
	17:32	Leq	**67**	74	66	61	63	64	61	53	44
		Lmax	**78**	90	81	76	76	72	69	63	61
		L90	**57**	64	58	54	53	53	49	42	31
	17:54	Leq	**62**	70	60	58	56	60	54	45	37
		Lmax	**70**	82	76	65	65	67	61	58	56
		L90	**52**	62	53	49	47	49	45	36	24
	17:59	Leq	**63**	71	64	60	58	61	55	46	37
		Lmax	**75**	86	83	79	68	69	63	57	51
		L90	**54**	63	54	52	50	51	47	39	29
	18:04	Leq	**62**	70	60	58	56	60	55	46	38
		Lmax	**73**	85	72	68	66	68	66	60	62
		L90	**53**	61	53	50	48	50	45	37	27

Night Time Measurements

Position	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1	23:00	Leq	**60**	69	61	58	54	57	51	44	37
		Lmax	**79**	90	79	78	71	77	68	61	55
		L90	**49**	54	50	47	44	45	42	32	21
	23:05	Leq	**59**	63	55	54	52	57	52	44	37
		Lmax	**70**	80	73	68	65	67	62	57	50
		L90	**48**	52	46	44	42	46	41	29	17
	23:10	Leq	**58**	59	54	52	51	55	51	41	34
		Lmax	**75**	73	72	64	68	73	68	58	50
		L90	**45**	50	46	41	40	43	38	28	16
	23:32	Leq	**64**	61	54	55	54	62	56	47	48
		Lmax	**87**	76	67	71	67	87	75	67	75
		L90	**48**	53	47	45	43	45	40	31	20
	23:37	Leq	**55**	60	55	51	50	53	48	41	34
		Lmax	**68**	81	76	64	64	64	59	54	52
		L90	**45**	49	43	41	40	43	38	28	17
	23:42	Leq	**60**	63	55	55	55	57	53	45	40
		Lmax	**76**	85	70	68	75	73	66	62	59
		L90	**48**	51	44	43	42	45	41	32	22
	00:04	Leq	**57**	57	51	51	51	55	50	42	37
		Lmax	**72**	75	66	63	65	70	64	58	63
		L90	**44**	49	44	40	38	41	36	25	16
	00:09	Leq	**57**	59	51	52	51	55	50	41	33
		Lmax	**68**	75	68	63	62	65	61	55	53
		L90	**49**	51	44	44	43	46	41	30	18
	00:14	Leq	**59**	61	54	53	53	57	51	43	35
		Lmax	**72**	75	70	69	66	70	64	55	49
		L90	**46**	50	44	42	41	43	39	29	18
	00:37	Leq	**53**	54	47	48	46	50	46	35	26
		Lmax	**66**	69	59	61	59	64	60	51	46
		L90	**43**	48	41	39	37	41	36	23	13
	00:42	Leq	**56**	58	51	50	50	53	49	41	33
		Lmax	**71**	74	66	64	64	69	63	56	52
		L90	**41**	49	43	38	36	37	33	23	14
	00:47	Leq	**58**	62	55	53	51	55	50	41	33
		Lmax	**70**	83	72	71	63	67	62	55	48
		L90	**42**	49	44	38	36	39	34	23	13
2	23:16	Leq	**68**	63	55	55	55	64	64	61	53
		Lmax	**92**	79	67	65	68	86	85	87	78
		L90	**46**	52	42	43	40	43	39	29	17
	23:21	Leq	**64**	66	56	56	56	61	57	50	42
		Lmax	**74**	86	75	66	67	71	66	62	55
		L90	**50**	53	44	44	43	47	43	33	20
	23:26	Leq	**63**	67	56	55	56	61	56	49	41
		Lmax	**75**	84	74	71	67	72	66	63	57
		L90	**50**	54	45	44	44	47	44	34	23
	23:48	Leq	**63**	67	55	55	56	60	56	49	43
		Lmax	**74**	83	68	65	67	70	66	64	64
		L90	**51**	54	46	45	44	48	44	34	24
	23:53	Leq	**63**	64	55	55	56	61	56	49	42
		Lmax	**75**	78	70	66	69	73	69	61	54
		L90	**51**	53	45	45	44	49	45	34	23
	23:58	Leq	**63**	65	58	56	56	61	56	50	43
		Lmax	**79**	80	73	69	72	78	71	65	57
		L90	**49**	54	47	44	44	46	42	34	23
	00:21	Leq	**60**	65	57	53	54	58	54	47	39
		Lmax	**76**	83	76	68	69	73	70	61	56
		L90	**47**	50	41	40	40	45	40	30	19
	00:26	Leq	**60**	64	54	53	53	58	53	45	38
		Lmax	**75**	81	68	65	70	73	67	62	57
		L90	**48**	53	42	41	41	45	41	29	17
	00:31	Leq	**60**	66	54	54	54	58	53	47	40
		Lmax	**74**	83	73	70	67	71	65	62	57
		L90	**46**	51	40	40	40	44	39	27	15
	00:53	Leq	**59**	60	51	52	52	57	52	44	37
		Lmax	**73**	75	66	65	65	71	66	57	54
		L90	**48**	51	41	42	41	46	40	29	17
	00:58	Leq	**62**	62	55	55	55	59	55	47	40
		Lmax	**76**	77	71	68	69	74	69	61	58
		L90	**48**	50	43	42	42	46	41	31	19
	01:03	Leq	**60**	63	53	53	52	57	53	45	40
		Lmax	**76**	83	69	65	69	73	70	61	63
		L90	**47**	49	41	41	40	45	40	30	18

Measurement Summary

Time	*Position*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Overall Rush Hour	1	Leq	**62**	68	63	58	57	58	54	46	41
		Lmax	**77**	85	84	72	73	72	69	64	65
		L90	**53**	62	55	51	49	50	46	37	28
	2	Leq	**66**	73	67	63	62	64	58	50	42
		Lmax	**85**	88	85	83	81	82	73	68	64
		L90	**54**	63	57	52	50	51	47	40	29
Overall Early Night	1	Leq	**59**	62	55	53	52	56	51	43	36
		Lmax	**78**	82	73	70	68	77	67	60	52
		L90	**46**	51	45	43	41	43	39	29	17
	2	Leq	**63**	65	55	54	55	60	57	52	44
		Lmax	**82**	82	72	68	68	77	75	76	67
		L90	**49**	52	44	43	42	46	42	32	20

Required Reductions for BS8233 Guidelines

Environment	*Position*	*Required Reductions*	
		Desirable	*Reasonable*
Living Areas	1	27 dB	22 dB
	2	31 dB	26 dB
Sleeping Areas	1	29 dB	24 dB
	2	33 dB	28 dB
Outdoor Living Areas	1	12 dB	7 dB
	2	16 dB	11 dB

Mitigation Summary

Façade	*Room Type*	*Make-Up on Which Calculations are Based*
Upper Brook St Façade	Living Areas	Walls: Traditional Masonry Glazing: 33 dB Rw, eg. 8+16+4 Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450
	Sleeping Areas	Walls: Traditional Masonry Open Internal Door Vents: n/a
Hathersage Road Façade	Living Areas	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+12+6 Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450
	Sleeping Areas	Walls: Traditional Masonry Open Internal Door Vents: n/a

Predicted Summary

Façade	*Room Type*	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Upper Brook St Façade	Living Areas	Rush	Leq	**35**	54	43	38	31	26	19	1	-3
	Sleeping Areas	Night	Leq	**24**	42	28	27	20	17	10	-8	-15
			Lmax	**42**	62	46	44	36	38	26	9	2
Hathersage Road Façade	Living Areas	Rush	Leq	**38**	57	44	40	34	31	25	8	1
	Sleeping Areas	Night	Leq	**26**	43	27	25	20	21	17	4	-4
			Lmax	**42**	60	43	39	34	38	35	28	19

Living Area Break-in

Upper Brook St Façade *Living Areas*			**dB(A)**	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	3.40 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	3.40 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	3.90 m										
Element Area	8.50 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	18.50 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	33.15 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	13	13	13	13	13	13	13	13
Room Correction 10 x Log (RT/0.163/V)			**-**	-10	-10	-10	-10	-10	-10	-10	-10
Walls: Traditional Masonry	3.90 m2		**-**	23	32	41	47	49	53	58	55
Glazing: 33 dB Rw, eg. 8+16+4	4.60 m2		**-**	16	22	21	28	38	40	47	47
Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450	10.00 m2		**-**	34	45	44	36	40	42	55	55
Composite SRI	18.50 m2		**-**	21	28	27	33	40	42	52	51
Level Difference (Reverberant only)			**-**	-19	-25	-25	-30	-38	-40	-49	-49
Façade relative to Measurement Position	0 dB		**-**	0	0	0	0	0	0	0	0
Allowance for flanking/workmanship	5 dB		**-**	5	5	5	5	5	5	5	5
Predicted Internal Levels	Rush	Leq	**35**	54	43	38	31	26	19	1	-3
	Night	Leq	**30**	48	34	34	27	23	16	-1	-8
		Lmax	**48**	68	52	50	42	44	32	15	8

Hathersage Road Façade *Living Areas*			**dB(A)**	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	3.40 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	3.40 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	3.90 m										
Element Area	8.50 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	18.50 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	33.15 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	13	13	13	13	13	13	13	13
Room Correction 10 x Log (RT/0.163/V)			**-**	-10	-10	-10	-10	-10	-10	-10	-10
Walls: Traditional Masonry	3.90 m2		**-**	23	32	41	47	49	53	58	55
Glazing: 35 dB Rw, eg. 10+12+6	4.60 m2		**-**	18	24	24	32	37	37	44	44
Vents: 40 dB Dn,e,w eg. Passivent TVALdB 450	10.00 m2		**-**	34	45	44	36	40	42	55	55
Composite SRI	18.50 m2		**-**	23	29	30	35	40	41	49	49
Level Difference (Reverberant only)			**-**	-20	-27	-28	-33	-37	-38	-47	-47
Façade relative to Measurement Position	0 dB		**-**	0	0	0	0	0	0	0	0
Allowance for flanking/workmanship	5 dB		**-**	5	5	5	5	5	5	5	5
Predicted Internal Levels	Rush	Leq	**38**	57	44	40	34	31	25	8	1
	Night	Leq	**32**	49	33	32	27	27	23	10	2
		Lmax	**49**	67	50	45	41	44	42	35	26

Sleeping Area Break-in

Upper Brook St Façade *Sleeping Areas*			***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	3.40 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	3.40 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	2.50 m										
Element Area	8.50 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	8.50 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	21.25 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	9	9	9	9	9	9	9	9
Room Correction 10 x Log (RT/0.163/V)			**-**	-8	-8	-8	-8	-8	-8	-8	-8
Walls: Traditional Masonry	6.90 m2		**-**	23	32	41	47	49	53	58	55
Open Internal Door	1.60 m2		**-**	0	0	0	0	0	0	0	0
Vents: n/a	0.00 m2		**-**	0	0	0	0	0	0	0	0
Composite SRI	8.50 m2		**-**	7	7	7	7	7	7	7	7
Level Difference (Reverberant only)			**-**	-6	-6	-6	-6	-6	-6	-6	-6
Façade relative to Measurement Position	0 dB		**-**	0	0	0	0	0	0	0	0
Allowance for flanking/workmanship	0 dB		**-**	0	0	0	0	0	0	0	0
Predicted Internal Levels	Rush	Leq	**29**	48	36	32	25	19	13	-5	-9
	Night	Leq	**24**	42	28	27	20	17	10	-8	-15
		Lmax	**42**	62	46	44	36	38	26	9	2

Hathersage Road Façade *Sleeping Areas*			***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	3.40 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	3.40 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	2.50 m										
Element Area	8.50 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	8.50 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	21.25 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	9	9	9	9	9	9	9	9
Room Correction 10 x Log (RT/0.163/V)			**-**	-8	-8	-8	-8	-8	-8	-8	-8
Walls: Traditional Masonry	6.90 m2		**-**	23	32	41	47	49	53	58	55
Open Internal Door	1.60 m2		**-**	0	0	0	0	0	0	0	0
Vents: n/a	0.00 m2		**-**	0	0	0	0	0	0	0	0
Composite SRI	8.50 m2		**-**	7	7	7	7	7	7	7	7
Level Difference (Reverberant only)			**-**	-6	-6	-6	-6	-6	-6	-6	-6
Façade relative to Measurement Position	0 dB		**-**	0	0	0	0	0	0	0	0
Allowance for flanking/workmanship	0 dB		**-**	0	0	0	0	0	0	0	0
Predicted Internal Levels	Rush	Leq	**32**	51	38	34	27	25	19	2	-6
	Night	Leq	**26**	43	27	25	20	21	17	4	-4
		Lmax	**42**	60	43	39	34	38	35	28	19