

Noise Assessment Report: Conversion of 4 storey dwelling house to flats at 9 Vachel Road, Reading.

A report assessing the noise impact of road traffic noise and other noise sources on the proposed flats at 9 Vachel Road in accordance with BS8233: 2014 and the WHO Guidelines on Community Noise (1999).

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Executive Summary:

This report assesses the noise impact of road traffic and other noise sources on the proposed development of a 4-storey dwelling house at 9 Vachel Road, Reading, to create four flats.

Noise measurements were made over a 24-hour period at the front and rear of the property to ascertain the noise climate at the location. These data were then used to determine the required sound insulation of the building façades to provide suitable internal noise levels for residential premises.

Noise levels were assessed in accordance with BS8233:2014, which gives target noise values for adverse noise impact based on the WHO Guidelines on Community Noise (1999).

The predominant noise source at the location is that of road traffic noise from the A329 Caversham Road, part of the Inner Distribution Road or ring road around Reading town centre. No other sources of industrial or commercial noise were noted at the premises.

To protect the amenity of future occupants, it is suggested that:

- Glazing is installed with a minimum sound reduction index of $29 \text{ dB } R_w + C_{tr}$ on the Vachel Road façade.
- Acoustic ventilation should have a minimum sound reduction index of $35 \text{ dB } D_{n,e,w} + C_{tr}$ on the Vachel Road façade.
- The glazing allows windows to be opened for purge ventilation and heat control.
- Separating partitions between habitable spaces should conform to the performance standards of Approved Document E of the Building Regulations.

If these steps are taken, the internal noise levels within the newly created flats will conform to the requirements of the BS8233:2014 and the WHO Guidelines on Community Noise.

Reasonable internal noise levels will be achieved to the rear of the property with standard double glazing and ventilation units. Noise levels in the rear garden conform to the requirements of BS8233:2014 for external amenity spaces.

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1 Introduction

101 Acoustics Ltd. were appointed by Jiggins Property to determine the noise impact of transportation noise and other noise sources on a proposed development of four flats at 9 Vachel Road, Reading following change of use from a single dwelling house.

Ambient noise measurements were made over a 24-hour period at the front and rear façades of the property to ascertain the noise climate at the location. These data were then used to determine the required sound insulation of the building façades to provide suitable internal noise levels for residential premises in accordance with BS8233:2014 *Guidance on sound insulation and noise reduction for buildings* and the World Health Organisation's *Guideline on Community Noise* (1999).

2 The nature, measurement and effect of 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, with the highest sound pressure level that humans can tolerate at the threshold of pain being over a million times that of the quietest audible sound. To reduce the relative magnitudes of the numbers involved a logarithmic scale of decibels (dB) is used, based on a reference level of the lowest audible sound.

As the response of the human ear is not constant over all frequencies it is 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 hearing response. Table 1 shows typical noise levels in decibels.

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

Table 1 Typical noise levels

When related to changes in noise level a change of ten decibels from 60 dB(A) to 70 dB(A) represents a doubling in perceived loudness. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) represents a halving in loudness and a change of 3 dB(A) is just perceptible under normal conditions.

3 Noise criteria, standards and guidance

Preapplication advice was sought from Reading Borough Council for this application (172123/PREAPP), which is summarized as follows from a noise impact perspective:

..”A noise assessment should be submitted in support of applications for new residential proposed in noisy areas.

The noise assessment will be assessed against the recommendations for internal noise levels within dwellings and noise levels within gardens / balconies in accordance with BS 8233:2014 and WHO Guidelines for Community Noise. The report should identify any mitigation measures that are necessary to ensure that the recommended standard is met.

Where appropriate, the noise assessment data should also include noise events ($L_{A,f,max}$) and the design should aim to prevent noise levels from noise events exceeding 45dB within bedrooms at night. Noise levels above 45dB are linked with sleep disturbance.

Room	Design criteria	Upper limit
Bedrooms (23:00 to 07:00)	<30dB LAeq,8hour	
Living rooms (07:00 – 23:00)	<35dB LAeq,16hour	
Gardens & Balconies	<50dB LAeq,T	<55dB LAeq,T

Table 2 Internal noise criteria (taken from BS8233:2014):

To minimise the disturbance by noise of future residential occupiers of the flats and its effect on neighbouring residents, residential accommodation must be designed and constructed or converted so as to achieve the insulation requirements set out in Building Regulations Approved Document E.”..

As such, criteria from BS8233:2014 and the WHO Guidelines for Community Noise will be used for this noise assessment and other guidance documentation will also be referenced.

3.1 BS 8233: 2014 ‘Guidance on sound insulation and noise reduction for buildings’

The 2014 edition of BS 8233 saw a change in the title of the Standard, moving from a ‘Code of Practice’ to ‘Guidance’, as the text largely comprises guidance that does not support claims of compliance.

BS 8233:2014 indicates that to control external noise ingress into a proposed development, a number of planning stages should occur as follows:

- Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels, and evaluate layout options
- Determine design noise levels for spaces in and around the building(s).
- Determine sound insulation of the building envelope, including the ventilation strategy

BS 8233:2014 suggests design noise levels for various types of building. The recommended internal noise levels for dwelling houses, flats and rooms in residential use when unoccupied can be seen in

Table 3 below (from Table 4 of Section 7.7.2 of BS 8233:2014). The guidance states that in general and for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values.

The noise levels in Table 3 do differ to those published in BS 8233:1999 'Sound insulation and noise reduction for buildings – Code of practice' but are based on the existing guidance from the current World Health Organisation (WHO) "Guidelines for Community Noise" 1999.

Activity	Location	07:00 to 23:00	23:00 to 0700
Resting	Living room	35dB LAeq, 16hour	-
Dining	Dining room/area	40dB LAeq, 16hour	-
Sleeping (daytime resting)	Bedroom	35dB LAeq, 16hour	30dB LAeq, 8hour

Table 3 Summary of Noise Criteria: BS8233:2014

When considering the noise level criteria considered in Table 3, the following points should be noted:

1. BS 8233: 2014 suggests that the above criteria should be adopted flexibly and that where a development is considered necessary or desirable that the internal target level may be *relaxed* by up to **5 dB** and reasonable internal conditions still achieved.
2. The noise levels quoted above are annual averages and do not need to be achieved in all circumstances e.g. New Year's Eve or fireworks night.
3. The noise levels in
4. Table 3 are for steady external noise sources such as traffic noise. Internal noise levels are irrespective of the external noise source and should not exceed 45 dB. Whilst this has been omitted from the 2014 version of BS 8233, it does state that regular individual noise events (for example, scheduled SEL or LAf,max) depend on the character and number of events per night.
5. BS 8233:2014 does not define the term 'normally' in relation to the number of exceedances per night, however, the World Health Organisation's 'Guidelines for Community Noise' references a study by Vallet & Vernet, 1991, which concluded that "for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAf,max than 10-15 times per night." Therefore, levels of LAf,max 45 dB should not be exceeded more than 10-15 times per night.
6. BS 8233:2014 notes that if the design of the building is relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or resulting noise level.
7. BS 8233:2014 provides guidance for noise in gardens and outdoor amenity space. It suggests that it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. In these circumstances developments should be designed to achieve the lowest practicable levels in external amenity spaces, but development should not be prohibited should target levels not be achievable.

3.2 World Health Organisation, Guidelines for Community Noise (WHO, 1999)

The WHO Guidelines for Community Noise were referenced in the development of the criteria for BS 8233:2014. In dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To avoid night time sleep disturbance, indoor guideline values for bedrooms are 30 dB

L_{Aeq} (8hour) for continuous noise and 45 dB $L_{A_{f,max}}$ for single sound events, although the guidance does state that lower levels may be annoying depending on the nature of the noise source. Daytime internal noise levels should not exceed 35 dB L_{Aeq} (16 hour) to avoid serious annoyance.

The guidelines also state 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} .

At night, sound pressure levels at the outside façades of living spaces should not exceed 45 dB L_{Aeq} and 60 dB $L_{A_{f,max}}$, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from a partly open window is 15 dB.

3.3 ProPG: Planning and Noise – Professional Guidance on Planning and Noise

The release of “Planning and Noise. Professional Practice Guidance on Planning and Noise, New residential development (May 2017)” gives acoustic guidance based upon the works of a working group formed by members of the Institute of Acoustics (IOA), Association of Noise Consultants (ANC) and the Chartered Institute of Environmental Health (CIEH).

Much of this guidance has been adopted by BCC’s PCGN which draws reference to façade sound insulation as follows:

Using fixed un-openable glazing for sound insulation purposes is generally unsatisfactory and should be avoided; occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents. (ProPG Paragraph 2.22)

and:

It should be noted that the acoustic performance of the building envelope will be reduced in the event windows are opened for ventilation or cooling purposes, typically reducing the insulation to no more than 10 to 15 dB(A). Most residents value the ability to open windows at will, for a variety of reasons, and LPAs should therefore normally request that designers principally aim, through the use of good acoustic design, to achieve the internal noise level guidelines in noise-sensitive rooms with windows open. Where internal noise levels are assessed with windows closed the justification for this should be included in the ADS. (Paragraph 2.33)

To address such issues the ProPG encourages “good acoustic design” as follows:

Good acoustic design is not just compliance with recommended internal and external noise exposure standards. Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements. (Paragraph 2.21)

3.4 BS 7445-1: 2003 'Description and measurement of environmental noise Part 2: Guide to quantities and procedures'

BS7445 – 1 defines the quantities to be used for the description of noise in community environments and describes the procedures for the determination of these quantities, individually and in combination. The results are expressed as $L_{Aeq, T}$, the equivalent continuous A-weighted sound pressure level over time period T.

Section 4 of BS7445 defines internal and external measurement positions. For measurement outside buildings, free field measurements should be made 3.5 meters or further from a reflecting side of the ground. Sound level meters should be located between 1.2 and 1.5 m from the floor.

The standard also provides guidance on appropriate parameter selection for the measurement of different types of noise, as well as measurement time intervals and meteorological conditions.

3.5 Birmingham City Council: Planning Consultation Guidance Note – Noise and Vibration

Although not a national guidance document, Birmingham City Council's *Planning Policy Guidance Note – Noise and Vibration* has been included as it offers values for Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect level (SOAEL) at facades and for living spaces in dwellings – akin to the planning classes B and C from the withdrawn Planning Policy Guidance 24 – *Planning and Noise* (PPG 24). The document also offers glazing and ventilation specifications based upon measured ambient noise levels at the façade of a building.

LOAEL and SOAEL values for determining the location of new noise sensitive developments are shown in shown in Table 4, Table 5, and Table 6 below.

Noise source	Assessment location	LOAEL	SOAEL	Times
General environmental noise, road traffic, rail traffic	Façade	55 dB $L_{Aeq,16hr}$	72 dB $L_{Aeq,16hr}$	Day 07:00 – 23:00
	Façade	50 dB $L_{Aeq,8hr}$	67 dB $L_{Aeq,8hr}$	Night 23:00 – 07:00

Table 4 PCGN - LOAEL and SOAEL values for environmental noise at facades

The LOAEL and SOAEL values have been determined using target values from BS8233:2014 and the WHO *Guidelines for Community Noise* (1999), allowing the 5dB relaxation in BS8233:2014 and 15dB attenuation from an open window.

Noise source	Assessment location	LOAEL	SOAEL	Times
General environmental noise, road traffic, rail traffic	Habitable room	30 dB $L_{Aeq,8hr}$	40 dB $L_{Aeq,8hr}$	Night 23:00 – 07:00
	Habitable room	35 dB $L_{Aeq,16hr}$	45 dB $L_{Aeq,16hr}$	Day 07:00 – 23:00
	Outdoor living space	50 dB $L_{Aeq,1hr}$	55 dB $L_{Aeq,1hr}$	Day 07:00 – 23:00

Table 5 PCGN - LOAEL and SOAEL values for environmental noise in living spaces

Noise source	Assessment location	LOAEL	SOAEL	Times
Commercial noise or noise of industrial nature (not anonymous)	Facade	$L_{Ar,Tr} \sim b/g$ dB	$L_{Ar,Tr} \sim b/g + 10$ dB	Noise source Hours of operation
	Facade	55dB L_{AFmax}	$b/g + 10$ dB	Evening / night 19:00 – 07:00
	Habitable room	Rating level 35 dB $L_{Ar,1hr}$	Rating level 45 dB $L_{Ar,1hr}$	Day 07:00 – 23:00
	Habitable room	Rating level 30 dB $L_{Ar,15min}$	Rating level 40 dB $L_{Ar,15min}$	Night 23:00 – 07:00

Table 6 Values of LOAEL and SOAEL for industrial and commercial noise at new noise sensitive developments.

Section 7.4 gives acoustic requirements for glazing and ventilation to reduce the effect of transportation noise, which are shown in Table 7.

External noise level Not exceeding		Acoustic Performance requirement	
Day (dB L _{Aeq})	Night (dB L _{Aeq})	Windows All windows and doors to habitable rooms to provide a sound reduction index (dB R _w + C _{tr}) of not less than	Ventilators Ventilation to habitable rooms to provide a sound reduction index (dB D _{n,e,W} +C _{tr}) of not less than
< 50	< 45	No requirement See Note 1 below	
57	52	25	31
60	55	26	32
63	58	29	35
66	61	32	38
69	64	35	41
72	67	38	44
≥ 72	≥ 67	See Note 2 below	
Noise levels shall be rounded up to a whole dB when determining the external noise exposure			

Table 7 PCGN – Acoustic specification for glazing and ventilation (transportation noise)

4 Noise assessment

4.1 Assessment methodology

Noise levels measured over a 24-hour period at the front and rear façade of the building were assessed in accordance with BS8233:2014 to determine the required sound insulation of the building envelope to provide a suitable internal living environment.

Any deviations from BS7445-1:2003 regarding environmental noise measurements are noted in the following sections, along with assumptions and justification for measurement locations.

A site noise survey was carried out for an hour when deploying and collecting the noise monitoring equipment for an un-attended noise survey. A further site visit was made between 23:00 and 23:30 to determine if any industrial noise sources could be detected.

4.2 Location of premises under assessment

Figure 1 shows the location of the 9 Vachel Road in relation to Caversham Road, 75m to the west of the property and

Figure 2 shows the measurement locations for this assessment and proposed floor plans are shown in Appendix A.

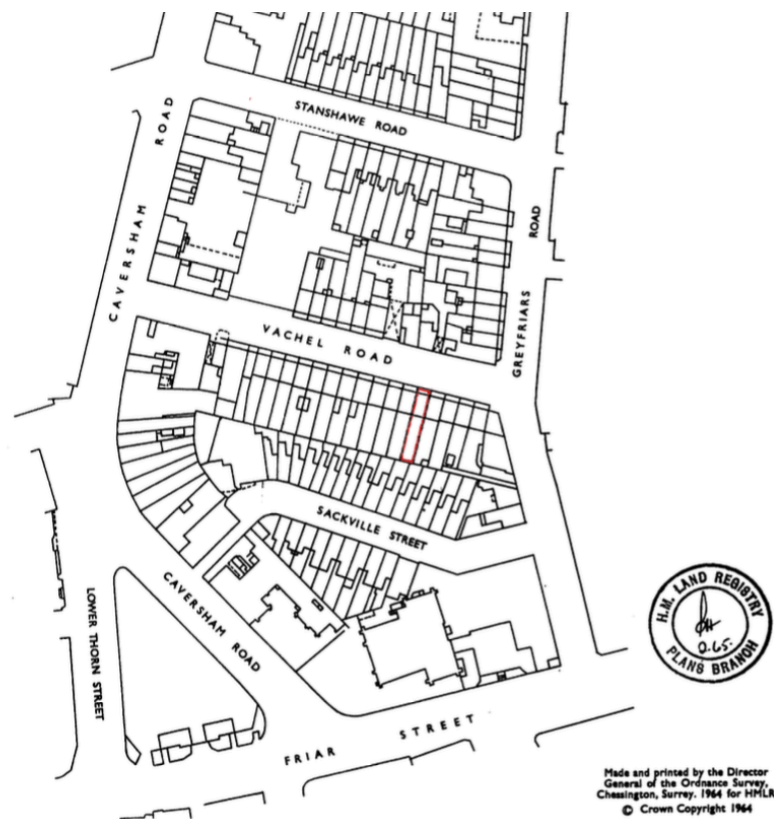


Figure 1 Location plan – 9 Vachel Road (in red)



Figure 2 Measurement locations (MP1 and MP2) for noise assessment.

4.3 Description of noise sources

As previously stated, the predominant noise source at the assessment location is that of traffic noise from the A329 Caversham Road, part of the Inner Distribution Road or ring road around Reading town centre. Distant rail transport noise was not discernible above road traffic noise during the attended survey periods, and no other industrial or commercial noise sources were apparent aside of some construction noise on the adjacent Greyfriars road, which was of a temporary nature.

A chiller unit was noted on the of the four-storey office building across the road from number 9 from Google Maps, but no audible noise was discernible from the unit during the daytime attended periods as presumably any plant noise was masked by road noise and the unit has parapet screening installed around it on the roof, as shown in Figure 3.

No noise was audible from the unit between 23:00 and 23:30 from the unit as presumably the HVAC plant is shut down over night or the parapet screening had been implemented to protect the amenity of the residential properties on Vachel Road by reducing noise accordingly.

No other prominent noise sources were noted throughout the survey period.

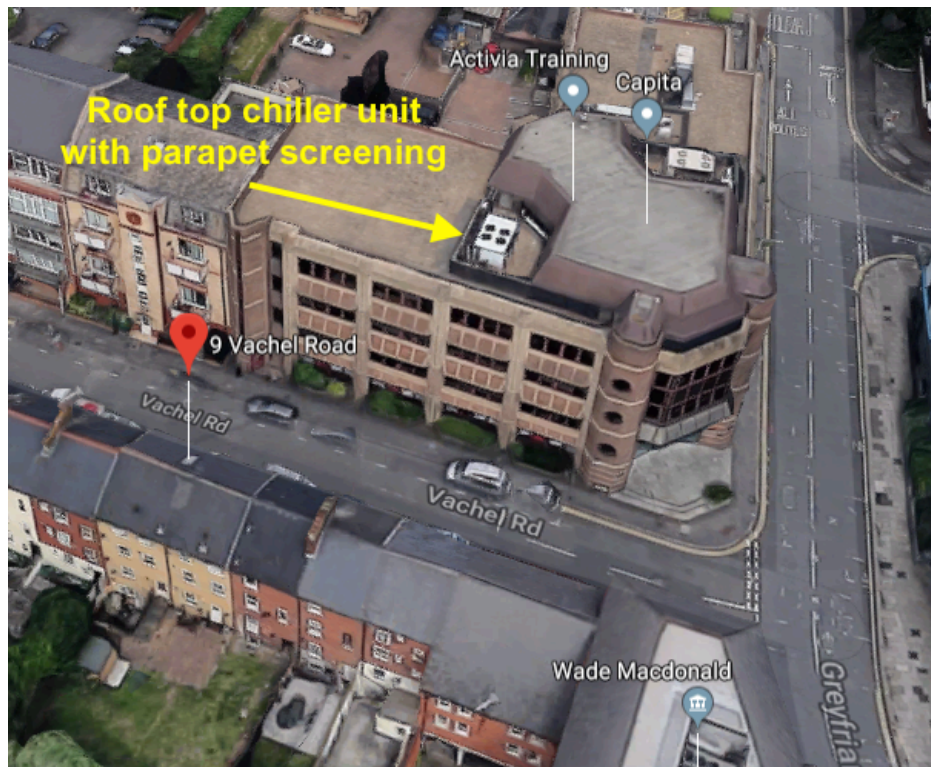


Figure 3 Roof top plant on office block on Vachel Road

4.4 Measurement of ambient sound levels

Ambient sound measurements were made at MP1 and MP2 marked in Figure 2. Microphones were located in secure locations protruding from windows on the 2nd floor on the front façade of the building (MP1) and from the first floor on the rear façade of the building (MP2). The sound level meters were set to record in logging mode to allow for data post processing if required.

A check measurement at street level indicated that façade reflections increased the noise level at MP1 (and presumably MP2) by 2dB, however the measurement positions captured the actual noise levels outside the windows rather than a free field measurement, thus no façade corrections were applied to the measurement data.

4.4.1 Survey periods and measurement durations

Noise measurements were made at MP1 and MP2 for the measurement period which ran from 11:00am on Monday the 16th of April 2018 to 11:00am on Tuesday the 17th of April 2018. The equipment used is detailed in Appendix B.

4.4.2 Weather conditions

Noise measurements were made in relatively calm conditions with variable 50 - 80% cloud cover. Temperatures varied between 8 and 11 degrees Celsius, and wind speed was below 5 m/s from the south south-west (checked on site with an anemometer) although some gusts peaked at 4.5 m/s. No fog or precipitation were experienced throughout the survey period.

4.4.3 Noise survey - measured noise levels

The sound level meters were calibrated before and after measurements were made. No noticeable drift was noted during the survey times.

The noise data from 16th – 17th April 2018 is shown in Appendix C and key values for day time and night time measurements are shown in Table 8 below.

Descriptor/period	MP1 Level (dB)	MP2 Level (dB)
Ambient $L_{Aeq, 16 \text{ hour}}$ (day time)	63	52
Ambient $L_{Aeq, 8 \text{ hour}}$ (night time)	57	47
$L_{Af, \text{max}}$ (highest day time)	91	81
$L_{Af, \text{max}}$ (highest night time)	82	74

Table 8 Noise measurements at MP1 and MP2

4.4.4 Discussion of the measured noise levels

Ambient ($L_{Aeq,t}$) sound levels were used to determine glazing and ventilation requirements for the new flats. The Birmingham City Council PCGN document offers glazing and ventilation sound insulation requirements for residential premises to provide along with external noise levels for LOAEL and SOAEL (shown in Table 4), based upon external measured noise levels.

At MP1 (the front façade) the measured night time level was **57dB $L_{Aeq, 8 \text{ hour}}$** and the daytime level was **63dB $L_{Aeq, 16 \text{ hour}}$** . These values are between the LOAEL and SOAEL, thus noise mitigation measures will be required.

At MP2 (the rear façade) the measured night time level was **47dB $L_{Aeq, 8 \text{ hour}}$** and the daytime level was **52dB $L_{Aeq, 16 \text{ hour}}$** both of which are below the LOAEL, thus noise mitigation measures are not necessary at this façade.

There were thirteen 15-minute night-time periods where the $L_{Af, \text{max}}$ level was above 70dB at MP1. Night time noise levels were then split into 5 minute periods and it was noted that of the 96 5-minute night time periods, 22 periods had an $L_{Af, \text{max}}$ of 70 dB or higher, and 11 of the periods has an $L_{Af, \text{max}}$ level of 71dB or higher. Both BS8233:2014 and the WHO guidelines require the number of $L_{Af, \text{max}}$ noise events above 45dB in bedrooms to be less than 15 times per night, which equates to 60dB outside an open window (assuming 15dB attenuation of sound through an open window).

As such, adequate ventilation will be required at the front façade of the building to allow for windows to remain closed if required to achieve suitable internal night time noise levels. For this purpose, attenuated acoustic ventilators will suffice.

At MP2 there were thirteen 15-minute night-time periods where the $L_{Af, \text{max}}$ level was above 60dB. This equates to internal noise levels of 45dB $L_{Af, \text{max}}$, which are compliant with BS8233:2015 and the WHO Guidelines.

Noise levels at the rear façade were in the region of 10dB lower than the roadside façade due to the screening effect of the building.

The measured daytime noise level at the rear façade of the building was **52dB $L_{Aeq, 16 \text{ hour}}$** . A 2dB correction to give a free field measured noise level, results in a noise level of 50dB $L_{Aeq, 16 \text{ hour}}$ in the garden which conforms with the requirements of BS8233:2014 for external amenity spaces.

4.5 Glazing and ventilation requirements based upon measured noise levels

BCC PCGN gives guidance values for glazing and ventilation to mitigate against traffic noise sources which are shown in

Table 7 in Section 3.5. The table shows that a night time noise level of 57dB $L_{Aeq, 8 \text{ hour}}$ and the daytime level was 63dB $L_{Aeq, 16 \text{ hour}}$ at the front facade of 9 Vachel Road are between the LOAEL and SOAEL values, thus noise mitigation measures will be required. The PCGN offers that the development will require window and ventilation acoustic performances of **29 dB $R_w + C_{tr}$** and **35 dB $D_{n,e,w} + C_{tr}$** respectively to protect the amenity of future occupants for the building.

The sound insulation of the glazing and ventilators will also reduce noise from the $L_{Af,max}$ events to an acceptable level in the region of 45dB internally.

A night time noise level of 47dB $L_{Aeq, 8 \text{ hour}}$ and the daytime level of 52dB $L_{Aeq, 16 \text{ hour}}$ at the rear facade of 9 Vachel Road were just above the LOAEL value. PCGN offers that the development may require window and ventilation acoustic performances of **25 dB $R_w + C_{tr}$** and **31 dB $D_{n,e,w} + C_{tr}$** respectively to protect the amenity of future occupants for the building, however given that BS8233:2014 allows for a 5dB relaxation of internal room noise levels, it can be argued that with standard glazing and opening windows at night for ventilation, a reasonable level of amenity will be achieved.

4.5.1 Uncertainty in measurements and calculations

Noise levels were measured over a 24-hour period to ensure the robustness of the gathered data set. The sound level meters were calibrated before and after the assessment period and no noticeable drift was recorded, thus uncertainty is assumed to be minimal.

5 Sound insulation scheme for the building envelope

In general, the glazed areas of a façade and ventilation penetrations are those areas which require consideration when considering the sound insulation of the building envelope.

In order to reduce noise levels in the habitable rooms of the on the Vachel Road façade of the premises to an acceptable level (LOAEL or lower), a suitable façade sound insulation scheme for the building was required.

5.1 Glazing considerations

The BCC PCGN guidance values for glazing and ventilation from

Table 7 in Section 3.5 determined that the acoustic performance of the glazing should be **29 dB $R_w + C_{tr}$** .

Standard Pilkington glazing units of 8/6-16/4 (or similar) should provide the required level of sound insulation, as shown in red Figure 4 below.

Sound insulation data for standard products

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						$R_w(C;C_{tr})$	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
4 mm Float Glass	17	20	26	32	33	26	29 (-2; -3)	29	27	26
6 mm Float Glass	18	23	30	35	27	32	31 (-2; -3)	31	29	28
8 mm Float Glass	20	24	29	34	29	37	32 (-2; -3)	32	30	29
10 mm Float Glass	23	26	32	31	32	39	33 (-2; -3)	33	31	30
12 mm Float Glass	27	29	31	32	38	47	34 (0; -2)	34	34	32
6 mm Laminated Glass	20	23	29	34	32	38	32 (-1; -3)	32	31	29
8 mm Laminated Glass	20	25	32	35	34	42	33 (-1; -3)	33	32	30
10 mm Laminated Glass	24	26	33	33	35	44	34 (-1; -3)	34	33	31
12 mm Laminated Glass	24	27	33	32	37	46	35 (-1; -3)	35	34	32
Insulating glass units										
4 mm / (6 - 16 mm) / 4 mm	21	17	25	35	37	31	29 (-1; -4)	29	28	25
6 mm / (6 - 16 mm) / 4 mm	21	20	26	38	37	39	32 (-2; -4)	32	30	28
6 mm / (6 - 16 mm) / 6 mm	20	18	28	38	34	38	31 (-1; -4)	31	30	27
8 mm / (6 - 16 mm) / 4 mm	22	21	28	38	40	47	33 (-1; -4)	33	32	29
8 mm / (6 - 16 mm) / 6 mm	20	21	33	40	36	48	35 (-2; -6)	35	33	29
10 mm / (6 - 16 mm) / 4 mm	24	21	32	37	42	43	35 (-2; -5)	35	33	30
10 mm / (6 - 16 mm) / 6 mm	24	24	32	37	37	44	35 (-1; -3)	35	34	32
6 mm / (6 - 16 mm) / 6 mm Laminated	20	19	30	39	37	46	33 (-2; -5)	33	31	28
6 mm / (6 - 16 mm) / 10 mm Laminated	24	25	33	39	40	49	37 (-1; -5)	37	36	32

Figure 4 Glazing requirements – Pilkington Standard glazing units

5.2 Ventilation considerations

The BCC PCGN guidance values for glazing and ventilation from

Table 7 in Section 3.5 determined that the acoustic performance of the ventilators for front façade of 9 Vachel Road should be **35dB $D_{n,e,w} + C_{tr}$** . Ventilators such as the Greenwood 2500 EAW.AC1 as shown in red in Figure 5 will provide this level of performance.

Models, control options and key data				The discount group applied to Acoustic Ventilation is F1			
Product code	Description	Controls	Acoustic performance			Equivalent area mm ²	Colour
			$D_{n,e,w}$	$D_{n,e,w}(C)$	$D_{n,e,w}(C_{tr})$		
2500EAW.AC1	Vent + 1 Acoustic External Module	Front	42dB(A)	41dB	40dB	2670	White
2500EAW.AC2	Vent + 2 Acoustic Modules	Front	45dB(A)	43dB	42dB	2670	White
5000EAW.AC1	Vent + 1 Acoustic External Module	Front	39dB(A)	38dB	37dB	5350	White
5000EAW.AC2	Vent + 2 Acoustic Modules	Front	42dB(A)	40dB	38dB	5350	White

Figure 5 Greenwood acoustic ventilator specification

No specific façade sound insulation is required for the rear of the building.

5.3 Separating walls and floors

Separating walls floors between habitable spaces at the development will need to be designed to achieve the sound insulation requirements of Approved Document E of the Building Regulations as shown in Table 9.

		D_{nT,w} + C_{tr} dB (Min Values)	L'_{nT,w} dB (Max Values)
Walls	D_{nT,w} (airborne)	43 dB	-
Floors	D_{nT,w} (airborne)	43 dB	-
	L'_{nT,w} (impact)	-	64 dB

Table 9 Building Regulations Performance Requirements – dwellings formed by material change of use

A sound insulation scheme between flats (separating floors) will be determined for the Building Regulations application to ensure that the requirements of ADE are met.

6 Conclusion

This report assesses the noise impact of road traffic and other noise sources on the proposed development of a 4-storey dwelling house at 9 Vachel Road to create four flats.

Noise measurements were made over a 24-hour period at the front and rear of the property to ascertain the noise climate at the location. These data were then used to determine the required sound insulation of the building façades to provide suitable internal noise levels for residential premises.

Noise levels were assessed in accordance with BS8233:2014, which takes target noise level values for adverse noise impact from the WHO Guidelines on Community Noise (1999).

The predominant noise source at the location is that of road traffic noise from the A329 Caversham Road, part of the Inner Distribution Road or ring road around Reading town centre. No other sources of industrial or commercial noise were noted at the premises.

To protect the amenity of future occupants, it is suggested that:

- Glazing is installed with a minimum sound reduction index of 29 dB $R_w + C_{tr}$.
- Acoustic ventilation should have a minimum sound reduction index of 35 dB $D_{n,e,w} + C_{tr}$.
- The glazing allows windows to be opened for purge ventilation and heat control.
- Separating partitions between habitable spaces should conform to the performance standards of Approved Document E of the Building Regulations.

If these steps are taken, the internal noise levels within the newly created flats will conform to the requirements of the BS8233:2014 and the WHO *Guidelines on Community Noise*.

Reasonable internal noise levels will be achieved to the rear of the property with standard double glazing and ventilation units. Noise levels in the rear garden conform to the requirements of BS8233:2014 for external amenity spaces.

Appendix A Site Floor plans

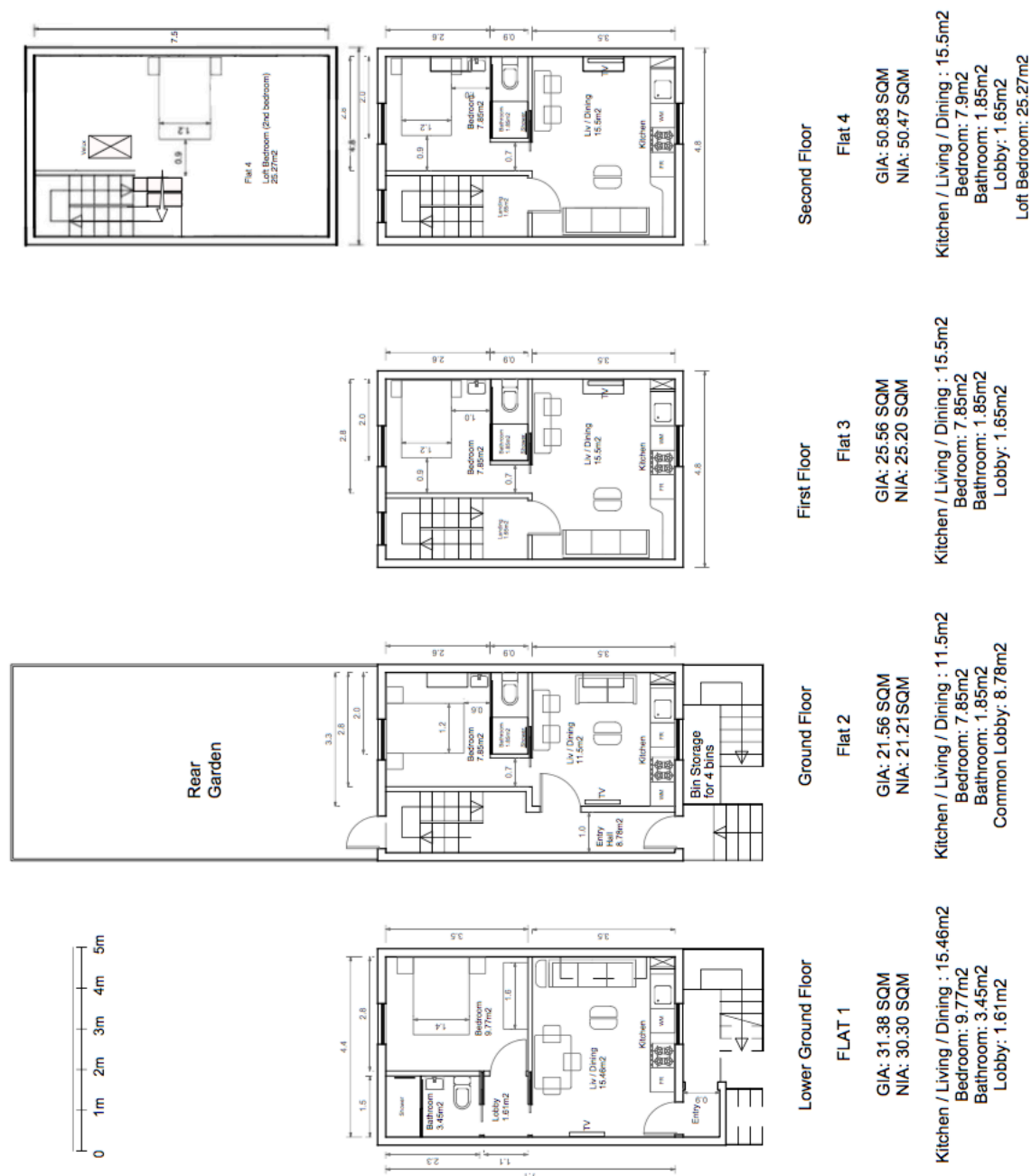


Figure 6 Floor plans – 9 Vachel Road

Appendix B Measurement equipment

The background residual ambient noise and specific noise levels were measured using a CESVA SC310 sound level meter, conforming to class 1 of BS EN 61672-1:2003 *Electroacoustics. Sound Level Meters. Specifications* & type 1 of the former standard BS EN 60804. Serial numbers are recorded in Table 10 follows:

CESVA model	Equipment Type	Serial Number
CESVA SC310	Real Time Analyser	# T224211
CESVA SC310	Real Time Analyser	# T231688
CESVA CB006	Sound Level Calibrator	# 49179
CESVA TK 200	Outdoor kit	# T239019
CESVA CN010	10m cable	# T982074

Table 10 Test equipment used for noise assessment

(calibration certificates available upon request).

The sound level meters were calibrated before & after usage using a type 1 CESVA CB006 Acoustic calibrator.

All levels measured by the meter are accurate to one decimal place of a decibel, however they have been reported to the nearest decibel.

Appendix C Survey noise data

Date	time from	time to	MP1 - 9 Vachel Road		
			LA90	LAF max	LAeq
16/04/2018	11:00:00	11:59:59	57	81	62
	12:00:00	12:59:59	57	80	62
	Day time	13:00:00	56	85	63
		14:00:00	56	92	63
		15:00:00	57	89	64
		16:00:00	57	84	63
		17:00:00	58	86	64
		18:00:00	57	80	63
		19:00:00	55	91	64
		20:00:00	55	81	62
		21:00:00	53	77	60
		22:00:00	51	82	59
17/04/2018	23:00:00	23:14:59	49	70	57
	23:15:00	23:29:59	48	71	56
	23:30:00	23:44:59	46	66	54
	23:45:00	23:59:59	47	69	56
	00:00:00	00:14:59	47	68	55
		00:15:00	46	69	55
		00:30:00	46	67	53
		00:45:00	46	77	54
	Night time	01:00:00	46	74	54
		01:15:00	44	66	52
		01:30:00	43	70	51
		01:45:00	42	65	49
		02:00:00	44	64	51
		02:15:00	43	65	50
		02:30:00	44	70	51
		02:45:00	43	67	51
		03:00:00	43	65	48
		03:15:00	44	68	52
	03:30:00	03:44:59	45	69	54
		03:45:00	45	80	56
		04:00:00	45	82	57
		04:15:00	45	69	54
		04:30:00	46	71	55
		04:45:00	46	65	54
		05:00:00	48	72	58
		05:15:00	48	74	57
		05:30:00	51	76	59
		05:45:00	52	72	59
		06:00:00	53	71	60
		06:15:00	55	78	61
		06:30:00	56	70	62
		06:45:00	57	74	63
Day time	07:00:00	07:59:59	58	86	64
	08:00:00	08:59:59	58	81	64
	09:00:00	09:59:59	58	79	63
	10:00:00	10:59:59	58	79	63

Table 11 24-hour measurement data MP1

MP2 - 9 Vachel Road					
Date	time from	time to	LA90	LAF max	LAeq
16/04/2018	11:00:00	11:59:59	48	76	53
	12:00:00	12:59:59	47	75	51
	Day time	13:00:00	47	72	52
		14:00:00	47	75	52
		15:00:00	48	81	52
		16:00:00	48	67	52
		17:00:00	48	78	52
		18:00:00	48	69	52
		19:00:00	46	73	52
		20:00:00	44	73	49
		21:00:00	44	68	48
		22:00:00	43	72	47
17/04/2018	23:00:00	23:14:59	42	74	48
	23:15:00	23:29:59	41	60	45
	23:30:00	23:44:59	40	57	43
	23:45:00	23:59:59	40	68	45
	Night time	00:00:00	40	60	44
		00:15:00	39	58	43
		00:30:00	37	56	41
		00:45:00	37	70	43
		01:00:00	38	70	47
		01:15:00	36	61	41
		01:30:00	36	57	41
		01:45:00	35	56	39
		02:00:00	38	60	41
		02:15:00	37	60	41
		02:30:00	36	57	41
		02:45:00	36	54	40
		03:00:00	35	56	38
		03:15:00	36	57	41
		03:30:00	38	59	43
		03:45:00	38	60	43
		04:00:00	38	67	45
		04:15:00	38	58	43
		04:30:00	40	57	43
		04:45:00	40	56	44
		05:00:00	41	61	46
		05:15:00	42	68	48
		05:30:00	44	60	48
		05:45:00	48	66	53
		06:00:00	48	64	52
		06:15:00	49	71	55
		06:30:00	49	63	52
		06:45:00	49	70	53
Day time	07:00:00	07:59:59	50	72	54
	08:00:00	08:59:59	50	79	54
	09:00:00	09:59:59	49	69	53
	10:00:00	10:59:59	50	69	54

Table 12 24-hour measurement data MP2

MP1 L _{Af} ,max 5min			
number	Hr Start	Hr End	L _{Af} Max max
1	23:00:00	23:59:59	66.7
2	23:00:00	23:59:59	70.1
3	23:00:00	23:59:59	69.1
4	23:00:00	23:59:59	68.1
5	23:00:00	23:59:59	70.6
6	23:00:00	23:59:59	65.0
7	23:00:00	23:59:59	62.8
8	23:00:00	23:59:59	66.0
9	23:00:00	23:59:59	63.8
10	23:00:00	23:59:59	68.6
11	23:00:00	23:59:59	65.7
12	23:00:00	23:59:59	67.5
1	00:00:00	00:59:59	67.6
2	00:00:00	00:59:59	64.9
3	00:00:00	00:59:59	66.9
4	00:00:00	00:59:59	67.7
5	00:00:00	00:59:59	68.5
6	00:00:00	00:59:59	65.8
7	00:00:00	00:59:59	67.2
8	00:00:00	00:59:59	64.6
9	00:00:00	00:59:59	62.6
10	00:00:00	00:59:59	67.0
11	00:00:00	00:59:59	77.3
12	00:00:00	00:59:59	63.5
1	01:00:00	01:59:59	66.7
2	01:00:00	01:59:59	66.7
3	01:00:00	01:59:59	73.6
4	01:00:00	01:59:59	66.2
5	01:00:00	01:59:59	64.7
6	01:00:00	01:59:59	64.3
7	01:00:00	01:59:59	69.8
8	01:00:00	01:59:59	62.9
9	01:00:00	01:59:59	63.3
10	01:00:00	01:59:59	65.1
11	01:00:00	01:59:59	59.2
12	01:00:00	01:59:59	58.2
1	02:00:00	02:59:59	64.3
2	02:00:00	02:59:59	63.7
3	02:00:00	02:59:59	64.1
4	02:00:00	02:59:59	62.5
5	02:00:00	02:59:59	64.9
6	02:00:00	02:59:59	63.1
7	02:00:00	02:59:59	64.8
8	02:00:00	02:59:59	70.3
9	02:00:00	02:59:59	65.5
10	02:00:00	02:59:59	63.2
11	02:00:00	02:59:59	61.8
12	02:00:00	02:59:59	66.8
1	03:00:00	03:59:59	64.5
2	03:00:00	03:59:59	62.5
3	03:00:00	03:59:59	59.1
4	03:00:00	03:59:59	63.1
5	03:00:00	03:59:59	67.6
6	03:00:00	03:59:59	68.1
7	03:00:00	03:59:59	68.6
8	03:00:00	03:59:59	68.5
9	03:00:00	03:59:59	67.3
10	03:00:00	03:59:59	67.7
11	03:00:00	03:59:59	67.9
12	03:00:00	03:59:59	79.9
1	04:00:00	04:59:59	68.5
2	04:00:00	04:59:59	82.3
3	04:00:00	04:59:59	67.3
4	04:00:00	04:59:59	68.7
5	04:00:00	04:59:59	68.8
6	04:00:00	04:59:59	68.1
7	04:00:00	04:59:59	67.2
8	04:00:00	04:59:59	67.1
9	04:00:00	04:59:59	70.7
10	04:00:00	04:59:59	63.8
11	04:00:00	04:59:59	65.0
12	04:00:00	04:59:59	65.2
1	05:00:00	05:59:59	71.6
2	05:00:00	05:59:59	71.7
3	05:00:00	05:59:59	70.7
4	05:00:00	05:59:59	74.1
5	05:00:00	05:59:59	69.5
6	05:00:00	05:59:59	72.0
7	05:00:00	05:59:59	66.8
8	05:00:00	05:59:59	75.6
9	05:00:00	05:59:59	68.3
10	05:00:00	05:59:59	70.4
11	05:00:00	05:59:59	67.8
12	05:00:00	05:59:59	72.1
1	06:00:00	06:59:59	69.3
2	06:00:00	06:59:59	71.4
3	06:00:00	06:59:59	68.4
4	06:00:00	06:59:59	72.5
5	06:00:00	06:59:59	70.7
6	06:00:00	06:59:59	78.3
7	06:00:00	06:59:59	69.0
8	06:00:00	06:59:59	69.9
9	06:00:00	06:59:59	70.0
10	06:00:00	06:59:59	74.2
11	06:00:00	06:59:59	68.7
12	06:00:00	06:59:59	70.0

Table 13

L_{Af},max 5min – MP1 (front façade)

Appendix D

Definitions

A summary of acoustics definitions follows:

dB Decibel – measurement of sound pressure level as a ratio to a reference level (2×10^{-5} Pa).

dB(A) The A-weighted sound pressure level whereby various frequency components of the sound are weighted (equalized) to reflect the way the human ear responds to different frequencies. The human ear is more susceptible to mid-frequency noise than high and low frequencies, thus A-weighting corrects for human noise perception.

The equivalent sound pressure level $L_{Aeq, T}$

The equivalent continuous A-weighted sound pressure level in decibels for time period T.

L_{AFmax}

The maximum, RMS, A-weighted sound pressure level occurring within a specified time period using the fast time weighting.

The specific noise source

The noise source under investigation for assessing the likelihood of complaints.

The equivalent sound pressure level $L_{Aeq, T}$

The equivalent continuous A-weighted sound pressure level in decibels for time period T.

The ambient noise

Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near & far.

The residual noise

The ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

The background sound level $L_{A90, T}$

The A-weighted sound pressure level exceeded for 90% of a given time interval of the total sound at the nearest noise sensitive site, at the time of maximum nuisance potential.

The assessment location

The location at which the rating level is assessed; usually the nearest resident. The specific noise at this position may be measured directly, or where measured as close to background noise, or not yet in operation, predicted by calculation.

The rating level $L_{Ar, Tr}$

The specific noise level plus any adjustment for the character of the noise.

Appendix E Predicting the reduction of sound with distance

Consider the case of sound radiating spherically. The sound intensity decreases with the square of the distance from the source.

I is proportional to $1/r^2$ where I is sound intensity & r is the distance from source to receiver.

$$I_r/I_R = R^2/r^2$$

where I_r = intensity at a distance r from the source & I_R = intensity at a distance R from the source.

If L_r = sound pressure level in decibels at distance r from the source, then, for spherical radiation:

$$L_r - L_R = 10 \log_{10} I_r/I_R$$

$$= 10 \log_{10} R^2/r^2$$

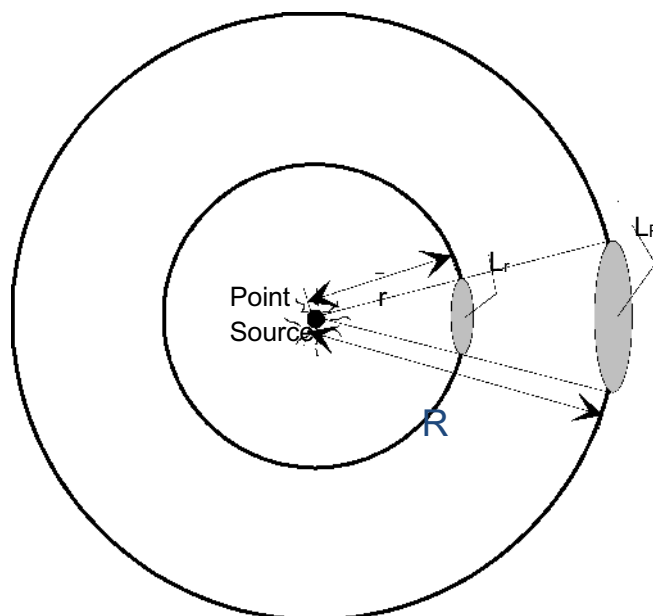
$$= 20 \log_{10} R/r \text{ dB}$$

From the above equation, to calculate the reduction of sound from the measurement location to the assessment location, or, in other words, the noise correction to be deducted from the value measured at the measurement location:

$$= 20 \log r_a/r_m \text{ dB where:}$$

r_a is the distance from the noise source to the assessment location (m)

r_m is the distance from the noise source to the measurement location, a distance sufficiently close to the source for the effect of residual noise on the measurement to be taken into account or discounted, yet far enough away for the source to be considered to be a point source (m)



Appendix F References

Birmingham City Council (2017), *Planning Consultation Guidance Note - Noise and Vibration*, Birmingham City Council, Birmingham.

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WHO (1999) World Health Organisation, *Guidelines for Community Noise*, Geneva

BSI (2003) *BS 7445-1: 2003 Description and measurement of environmental noise Part 2: Guide to quantities and procedures*, British Standards, London

IOA, ANC, CIEH (2017) *Planning and Noise - Professional Practice Guidance on Planning and Noise, New residential development*

WHO (1999) World Health Organisation, *Guidelines for Community Noise*, Geneva

Appendix G Qualifications and experience of the author

Darren Ryder – Qualifications and professional registrations

HNC Engineering – Avionics

Post Graduate Diploma in Acoustics and Noise Control (Institute of Acoustics)

MSc. Applied Acoustics (Derby University)

MIOA – Corporate Member of the Institute of Acoustics

MIET – Member of the Institute of Engineering and Technology

Darren Ryder - Brief Curriculum Vitae

Darren Ryder is a director and founder of 101 Acoustics Ltd. being employed in acoustics since 2001. Experience includes the undertaking noise surveys and assessments to BS4142 and BS8233, entertainment noise surveys in accordance with the “pop code”, the acoustic design of; dwelling houses in accordance with Approved Document E of the Building Regulations, hospitals in accordance with HTM08-01, pubs, clubs, auditoria, recording studios, factories etc.in accordance with BS8233 and client specifications and schools in accordance with BB93. He has previously worked for Adi Technical Ltd, Birmingham City Council, CareTech Ltd, Conwy County Borough Council, Greaves Welsh Slate Ltd, the Grosvenor Estate, Heart of England NHS Trust, Highbury Design, Interserve, Kerwood Property Development, Lockheed Martin UK Ltd, M.W. Construction, Matlab Architects, The Met Office, R.W.Twinings Ltd, Warwickshire Construction and Zip World Ltd. amongst others.