

Report

Noise Assessments

Proposed residential flats at Silver Street/Crown Street, Reading

Calculation of the performance of the screening to the garden & the
glazing required and of the maximum sound that can be emitted by
the air handling units

Measurements' dates: 26-27 April 2017

Prepared for Thomas Homes

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Contents

1 Measurement of road traffic noise and choice of glazing	Page 1
1.1 Introduction	Page 1
1.2 Calculation of the noise level in the outdoor living areas	Page 1
1.2.1 Design noise level	Page 1
1.2.2 Screening	Page 1
1.3 Design noise levels within the proposed building	Page 2
1.4 Measurement of the traffic noise levels	Page 2
1.5 Determination of design noise levels at the façades of the proposed building	Page 3
1.5.1 Correction for façade reflections	Page 3
1.5.2 Correction for distance	Page 3
1.5.3 Calculation of the design exterior noise levels	Page 3
1.6 Calculation of the sound level within the rooms of the proposed building	Page 3
1.6.1 Calculation of the performance of the glazing when open	Page 3
1.6.2 Calculation of the performance of the glazing when closed	Page 4
1.7 Sound Reduction Indices of Pilkington's glazing	Page 5
1.8 Choice of Glazing	Page 5
1.9 Manufacturers of glass	Page 6
1.10 Conclusion	Page 6
2 Assessment of the impact of air handling plant for the proposed building on the surrounding residents	Page 7
2.1 Introduction	Page 7
2.2 Hours and mode of operation	Page 7
2.3 Background sound	Page 7
2.4 Prediction of $L_{Aeq,Tr}$ the specific sound level	Page 7
2.5 Subjective description of the sound	Page 4
2.6 Assessment of sound	Page 8
2.7 Conclusion	Page 8

Figure

Figure: Plan of the site Page 13

Appendices

Appendix I: Derivation of the equation for calculation of the sound reduction index of the glazing	Page 9
Appendix II: References	Page 9
Appendix III: Measurement equipment	Page 10
Appendix IV: 24 hour sound monitoring survey results	Page 11
Appendix IV: The author and acoustic consultant	Page 14
Appendix V: Revision history	Page 14

1 Measurement of road traffic noise and choice of glazing

1.1 Introduction

BS 8233: 2014 "Sound Insulation and noise reduction for buildings - Code of practice" states in section 1 "Scope":

This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

This British Standard does not cover:

- a) specialist applications, such as auditoria and cinemas (for cinemas, see BS ISO 9568);*
- b) vibration control, except where it is evident in the form of radiate sound; or*
- c) noise that breaks out from the building that might affect external receptors.*

It is proposed that a residential development be erected at Crown Street, Reading on a brown field site. The site has Crown Street immediately to the north and Silver Street immediately to the east however the dominant noise would be that of Crown Street which carries more traffic. This report has been commissioned to recommend measures to be taken so as to ensure that reasonable standards of peace and quiet are achieved in the garden and within the building when constructed.

This has been achieved by measuring the existing sound levels on the site and the amount of sound insulation required of the building envelope so as to ensure that target noise levels within the building are achieved.

As the façades of the building would vary in their distance from the Crown Street the design will be for the worst case; that of the façade of the building which would be closest to the road. Although it is recognised that the other façades facing away from the road would not be as noisy it is suggested that all

the glazing be similar for practical reasons of ordering and construction.

1.2 Calculation of the noise level in the outdoor living areas

1.2.1 Design noise level

In BS 8233: 2014 "Sound Insulation and noise reduction for buildings - Code of practice" paragraph 7.7.3.2 the following guidance is given:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to be sure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

1.2.2 Screening

There would a garden to the rear of the proposed building. The traffic noise during the day was measured in the a location a similar distance from Crown Street to the proposed garden and was found to be 61 dB $L_{Aeq, 16 \text{ hour}}$.

As this level exceeds 55 dB $L_{Aeq,T}$ it will be assumed that the garden would not have an not acceptable level of noise however it would be screened from the traffic noise by the building itself.

This would reduce the traffic noise by approximately 10 dB. Reference to BS 5228-1:2009 "Code of practice for noise and vibration control on construction and open sites - Part 1: Noise" gives guidance for the prediction of the influence of screens. Paragraph F.2.2.2.1 (page 129) states as a *working approximation, if there is a barrier ... between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the*

plant is just visible to the receiver over the noise barrier, and 10 dB when the noise screen completely hides the source from the receiver.

As the proposed building would completely hide the source (engine noise and the tyres on the surface of the road) from the receiver (those standing in the garden), a sound reduction of 10 dB will be assumed.

Measured average daytime noise	61 dB $L_{Aeq, 16 \text{ hour}}$
Less barrier correction	- 10 dB
Total exterior noise levels	51 dB $L_{Aeq, 16 \text{ hour}}$

After screening the traffic level would not exceed 55 dB $L_{Aeq,T}$ and it will be assumed that the garden would then have an acceptable level of noise.

1.3 Design noise levels within the proposed building

BS 8233: 2014 "British Standard Code of practice for Sound insulation and noise reduction for buildings", Table 4 gives desirable indoor ambient noise levels:

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

Less sensitive areas are considered to be the kitchen, bathroom, utility room, W.C., and internal circulation areas for which no noise limits are set.

1.4 Measurement of the traffic noise levels

The day time and night time measurements were found to be:

Time	Ambient noise levels
Night time	55 dB $L_{Aeq, 8 \text{ hour}}$
Daytime	61 dB $L_{Aeq, 16 \text{ hour}}$

See Appendix IV on page 11.

1.5 Determination of design noise levels at the façades of the proposed dwellings

1.5.1 Correction for façade reflections

Clause 3.1.10 of BS 8233:2014 states:

Façade level measurements ... are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflections from the façade.

As the meter was positioned well away from any reflecting surfaces (other than the ground) the measured values have been corrected by adding 2 dB to allow for the façade reflection.

1.5.2 Correction for distance

As the measurement location is at a different location from the façade of the proposed development the measured noise levels should be corrected for distance. (See the plan of the environs on page 13). It will be assumed that the sound would increase as a line source.

The equation for the increase is:

$$\text{Increase} = 10 \log \frac{r_m}{r_f}$$

where r_m is the distance from the centre line to the measurement location (16 metres) and r_f is the distance from the centre line of Crown Street to the façade location (12 metres).

Substituting:

$$\text{Increase} = 10 \log \frac{16}{12} = 1 \text{ dB}$$

1 dB will be added to the measured noise levels.

1.5.3 Calculation of the design exterior noise levels

The following highest exterior design noise levels will be taken as the worst case for the purpose of design of the building envelope:

At the façade of the living rooms and dining rooms/areas

Measured average daytime noise	61 dB L_{Aeq} 16 hour
Distance correction	+ 1 dB
Plus façade reflection	+ 2 dB
Total exterior design noise levels	<u>64 dB L_{Aeq} 16 hour</u>

At the façade of the bedrooms:

Measured average night time noise	55 dB L_{Aeq} (8 hours)
Distance correction	+ 1 dB
Plus façade reflection	+ 2 dB
Total exterior design noise levels	<u>58 dB L_{Aeq} (8 hours)</u>

1.6 Calculation of the sound level within the rooms of the proposed dwellings

1.6.1 Calculation of the performance of the glazing when open

Consider first the sound levels in the dwelling with the windows open.

A partially open window provides a noise reduction from outside to inside of 10-15 dB R_w . The sound level outside the proposed building's windows at night would be 58 dB L_{Aeq} , 8 hour. The sound level outside the proposed building's windows during the day would be 64 dB L_{Aeq} , 16 hour.

To reduce the noise exposure inside the building, attention should be given to the sound insulation of both the roof and façade. A traditional pitched roof with concrete tiles and a 9 mm plasterboard ceiling, covered in mineral fibre thermal insulating material, will have a sound insulation of about 43 dB R_w (see Table 8 of BS 8233). The windows would normally be the weakest part of a brick and block façade. (A brick and block external wall would have a sound insulation of about 50 dB R_w).

If the windows are intended to be opened to provide rapid ventilation and summer cooling, the insulation would reduce to about 10-15 dB R_w .

The sound level within the dwelling with an open window is the external sound level minus the sound reduction index of an open window (for the derivation of this formula see the Appendix I on page 9).

Consider the living rooms:

External noise level outside the living rooms	64	dB $L_{Aeq, 16 \text{ hour}}$
Deduct the sound reduction index of an open window	-10	dB R_w
Internal noise level during the day inside the living rooms	54	dB $L_{Aeq, 16 \text{ hour}}$

Consider the dining rooms/areas:

External noise level during the day outside the dining rooms/areas	64	dB $L_{Aeq, 16 \text{ hour}}$
Deduct the sound reduction index of an open window	-10	dB R_w
Internal noise level during the day inside the dining rooms/areas	54	dB $L_{Aeq, 16 \text{ hour}}$

Consider the bedrooms during the day:

External noise level outside the bedrooms	64	dB $L_{Aeq, 16 \text{ hour}}$
Deduct the sound reduction index of an open window	-10	dB R_w
Internal noise level at first floor level outside the bedrooms	54	dB $L_{Aeq, 16 \text{ hour}}$

Consider the bedrooms at night:

External noise level outside the bedrooms	58	dB $L_{Aeq, 16 \text{ hour}}$
Deduct the sound reduction index of an open window	-10	dB R_w
Internal noise level at first floor level outside the bedrooms	48	dB $L_{Aeq, 16 \text{ hour}}$

As the all noise levels inside the rooms exceed the target noise level mechanical ventilation for rapid ventilation should be considered.

1.6.2 Calculation of the performance of the glazing when closed

Different types of glazing will control noise to differing amounts and will vary according to the type of noise that should be reduced. The performance of glazing is established by measurement in the laboratory.

Reference to Pilkington's literature "Pilkington Optiphon" CI/SfB (31) Ro8 (P2) dated June 2016:

Sound Reduction Index

R_w is the weighted sound reduction, in decibels, which incorporates a correction for the ear's response.

C and C_{tr} are the spectrum adjustments, which are the values added to R_w to take account of the characteristics of particular sound spectra.

As the weighted sound reduction plus spectrum adaptation term $R_w + C_{tr}$ is used for urban road traffic, emitting mainly low and medium frequency noise, $R_w + C_{tr}$ will be used as the measure of control by the glazing of this: urban traffic noise.

The following equation will be used to identify the minimum sound reduction index required of the glazing.

$$SRI = L_2 - L_1 \text{ dB}$$

Where

SRI is the sound reduction index of the façade which is $R_w + C_{tr}$.

R_w is the weighted sound reduction, in decibels, which incorporates a correction for the ear's response.

C_{tr} takes into account the particular characteristics of the spectrum of the dominant noise outside the building which in this case is of urban road traffic.

L_1 is the design noise level in the building ($L_{Aeq T}$)

L_2 is the noise level immediately outside (1.0 m) ($L_{Aeq T}$)

This equation is derived in Appendix I on page 9.

L_1 is the design noise level in the bedrooms at night	30	dB $L_{Aeq, 8 \text{ hour}}$
L_2 is the noise level immediately outside the bedrooms at night	58	dB $L_{Aeq, 8 \text{ hour}}$
Traffic noise reduction of the glazing	28	dB $R_w + C_{tr}$

L_1 is the design noise level in the bedrooms during the day	35	dB $L_{Aeq, 8 \text{ hour}}$
L_2 is the noise level immediately outside the bedrooms during the day	64	dB $L_{Aeq, 8 \text{ hour}}$
Traffic noise reduction of the glazing	29	dB $R_w + C_{tr}$

L_1 is the design noise level in the living rooms	35	dB $L_{Aeq, 16 \text{ hour}}$
L_2 is the noise level immediately outside the living rooms	64	dB $L_{Aeq, 16 \text{ hour}}$
Traffic noise reduction of the glazing	29	dB $R_w + C_{tr}$

L_1 is the design noise level in the dining rooms/areas	40	dB $L_{Aeq, 16 \text{ hour}}$
L_2 is the noise level immediately outside the dining rooms/areas	64	dB $L_{Aeq, 16 \text{ hour}}$
Traffic noise reduction of the glazing	24	dB $R_w + C_{tr}$

To summarise:

Glazing to the bedrooms . .	29	dB $R_w + C_{tr}$
Glazing to the living rooms	29	dB $R_w + C_{tr}$
Glazing to the dining rooms/areas	24	dB $R_w + C_{tr}$

Of course, these are minimum sound reduction indices and, for practical reasons, higher specifications could be used; particularly if it is intended that the rooms be tested after completion to check that the target noise levels have been achieved.

1.7 Sound Reduction Indices of Pilkington's glazing

Although Pilkington's glazing has been suggested in this report other manufacturers of glazing would be equally suitable provided that the sound reduction

indices of the glazing meet the minimum calculated in this report.

The following is a summary of the sound reduction indices of Pilkington's glazing:

Both panes are conventional float glass.

Outer pane of float glass	Cavity	Inner pane of float glass	Weighted sound reduction plus spectrum adaptation term $R_w + C_{tr}$
4 mm	6-20 mm	4 mm	25 dB
6 mm	6-20 mm	6 mm	27 dB
6 mm	6-20 mm	4 mm	28 dB
10 mm	6-20 mm	4 mm	30 dB
10 mm	6-20 mm	6 mm	32 dB

The following are as tested in the laboratory by Pilkingtons. The outer pane is of conventional float glass and the inner pane is of Pilkington "Optiphon" glass.

Although the laminated pane of glass (including a PVB (polyvinyl butyral) interlayer) is normally used as the inside pane for safety reasons the sound reduction is the same no matter which are the inner or outer panes.

Outer pane	Cavity	Inner pane	Weighted sound reduction plus spectrum adaptation term
6 mm	6-20 mm	6.8 mm	33 dB $R_w + C_{tr}$
6 mm	6-20 mm	8.8 mm	34 dB $R_w + C_{tr}$
6 mm	6-20 mm	10.8 mm	35 dB $R_w + C_{tr}$
6 mm	6-20 mm	12.8 mm	34 dB $R_w + C_{tr}$

1.8 Choice of Glazing

After inspection of the above tables, the following glazing exceeds the minimum sound insulation performance required. (This is considering the performance of the glazing as tested in the

laboratory. The manufacturers of the windows should be consulted to ensure that their window frames when glazed would achieve the target sound insulation values):

Glazing to the bedrooms

The glazing to the bedrooms' windows should comprise:

*4 mm outer pane of float glass
6-20 mm cavity
10 mm inner pane of float glass*

The sound reduction index of this construction is:

$$30 \text{ dB } R_w + C_{tr}$$

This exceeds the minimum sound reduction index required which has been calculated as:

$$29 \text{ dB } R_w + C_{tr}$$

Glazing to the living rooms

The glazing to the living rooms' windows should comprise:

*4 mm outer pane of float glass
6-20 mm cavity
10 mm inner pane of float glass*

The sound reduction index of this construction is:

$$30 \text{ dB } R_w + C_{tr}$$

This exceeds the minimum sound reduction index required which has been calculated as:

$$29 \text{ dB } R_w + C_{tr}$$

Glazing to the dining rooms/areas

The glazing to the dining rooms/areas' windows should comprise:

*4 mm outer pane of float glass
6-20 mm cavity
4 mm inner pane of float glass*

The sound reduction index of this construction is:

$$25 \text{ dB } R_w + C_{tr}$$

This exceeds the minimum sound reduction index required which has been calculated as:

$$24 \text{ dB } R_w + C_{tr}$$

1.9 Manufacturers of glass

Pilkington Glass Limited
Prescot Road
St Helens
WA10 3TT

telephone: (01744) 692000

pilkington@respond.uk.com

[Www.pilkington.co.uk](http://www.pilkington.co.uk)

1.10 Conclusion

The results of the noise survey, when calculated using data for double glazing show that the glazing would be sufficient to bring the noise levels within the dwellings to below the maximum design noise levels, provided that the specialist ventilation units are used. If preferred all the glazing could be the same as the worst case; that of the bedrooms.

The garden would be located to the rear of the proposed building and so would be within recommended noise limits.

2 Assessment of the impact of air handling plant for the proposed building on the surrounding residents

2.1 Introduction

This part of the report deals with the noise impact on the surrounding residents of any air handling equipment (air conditioning units and condensers etc.). At the time of writing the types and locations plant have not yet been chosen and so the maximum sound that would not create an adverse impact has been calculated. This could be used to calculate the maximum permissible sound power levels or sound pressure levels measured at a certain distance that the air handling units would emit, given the distance to the façades of the residents and whether or not there would be line of sight.

As shown on the plan on page 13, the nearest residents are a students' hall of residence across the road to the north and residential flats across the road immediately to the east.

The method employed for assessing the likelihood of noise impact is a standard method laid out in BS 4142: 2014: "Methods for rating and assessing industrial and commercial sound".

This British Standard describes a method for determining, at the outside of a building:

(a) sound levels from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises; and

(b) background sound level.

This standard also describes a method for assessing the impact of the sound referred to in (a) on surrounding residents. The likelihood of a sound provoking complaints depends on its level relative to the background sound level and whether or not it has certain tonal or impulsive audible characteristics, such as a distinctive whine, bangs, thumps or clatters. Such sounds are assumed to increase the sound depending how perceptible these sounds are.

The standard states that a sound 10 dB or more greater than background sound would be likely to be an indication of a significant adverse impact.

Around 5 dB would be an adverse impact, whereas a sound equal to background would be a low impact.

2.2 Hours and Mode of operation

It is assumed that the plant could be in operation for 24 hours a day.

2.3 Background sound

A meter was set up in the location shown in the plan of the environs on page 13. As background sound varies little from place to place the precise location of the meter is not significant and is assumed to be the same as the background sound at the surrounding residents.

The background sound was measured and found to be 31 dB $L_{A90,T}$.

See Appendix IV on page 11.

2.4 Prediction of $L_{Aeq,T}$ the specific sound level

Assume that the air handling plant would be no louder than 26 dB $L_{Aeq,T}$ at the façade of the nearest residents.

Assume at this stage that there would be line of sight with the air handling units.

2.5 Subjective description of the sound

It is assumed that the sound emanating from the air handling units would be of rushing air.

BS 4142 states:

Correct the specific sound level if a tone, impulse or other characteristic occurs, or is expected to be present, for new or modified sound sources. Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention.

Tonality

For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of

between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

Assume that tonal sound would be only just perceptible and so a penalty of 2 dB will be added to the specific sound.

Impulsivity

A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

It will be assumed that the sound would not be impulsive and so no penalty will be added to the specific sound.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

It will be assumed that the air handling plant would cut in and out as required so in this case the specific sound would be intermittent and so a penalty of 3 dB for intermittency will be made.

Following guidance in paragraph 9.2 of BS 4142 it is therefore estimated a correction of 2 dB be applied for tonality and 3 dB for impulsivity; a total of a 5 dB character correction.

2.6 Assessment of the sound

The specific sound level has been determined, i.e. the sound at the assessment location.

Using the method given in BS 4142, this is now adjusted by adding 5 dB to allow for the character of the sound to give the rating level.

The background sound is then deducted from the rating level to give an assessment level.

Specific sound level	=	26	dB $L_{Aeq, (15 \text{ min})}$
Character correction	+	5	dB
Rating level	=	31	dB $L_{Ar, (15 \text{ min})}$
Deduct background level	-	31	dB $L_{A90, (15 \text{ min})}$
Assessment level	=	0	dB

Reference to paragraph 11 “Assessment of the impacts” gives the following conclusion:

- a) Typically, the greater this difference, the greater the magnitude of the impact.*
- b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

The rating level would not exceed background sound level. (The assessment level is predicted to be 0 dB) . We can therefore conclude that there is likely to be a low impact on the surrounding residents.

2.7 Conclusion

Following guidance given in BS 4142 we can conclude that there is likely to be a low impact on the surrounding residents provided that the air handling units do not exceed a sound level of 26 dB $L_{Aeq, T}$ at the façade of the nearest residents.

Appendix I: Derivation of the equation for calculation of the sound reduction index of the glazing

In most cases the area of the façade having the lowest sound reduction index will be the glazing; the walls being of brickwork and concrete blockwork having relatively good sound insulation properties and may be discounted. To achieve the noise criteria, given the level of external noise, the sound reduction index of the glazing may be chosen using the following formula (as shown on page 30 of the B.R.E. Publication "Sound Control for Homes" published in 1993):

$$L_1 - L_2 = R - 10 \log S/A \text{ (dB)}$$

where

L_1 is the sound level 2 m outside the façade (dB)

L_2 is the received sound level in the room (dB)

R is the sound reduction index of the façade

S is the surface area of the room façade element (in this case of the window) m^2

A is the absorption in the room (m^2)

For housing design purposes a more simple approach is proposed:

The surface area and area of sound absorption can be ignored. In typically furnished domestic rooms they have little effect on the final result.

A typical external noise spectrum is adopted and the sound insulation of the building envelope described in terms of the difference between outside and inside levels in dB.

Since 1993 the sound reduction index for urban road traffic noise has been adopted (in line with European standards) as the weighted sound reduction plus spectrum adaptation term $R_w + C_{tr}$.

The above equation therefore becomes:

$$R_w + C_{tr} = L_1 - L_2$$

Appendix II: References

Pilkington's literature "Pilkington Optiphon" CI/SfB (31) Ro8 (P2) dated June 2014.

BS EN 12354-3: 2000. Building Acoustics. Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound.

B.R.E. information paper IP6/94. "The sound insulation provided by windows".

B.R.E. Digest No. 266 "Thermal Visual and Acoustic requirements in buildings" 1979

BS 8233: 2014 "British Standard Code of practice for Sound insulation and noise reduction for buildings"

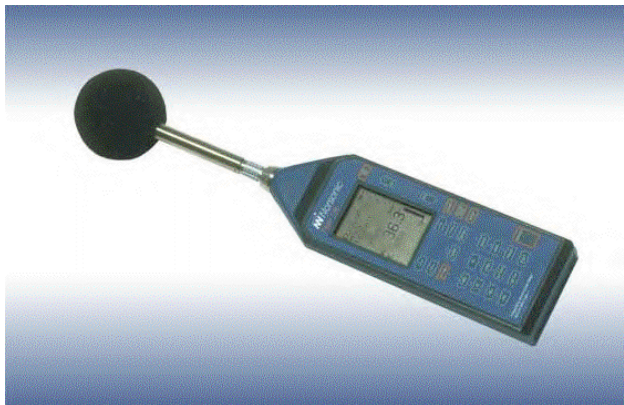
Building Research Establishment and Construction Industry Research and Information Centre "Sound control for homes", 1993.

BS EN ISO 140-3 1985 Laboratory measurements of airborne sound insulation of building elements.

BS EN ISO 717-1 1996 Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation.

Appendix III: Measurement equipment

Sound Level Meter



The background and ambient sound levels were measured using a Norsonic Nor-116 (conforming to class 1 of BS EN 61672-1:2003 *Electroacoustics. Sound Level Meters. Specifications & type 1* of the former standard BS EN 60804) real time sound analyser, with a GRAS-41AL-S weather protected microphone.

The meter was calibrated before & after usage using a type 1 Norsonic Nor-1251 Acoustic calibrator.

These conform with the specification for equipment set out in paragraph 5.1 of BS 4142: 2014.

All levels are measured by the meter accurate to one decimal place of a decibel, however, as recommended in BS 4142, they have been reported to the nearest decibel.

Item	Date of calibration
Meter	9 February 2017
Preamplifier	27 October 2016
Microphone	21 October 2016
Calibrator	16 January 2017

Anemometer



The wind speeds and air temperatures were measured using a using a Perfect Prime New Digital Mini LCD wind speed gauge anemometer meter & temperature thermometer.

Appendix IV: 24 hour sound monitoring survey results

Measurements were made from 11:00 am on Wednesday 26 April 2017 - 11:00 am on Thursday 27 April 2017.

	Before measurements started	After measurements finished
Cloud Cover	80 %	90 %
Air temp.	8 °C	9 °C
Wind speed	Dead calm	Dead calm

The following results were obtained over a 24 hour period:

Location of equipment

The equipment was set up at the position shown on the plan of the environs on page 3.



The following results were obtained over a 24 hour period:

Time of reading	Ambient sound levels L_{Aeq} (15 minutes)	Background sound levels L_{A90} (15 minutes)
	dB	dB
11:00 am - 11:15 am	65	48
11:15 am - 11:30 am	65	48
11:30 am - 11:45 am	68	50
11:45 am - noon	59	49
Noon - 12:15 pm	66	49
12:15 pm - 12:30 pm	58	50
12:30 pm - 12:45 pm	64	48
12:45 pm - 1:00 pm	60	48
1:00 pm - 1:15 pm	59	48
1:15 pm - 1:30 pm	58	49
1:30 pm - 1:45 pm	57	49
1:45 pm - 2:00 pm	57	48
2:00 pm - 2:15 pm	58	48
2:15 pm - 2:30 pm	58	47
2:30 pm - 2:45 pm	59	48
2:45 pm - 3:00 pm	64	49
3:00 pm - 3:15 pm	63	49
3:15 pm - 3:30 pm	67	49
3:30 pm - 3:45 pm	61	51
3:45 pm - 4:00 pm	60	50
4:00 pm - 4:15 pm	62	52
4:15 pm - 4:30 pm	63	52
4:30 pm - 4:45 pm	59	52
4:45 pm - 5:00 pm	58	60
5:00 pm - 5:15 pm	59	49
5:15 pm - 5:30 pm	58	49
5:30 pm - 5:45 pm	65	49
5:45 pm - 6:00 pm	59	50
6:00 pm - 6:15 pm	60	50
6:15 pm - 6:30 pm	60	50
6:30 pm - 6:45 pm	58	53
6:45 pm - 7:00 pm	60	53
7:00 pm - 7:15 pm	58	52
7:15 pm - 7:30 pm	58	51
7:30 pm - 7:45 pm	57	46
7:45 pm - 8:00 pm	57	48
8:00 pm - 8:15 pm	59	48
8:15 pm - 8:30 pm	60	47
8:30 pm - 8:45 pm	58	51
8:45 pm - 9:00 pm	57	51
9:00 pm - 9:15 pm	56	45
9:15 pm - 9:30 pm	56	43
9:30 pm - 9:45 pm	56	44

9:45 pm - 10:00 pm	66	44
10:00 pm - 10:15 pm	57	51
10:15 pm - 10:30 pm	55	44
10:30 pm - 10:45 pm	51	42
10:45 pm - 11:00 pm	56	42
11:00 pm - 11:15 pm	54	40
11:15 pm - 11:30 pm	54	41
11:30 pm - 11:45 pm	52	38
11:45 pm - midnight	52	38
Midnight - 12:15 am	52	38
12:15 am - 12:30 am	51	38
12:30 am - 12:45 am	52	39
12:45 am - 1:00 am	50	38
1:00 am - 1:15 am	51	36
1:15 am - 1:30 am	49	34
1:30 am - 1:45 am	49	34
1:45 am - 2:00 am	47	36
2:00 am - 2:15 am	47	34
2:15 am - 2:30 am	47	32
2:30 am - 2:45 am	47	31
2:45 am - 2:00 am	46	34
3:00 am - 3:15 am	45	35
3:15 am - 3:30 am	47	34
3:30 am - 3:45 am	50	34
3:45 am - 4:00 am	45	33
4:00 am - 4:15 am	47	32
4:15 am - 4:30 am	48	33
4:30 am - 4:45 am	49	38
4:45 am - 5:00 am	50	40
4:00 am - 5:00 am	52	40
5:00 am - 5:15 am	50	39
5:30 am - 5:45 am	53	41
5:45 am - 6:00 am	56	42
6:00 am - 6:15 am	58	41
6:15 am - 6:30 am	63	51
6:30 am - 6:45 am	61	51
6:45 am - 7:00 am	63	52
7:00 am - 7:15 am	63	51
7:15 am - 7:30 am	63	52
7:30 am - 7:45 am	63	50
7:45 am - 8:00 am	61	51
7:00 am - 8:00 am	61	52
8:15 am - 8:30 am	61	51
8:30 am - 8:45 am	61	50
8:45 am - 9:00 am	57	50
9:00 am - 9:15 am	58	49
9:15 am - 9:30 am	58	50
9:30 am - 9:45 am	58	50
9:45 am - 10:00 am	58	50
10:00 am - 10:15 am	57	49
10:15 am - 10:30 am	57	48
10:30 am - 10:45 am	66	50
10:45 am - 11:00 am	61	49

The lowest result will be taken as the design background sound level, i.e.:

$$31 \text{ dB } L_{A90,(15 \text{ minutes})}$$

The day time and night time ambient sound measurements are combined with logarithmic averaging:

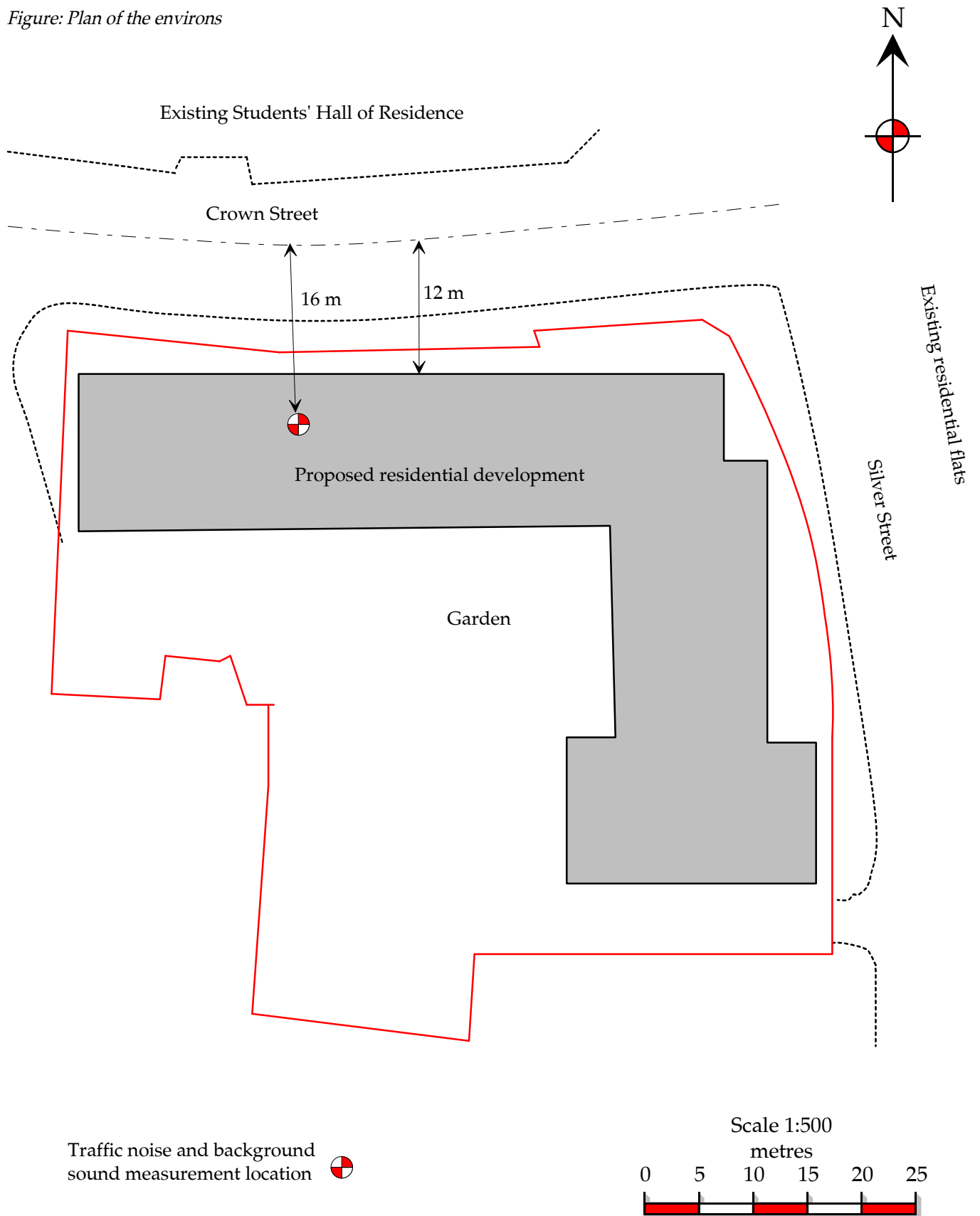
Time	Ambient noise levels
Night time	55 dB $L_{Aeq, 8 \text{ hour}}$
Daytime	61 dB $L_{Aeq, 16 \text{ hour}}$

Calibration

The microphone cartridge is of the free field type, i.e. it has been designed to compensate for its own influence on the sound field. To neutralise this when inserting the cartridge in a closed coupler like the sound calibrator, the meter was adjusted to a value 0.9 dB higher than the calibrator output.

Meter reading with calibrator on before calibration	114.9 dB
Meter reading with calibrator on after calibration and before commencement of measurements	114.9 dB
Meter reading with calibrator on after completion of measurements	114.9 dB

Figure: Plan of the environs



Appendix IV: The author and acoustic consultant

John Waring, Acoustic Consultant



Qualifications of the Acoustic Consultant

B.Sc. in Civil Engineering.
M.Sc. in Acoustics, Vibration and Noise Control.
MIOA full member of the Institute of Acoustics.

Brief Curriculum Vitae of the Acoustic Consultant

The acoustic consultant has been practising since 1989 following a career in the building industry. John Waring was a civil engineer with Gallifords, a technical adviser at Torvale Woodcemair Ltd., and was the technical manager at Kingspan Insulation Ltd.

He currently is, or has been, the acoustic consultant for Hugo Boss, the Wahaca chain of restaurants, Jaguar LandRover, Gala Coral Group bingo halls and casinos, Westons Cider, Hobsons Brewery, Tyrrells Potato Chips, Bentley Motor Cars, Dixons Stores Group, West Midlands Safari Park, GlaxoSmithKline, Ladbrokes, A.D.A.S., Hyder Industrial Limited (now United Green Energy), ThyssenKrupp GmbH, Wiggin Special Metals (Hereford), Interserve, Beacon Radio, Harper Builders, South Shropshire District Council, South Shropshire Housing Association, Wrekin Construction, Somerfield stores, Mowlem Midlands, Costains, Pubmaster, Marston plc brewers, Kendrick Construction, Ladbrokes, Perkins Engines and William Hill bookmakers amongst others.

He has made television appearances as a consultant for both BBC and ITV. He is a limited company operating from Ludlow, covering the entire country.

Appendix V: Revision history

Issue No.	Date	Details
1	4 May 2017	First issue

John Waring

Acoustic Consultant

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