

**Assessment of the Existing Noise Climate in the
Vicinity of the Proposed Residential Development at
Windermere Close, Openshaw, Manchester.**

Report Prepared for:

One Manchester
Lovell House
6 Archway
Manchester
M15 5RN

Report Prepared By:

Robert Smith

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1.0 Summary

Planning permission is being sought to permit the construction of six new bungalows on a rectangular parcel of land located on Windermere Close in Openshaw, Manchester. In support of the planning application, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the proposed residential development.

Using the noise climate data obtained from the surveys, calculations have been performed to provide an indication of the likely internal noise levels within the proposed new bungalows, resulting from external noise break-in. In addition, an assessment of the likely noise climate within the external amenity areas, associated with the bungalows, has also been undertaken.

The noise climate in the vicinity of the proposed residential development on Windermere Close in Openshaw was regarded as being typical of an urban environment that was primarily influenced by road traffic. Additional noise contributions were made by: intermittent noise from the surrounding houses, occasional aircraft overflights, the occasional barking of dogs etc. However, despite its proximity to a major arterial road, the existing noise climate in the vicinity of the proposed development site was not regarded as being particularly noisy.

The results of the calculations have revealed that the internal noise climate, resulting from external noise break-in, within the proposed bungalows would comply with the design guide values, expressed in terms of the L_{Aeq} and L_{Amax} levels, for both the day and night time periods. As a result it is suggested that the sound insulation provided by the building envelope components, detailed in this report, would be sufficient to control the break-in of external noise in compliance with the design values. In addition, it has been demonstrated that the perimeter fences enclosing the rear gardens of the proposed bungalows, would reduce the resulting noise levels within these areas to levels that would comply with the adopted design guide values.

Consequently it is contended that, based on the obtained sound levels from the noise surveys and the application of the sound insulation measures detailed in this report, the existing noise climate in the vicinity of the proposed residential development at Windermere Close should not be regarded as impediment to the granting of planning permission for the proposed residential housing scheme.

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Robert Smith

2.0 Introduction

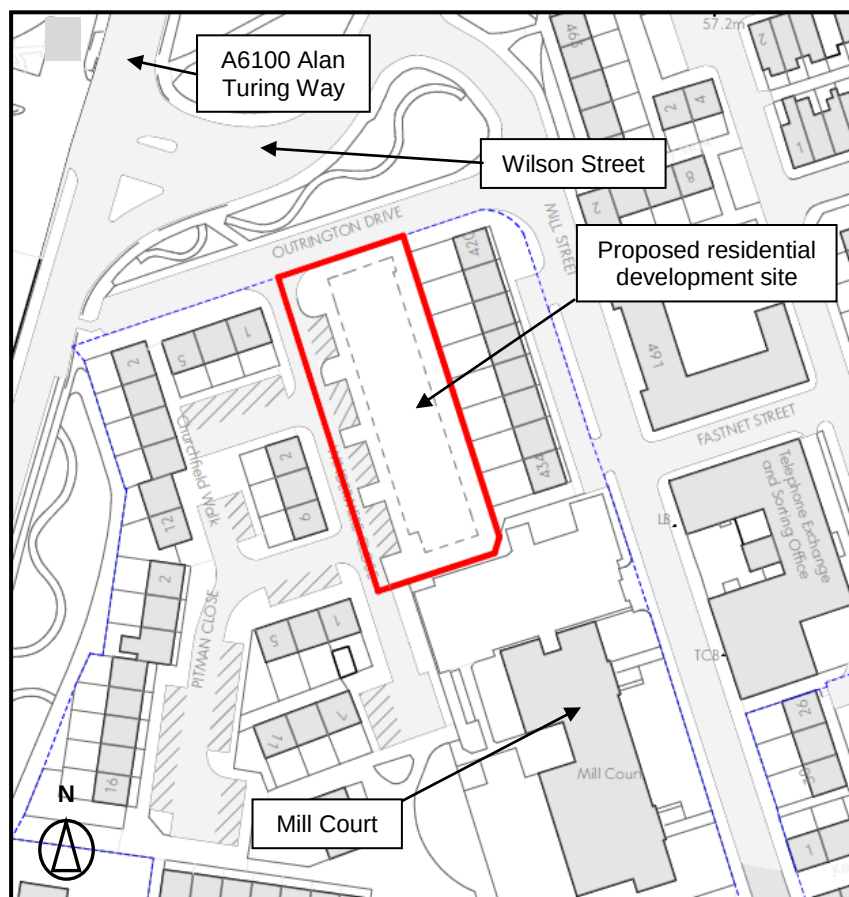
Planning permission is being sought to permit the construction of six new bungalows on a rectangular parcel of land located on Windermere Close in Openshaw, Manchester. In support of the planning application, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the proposed residential development.

Using the noise climate data obtained from the surveys, calculations have been performed to provide an indication of the likely internal noise levels within the proposed new bungalows, resulting from external noise break-in. In addition, an assessment of the likely noise climate within the external amenity areas, associated with the bungalows, has been undertaken.

3.0 Site Description

The proposed new residential development would be built on a rectangular parcel of open land located on Windermere Close in Openshaw, Manchester (figure 1 below and photograph 1 overleaf). Immediately to the north of the proposed development site are Outrington Drive and Wilson Street with the A6010 Alan Turing Way beyond (photograph 2 overleaf). Immediately to the east and west of the proposed development site are the existing properties on Mill Street and Windermere Close respectively (photographs 1 and 3 overleaf). To the south of the proposed development site is the residential apartment block known as Mill Court (photograph 4 overleaf).

Figure 1. Location of the proposed residential development site (edged in red), Windermere Close



Photograph 1. Proposed development site on Windermere Close



Photograph 2. Outrington Drive and Wilson Street with the Alan Turing Way beyond



Photograph 3. Existing residential houses on Windermere Close



Photograph 4. Existing residential apartment development - Mill Court



4.0 Assessment Criteria

As planning permission is currently being sought, no formal planning conditions relating to the acoustic conditions to be achieved within the proposed bungalows currently exist. As a result, guidance relating to the form of the assessment of the existing noise climate in the vicinity of the proposed development site and the evaluation of the likely noise climate within the proposed bungalows, was obtained from Manchester City Council's Planning and Noise Technical Guidance document, published in December 2015.

In addition, the Manchester City Council Technical Guidance document also makes reference to World Health Organisation's (WHO) "Guidelines for Community Noise" document and British Standard (BS) 8233:2014 "Guidance on sound insulation and noise reduction for buildings". As a result, the relevant provisions of these additional documents will be summarised below.

4.1 Manchester City Council's Planning and Noise Technical Guidance

With regard to proposed new residential developments, Manchester City Council's Planning and Noise Technical Guidance document expands on the guidance contained within the Noise Policy Statement for England (NPSE) document (originally released in 2010). The NPSE document provided guidance on 'acceptable' noise levels with particular reference to residential developments, which was framed with reference to avoiding "significant adverse" impacts on health and quality of life and where necessary minimising such "adverse" impacts on health and quality of life.

In order to reflect these objectives the NPSE referenced concepts utilised by the World Health Organisation, which in turn employed two concepts from toxicology and applied them to noise impacts. These two concepts are:

- NOEL – No Observed Effects Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level This is the level above which adverse effects on health and quality of life can be detected.

In addition the NPSE introduced the further concept of a Significant Observed Adverse Effect Level (SOAEL) and defined this as "the level above which significant adverse effects on health and quality of life occur".

With the above in mind the Manchester City Council Technical Guidance document references the guidance contained within other published documents such as the World Health Organisations (WHO) "Guidelines for Community Noise" document published in 1999 and BS 8233:2014 "Guidance on sound insulation and noise reduction for buildings" amongst others. The Manchester City Council Technical Guidance combines elements of these documents to in order to define the internal noise limits that it deems are acceptable for residential properties. The relevant parts of this guidance are summarised in table 1 overleaf.

Table 1. Indoor ambient noise levels for dwellings (reproduced from page 16 of the Manchester City Council Technical Guidance document).

Assessment location	Time of day	$L_{Aeq,T}$	$L_{Amax,F}$
Bedrooms	Night time 2300 - 0700 hours	30dB	45dB*
Living rooms	Daytime 0700 - 2300 hours	35dB	-
Gardens and terraces	Daytime 0700 - 2300 hours	55 dB	-

* Individual noise events should not normally exceed this criterion on more than 15 occasions

The guidance detailed above largely replicates that which is contained within both the World Health Organisation document and BS 8233:2014.

4.2 World Health Organisation Guidance

The WHO “Guidelines for Community Noise” is a comprehensive document that codifies much of the work contained within the earlier “Community Noise” document produced in 1995. The 1999 document includes summaries: the effects of noise on health, guideline values, noise management proposals and recommendations. It is the guideline values on community noise levels, contained in Table 1 of the Executive Summary, that are amongst the most frequently cited elements of the document. For the sake of clarity the sections of this table that are applicable to residential dwellings are reproduced in Table 2 below.

Table 2. Guidelines for noise levels in specific environments (reproduced from Table 1 of the “Guidelines for Community Noise” document, (WHO 1999))

Specific environment	Critical health effect(s)	L_{Aeq} [dB(A)]	Time base [hours]	L_{Amax} fast dB
Outdoor living area	Serious annoyance, daytime and evening.	55	16	-
	Moderate annoyance, daytime and evening.	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening.	35	16	-
Inside bedrooms	Sleep disturbance, night time	30	8	45

It should however be remembered that this is design guidance, it is not a set of rigid criteria. Also, there is the issue that the L_{Amax} criteria which many argue have little relevance in many areas, especially urban environments, where a higher level would certainly be more reasonable.

4.3 BS 8233:2014 “Guidance on Sound Insulation and Noise Reduction for Buildings”

BS 8233:2014 draws together research and best practice relating to building design and provides guidance to facilitate the development of buildings that have internal noise environments that are consistent with, and appropriate for their intended use. The British Standard highlights methods for the control of noise from a number of sources including external noise and building services etc., as well as evaluating the effect that noise from these sources may have on the acoustics of the internal spaces.

With reference to the design guidance relating to the internal noise climate of residential dwellings, BS 8233:2014 summarises this guidance within table 4 of section 7.7.2. The main elements of this guidance are reproduced in table 3 below.

Table 3. Indoor ambient noise levels for dwellings (reproduced from table 4 of BS8233:2014)

Activity	Location	0700 to 2300	2300 to 0700
Resting	Living room	35dB $L_{Aeq, 16 \text{ hour}}$	-
Dining	Dining room/area	40dB $L_{Aeq, 16 \text{ hour}}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq, 16 \text{ hour}}$	30dB $L_{Aeq, 8 \text{ hour}}$

In addition to the internal noise design guidance, BS 8233:2014 also provides guidance on the external noise environment. In this situation BS 8233:2014, at paragraph 7.7.3.2, states the following: "For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise climate does not exceed 50dB $L_{Aeq,T}$ with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments".

With reference to the 2014 version of BS 8233, it must be remembered that the advice contained within this documents is design guidance and the suggested levels are *desirable*. It does not represent a set of rigid criteria, below which a development 'passes' and above which a development 'fails'. Indeed this point is reinforced in section 7.7.2 of BS 8233:2014 which states "In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guidance values in table 4". Further in note 7 of table 4 in section 7.7.2 it is suggested that "where development is considered as necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved".

5.0 Survey Details

5.1 Survey Times and Personnel

The surveys to evaluate the existing noise climate in the vicinity of the proposed residential development on Windermere Close were undertaken between: 16:00- 19:00 hours on the 20th August 2019, between 07:30 - 09:30 hours on the 21st August 2019 and between 16:00 - 19:00 hours on the 23rd - 24th August 2019.

All measurements were fully attended for the duration of the surveys and all survey work was conducted by Mr. R Smith of Druk Limited.

5.2 Weather

Throughout the assessments of the existing noise climate in the vicinity of the proposed residential development, the weather conditions were as follows:

20th August, afternoon

All surfaces were dry, cloud cover was approximately 80%, the temperature was approximately 19°C, the wind speed was approximately 0.4m/s and the barometric pressure was 1015mb.

21st August, night time

All surfaces were damp, the sky was overcast, the temperature was approximately 15°C, the wind speed was less than 0.3m/s and the barometric pressure was 1007mb.

23rd - 24th August, Morning

All surfaces were dry, the sky was clear, the temperature was approximately 19°C, the wind speed was less than 0.3m/s and the barometric pressure was 1013mb.

5.3 Equipment

The noise surveys were conducted using the equipment detailed in the table 4 below.

The sound level meter was field calibrated before, after and during the surveys as necessary, during which time no significant deviation in the calibrated levels was observed.

All the equipment used is calibrated by a UKAS accredited calibration laboratory and the calibration certificates are available on request.

Table 4. Equipment used during the noise surveys

Equipment description	Manufacturer	Model number	Serial number
Sound level meter	Norsonic AS	Nor 140	1402738
Microphone pre-amplifier	Norsonic AS	Nor 1209	12075
Microphone	Norsonic AS	Nor 1225	72843
Acoustic calibrator	Norsonic AS	Nor 1251	31522

5.4 Measurement Procedure

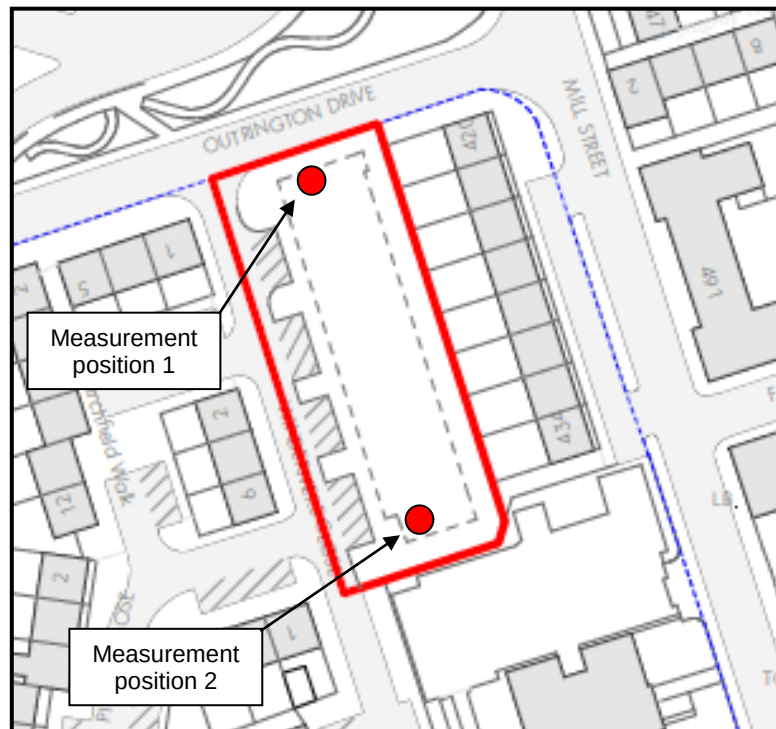
The location of the proposed residential development suggested that the principal contributor to the exiting noise climate would be road traffic, primarily on the Alan Turing Way but also on the local roads surrounding Windermere Close. An initial 'walkover' survey of the proposed development site indicated that there was some variation in the noise climate between the northern (closer to Outrington Drive and the Alan Turing Way) and the southern (closer to Mill Court) ends of the proposed development site.

As a consequence the assessment of the existing noise climate on the proposed development site was undertaken using two measurement positions. All the measurements were made with one sound level meter that was used alternately in the

two measurement positions. The approximate location of the measurement positions is detailed on figure 2 below.

Throughout the survey periods, the measurement time interval was 10 minutes. All the measurements were made alternately in the two positions such that three measurements per hour were obtained in each position. All the measurements were made with the fast time weighting engaged.

Figure 2. The proposed development site detailing the approximate location of the measurement positions



6.0 Noise Survey Results

The noise climate in the vicinity of the proposed residential development on Windermere Close was regarded as being typical of an urban environment that was primarily influenced by road traffic. However, despite its proximity to a major arterial route, the existing noise climate in the vicinity of the proposed development site was not regarded as being particularly noisy.

The following paragraphs contain qualitative descriptions of the noise sources noted during the survey periods. As the existing noise climate in both positions was of essentially the same character, the commentary presented in the following paragraphs is applicable to both positions.

6.1 Qualitative Assessment, Afternoon Period

As anticipated, the principal contributor to the existing noise climate in the vicinity of the proposed development site was road traffic, primarily on the Alan Turing Way but also on the local roads. The road traffic comprised mainly private cars although a number of buses, light and heavy goods vehicles and emergency ambulances and police cars were also noted. During the afternoon period the flow of traffic on the Alan Turing Way remained very steady and relatively freely flowing. Despite this a very slight increase in the volume of traffic was noted between 17:00 – 18:00 hours.

Turning to the traffic on the surrounding roads, Wilson and Mill Streets were comparatively busier than Outrington Drive and Windermere Close. In all cases the vehicles on the local roads comprised either private cars or taxis.

Additional noise sources noted included: intermittent noise from the surrounding houses including some DIY type noise, occasional aircraft overflights, occasional dog barking noise and noise from birds including both birdsong and the screeching of gulls.

6.2 Qualitative Assessment, Morning Period

The existing noise climate during this period was essentially the same as that experienced during the afternoon period, with road traffic noise again representing the principal noise source. As was previously the case, private cars represented the dominant class of vehicle, although there appeared to be slightly more buses on the Alan Turing Way at this time than was the case during the afternoon period. The volume of traffic was again very consistent throughout the survey period.

Additional noise sources during this period included aircraft overflights, emergency vehicle sirens and noise from birds. Very little if any noise from the surrounding residential dwellings was audible in either position during this period.

6.3 Qualitative Assessment, Night time Period

Once again, the principal contributor to the existing noise climate was road traffic, primarily on the Alan Turing Way, that again comprised mainly private cars although a few buses were also noted. During the course of the night time survey two sustained periods of emergency vehicle activity, on the Alan Turing Way, occurred between 23:00 - 23:15 and again between 00:20 - 00:30 hours.

Additional noise sources during this period included occasional aircraft overflights, barking dogs, some music noise from the surrounding houses and what sounded like distant train noise.

6.4 Basic Results

The measured noise levels from the two measurement positions are detailed in tables 3 - 8 below and overleaf. With reference to measured noise levels from both measurement positions, these are presented in terms of the L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} parameters. Full data are presented in tabular form in Appendix 1.

Table 3. Measured noise levels, position 1, afternoon period

Start time	dB L_{Aeq} , (10 minutes)	dB L_{Amax} , (10 minutes)	dB L_{A10} , (10 minutes)	dB L_{A90} , (10 minutes)
1600	58	72	61	53
1620	58	69	61	51
1640	57	67	60	51
1700	58	69	61	51
1720	58	76	60	51
1740	58	77	61	52
1800	58	76	61	50
1820	57	72	60	49
1840	57	68	60	49
Standard deviation	0.61	3.77	0.50	1.19

Table 4. Measured noise levels, position 1, morning period

Start time	dB L_{Aeq} , (10 minutes)	dB L_{Amax} , (10 minutes)	dB L_{A10} , (10 minutes)	dB L_{A90} , (10 minutes)
0730	59	68	62	51
0750	59	73	62	53
0810	59	68	62	53
0830	59	79	62	53
0850	59	70	62	53
0910	58	68	61	52
Standard deviation	0.37	4.50	0.27	0.66

Table 5. Measured noise levels, position 1, night time period

Start time	dB $L_{Aeq,1}$ (10 minutes)	dB $L_{Amax,1}$ (10 minutes)	dB $L_{A10,1}$ (10 minutes)	dB $L_{A90,1}$ (10 minutes)
2300	56	73	59	47
2320	54	71	58	47
2340	53	65	57	46
0000	53	65	57	46
0020	53	69	58	45
0040	54	66	57	47
Standard deviation	0.94	3.35	0.75	0.72

Table 6. Measured noise levels, position 2, afternoon period

Start time	dB $L_{Aeq,1}$ (10 minutes)	dB $L_{Amax,1}$ (10 minutes)	dB $L_{A10,1}$ (10 minutes)	dB $L_{A90,1}$ (10 minutes)
1610	54	71	56	49
1630	53	62	56	50
1650	54	69	57	49
1710	54	67	57	50
1730	53	66	55	49
1750	53	68	55	48
1810	55	79	57	48
1830	52	67	55	46
1850	52	66	54	46
Standard deviation	0.99	4.75	0.96	1.26

Table 7. Measured noise levels, position 2, morning period

Start time	dB L_{Aeq} , (10 minutes)	dB L_{Amax} , (10 minutes)	dB L_{A10} , (10 minutes)	dB L_{A90} , (10 minutes)
0740	52	60	55	48
0800	53	65	56	50
0820	53	64	55	50
0840	53	65	56	50
0900	53	75	55	49
0920	53	65	55	49
Standard deviation	0.45	4.84	0.55	0.64

Table 8. Measured noise levels, position 2, night time period

Start time	dB L_{Aeq} , (10 minutes)	dB L_{Amax} , (10 minutes)	dB L_{A10} , (10 minutes)	dB L_{A90} , (10 minutes)
2310	49	60	52	45
2330	49	61	52	45
2350	49	60	51	44
0010	48	60	51	43
0030	49	65	51	43
0050	48	63	51	44
Standard deviation	0.44	1.86	0.50	0.84

As can be seen from the above tables, the measured noise levels from the surveys demonstrate little deviation, in terms of the L_{Aeq} , L_{A10} and L_{A90} parameters, in either position over the measurement periods. This fact suggests that the existing noise climate was primarily influenced by a relatively steady noise source namely, road traffic. With reference to the L_{Amax} noise levels at this time, these were a consequence of individual noise sources.

7.0 Noise Transmission Calculations

Using the measured noise levels from the noise surveys, calculations have been undertaken to assess the likely internal noise levels within the proposed bungalows. The calculations have been undertaken using the façade elements detailed in the following paragraphs.

The proposed bungalows will utilise a low energy building specification and will be arranged in two blocks of three bungalows. The layouts and dimensions of the bungalows have been obtained from drawings issued by GWP Architects of Lidgett Lane, Leeds. The assessment of the potential internal noise levels, resulting from external noise break-in, within the proposed bungalows will be undertaken using the highest measured noise levels from the surveys and these levels are detailed in table 9 below. Consequently the subsequent assessments may be regarded as representing a worst case.

Table 9. Highest measured noise levels, Windermere Close, Openshaw, Manchester

OBCF, Hz*	63	125	250	500	1k	2k	4k	8k	Overall, dB(A)
P1, Daytime, L_{Aeq} (07:30 - 07:40 hours)	66	61	57	54	56	50	41	32	59
P1, Night time, L_{Aeq} (23:00 - 23:10 hours)	60	58	52	49	52	48	42	30	56
P1, Night time, L_{Amax} (23:20 - 23:30 hours)	71	75	66	63	68	68	63	52	73
P2, Daytime, L_{Aeq} (18:10 - 18:20 hours)	63	57	54	50	51	45	37	35	55
P2, Night time, L_{Aeq} (23:30 - 23:40 hours)	61	55	47	44	46	40	28	18	49
P2, Night time, L_{Amax} (00:30 - 00:40) hours	77	77	67	54	55	50	51	43	65

The sound insulation of a building envelope is calculated from the sound insulation provided by the various façade elements, such as the glazing, external walls etc., and the areas they cover. In the majority of cases it is the glazing that can be considered as the 'weak' link acoustically; therefore increasing the sound insulation of the glazing will improve the overall sound insulation of the façade. The result of the calculation is a composite sound insulation value for the whole façade.

The calculations are based on dimensions and layouts derived from drawings issued by GWP Architects of Lidgett Lane, Leeds. In addition to the internal and façade dimensions obtained from the drawings the following assumptions have been made:

- The reverberation times within the living rooms and bedrooms will be 0.5 seconds.
- The floor to ceiling height will be approximately 2.4 metres in the majority of locations.

The scheme drawings indicate that the proposed development will comprise six new two bedroom bungalows of the same design, arranged in two blocks of three bungalows. The proposed internal layout of the bungalows is reproduced in figure 1 in Appendix 2. As a result, calculations have been undertaken for bungalows using the highest measured levels from both measurement positions. In this way it is believed that the calculations will be representative of the likely situation across the entire proposed development site.

7.1 Construction Specification

The building envelope constructional details described below and overleaf have been utilised for the purposes of the subsequent calculations.

External Walls

The external walls of the bungalows will consist of a timber frame structure comprising an 89 x 38mm CLS timber frame filled with 70mm rigid PIR insulation and lined with one layer of 9mm OSB board and one layer of 12.5mm plasterboard separated from the brick outer leaf by a 125mm cavity. Test results for a similar construction suggest that external walls of this type should provide an overall sound insulation value of around R_w 55dB, with the octave band sound insulation values being as detailed in table 10 below.

Table 10. Timber Frame External Wall Construction, Octave Band Sound Insulation Values

OBCF, Hz*	125	250	500	1k	2k	4k	Overall, R_w dB(A)
Sound Insulation, dB	40	47	53	62	70	74	55

* Octave Band Centre Frequency

Glazing

The assessments have been based on the application of sealed unit triple glazing to all the windows. The glazing specification used in the calculations is as follows:

- 4mm pane - 12/16mm cavity - 4mm pane – 12/16mm cavity – 4mm pane.

Laboratory data obtained from Pilkington and on site test data suggest that this configuration should provide sound insulation values of at least 32dB R_w in the closed position. The applied octave band sound insulation values are as detailed in table 11 below. Alternative glazing configurations would be acceptable providing the sound insulation performances are at least equivalent to the specifications detailed in table 11 below.

Table 11. Proposed glazing, octave band sound insulation values

OBCF, Hz*	125	250	500	1k	2k	4k	Overall, R_w dB
4mm pane - 12/16mm cavity - 4mm pane – 12/16mm cavity – 4mm pane	21	20	31	39	37	47	32

* Octave Band Centre Frequency

Ventilation

It is proposed that the bungalows will be provided with full mechanical ventilation system incorporating heat recovery (MVHR). As a consequence there will be no need for the provision of window frame mounted or through the wall ventilators to provide background ventilation. This is significant as openings in the building envelope, such as trickle ventilators, can be regarded as being acoustically weak areas. Consequently, the omission of such elements will serve to preserve the sound insulation integrity of the external building envelope.

As a result of the adoption of an MHVR system, the proposed ventilation provision would comply with the advice given in note 5 to paragraph 7.7.2 of BS8233:2014, which states the following: "...there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level".

Despite this it would be prudent, where possible, to locate the intake and exhaust terminations of such systems on the quieter façades of the proposed bungalows or provide them with suitable attenuators, where necessary, to minimise the ingress of external noise. Where duct attenuators are to be provided it is not uncommon to specify that they achieve similar sound insulation values to that provided by the windows. It may however be prudent to engage an M & E contractor to undertake an assessment of the likely noise levels that would prevail at the room terminations.

7.2 Calculation Results

The proposed development will comprise six bungalows of the same design. As a result, calculations have been performed to evaluate the likely internal noise climate resulting from external noise break-in, using the highest measured noise levels from both positions 1 and 2. The results of the break-in noise calculations for the proposed bungalows are presented in terms of the day and night time, as appropriate, L_{Aeq} and L_{Amax} levels in tables 12 and 13 below and overleaf. With respect to the calculations relating to the night time situation, the L_{Aeq} and L_{Amax} results are presented in the same columns with the L_{Amax} results being contained in brackets. Full data are available in Appendix 3.

Table 12. Calculated internal noise levels, 2 bedroom 3 person bungalow, position 1 noise levels

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq} and (L_{Amax})	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Living/kitchen/dining room	35	29	-	-
Bedroom 1	35	26	30 (45)	21 (36)
Bedroom 2	35	25	30 (45)	21 (36)

Table 13. Calculated internal noise levels, 2 bedroom 3 person bungalow, position 2 noise levels

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq} and (L_{Amax})	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Living/kitchen/dining room	35	26	-	-
Bedroom 1	35	22	30 (45)	18 (38)
Bedroom 2	35	22	30 (45)	17 (37)

The calculated internal noise levels contained in the above tables have highlighted that the resulting internal noise levels within the proposed bungalows, expressed in terms of the L_{Aeq} and L_{Amax} levels, would comply with the design guide values contained within section 4 above for both the day and night time periods. As a result it is suggested that the sound insulation provided by the building envelope components, detailed in this report, would be sufficient to control the 'break-in' of external noise in compliance with these design values.

Consequently, it is contended that it will not be necessary to apply any additional sound insulation measures, beyond those specified within this report, to the building envelope in order to ensure compliance with the stated design guide values relating to the internal noise environment within the proposed bungalows. As a result, it is suggested that the existing noise climate should not be regarded as an impediment to the granting of planning permission for the bungalows.

7.3 External Amenity Areas

In addition to the noise levels within the proposed bungalows, section 4.0 above also provides guidance for external amenity areas, expressed in terms of a desirable noise environment specified in terms of the L_{Aeq} parameter. The Manchester City Council's Planning and Noise Technical Guidance specifies a design target are 55dB $L_{Aeq,T}$ for the period between 0700 - 2300 hours, for external amenity areas. The guidance contained within BS 8233:2014 specifies design targets of 50dB $L_{Aeq,T}$ with an upper guideline value of 55dB $L_{Aeq,T}$, which would be acceptable in noisier environments.

The proposed site layout, detailed on figure 2 in Appendix 2, indicates that the proposed bungalows would be provided with rear gardens. In most cases, it is the garden to the rear of a dwelling that is often considered to have the principal amenity value and this will be assumed to be the case for this proposed development. In addition it is often assumed that the noise climate during the afternoon into the early evening periods would be of most relevance to the use of any garden serving a residential dwelling

Turning to the assessment of the existing noise climate, the measured noise levels from Windermere Close indicate that the daytime noise levels from position 1 would exceed the suggested upper limit of 55dB $L_{Aeq,T}$, whereas the measured levels from position 2 would not. The average of the measured noise levels from the afternoon measurement period are detailed in table 14 overleaf.

Table 14. Average daytime (afternoon) noise levels, Windermere Close

Measurement position	Period	Average noise level, dB $L_{Aeq,T}$
Position 1	16:00 - 19:00 hours	58
Position 2	16:00 - 19:00 hours	53

The perspective representation of the proposed development, detailed on figure 3 in Appendix 2, indicates that the bungalows would be provided with perimeter fences completely enclosing the rear gardens. These fences would be expected to provide a degree of acoustic shielding to the back gardens of the proposed bungalows, so reducing the noise levels within the rear gardens. The potential degree of acoustic shielding provided by the fences will be evaluated further.

The principal noise source affecting the existing noise climate in the vicinity of Windermere Close is road traffic, from the roads to the north and north west of the proposed development site. In this respect it would be the bungalows to the northern end of the site, close to measurement position 1, which would be exposed to the highest noise levels. As a result of the fact that the principal noise source affecting the proposed development site is road traffic, the evaluation will be based on the application of the procedures detailed in the Calculation of Road Traffic Noise Procedure (CRTN). This evaluation will incorporate the beneficial shielding provided by the fences surrounding the rear gardens. For the purposes of this assessment, the following assumptions have been made:

- The source height will be 0.5 metres.
- The height of the perimeter fence will be 1.8 metres.
- The height of the receiver, a seated person in the centre of the garden, will be 1.3 metres.
- The centre point of the rear garden serving the bungalow closest to Outrington Drive, will be approximately 9 metres from the centre point of Outrington Drive.
- The intervening ground is essentially flat.
- The fence will be located approximately 4.5 metres from the noise source.
- The receiver would be 4.5 metres from the fence.

Applying these assumptions it is suggested that the path difference (δ) resulting from the intervening perimeter fence surrounding the rear gardens would be approximately 0.18 metres. Applying the suggested barrier correction from Chart 9B of CRTN, a path difference of this order would result in an overall reduction in the source noise level of about 10dB. Applying this suggested reduction to the highest measured afternoon noise level from position one, 58dB(A), it can be seen that the resulting level would be around 48dB within the rear garden of the house closest to Outrington Drive and the other roads beyond. Noise levels of this order in the rear garden serving the bungalow at the northern end of the proposed development site would comply with adopted guide values of 50dB $L_{Aeq,T}$ with an upper guideline value of 55dB $L_{Aeq,T}$, contained within Manchester City Council's Planning and Noise Technical Guidance and BS 8233:2014. The noise levels in the remaining rear gardens serving the other bungalows would be expected to be lower by virtue of both the screening provided by the fences and the increased separation distance from the source.

It should however be remembered that in order to prove effective, the fence should be produced from material with a mass of at least 20kg/m^2 and be imperforate along its length. In this respect a close boarded timber fence would be acceptable.

As before, it is contended that the existing local noise climate in the vicinity of the proposed residential development on the site, and the potential effect this may have on external amenity areas serving the proposed bungalows, should not be regarded as an impediment to the granting of planning permission.

8.0 Conclusion

The noise climate in the vicinity of the proposed residential development on Windermere Close in Openshaw was regarded as being typical of an urban environment that was primarily influenced by road traffic. Additional noise contributions were made by intermittent noise from the surrounding houses, occasional aircraft overflights, occasional dog barking noise etc.

The calculations have revealed that the internal noise climate, resulting from external noise break-in, within the proposed bungalows would comply with the design guide values, expressed in terms of the L_{Aeq} and L_{Amax} levels, for both the day and night time periods. As a result it is suggested that the sound insulation provided by the building envelope components, detailed in this report, would be sufficient to control the break-in of external noise in compliance with these design values. In addition it has been demonstrated that the provision of perimeter fences to the rear gardens of the proposed bungalows would reduce the resulting noise levels within these spaces, in compliance with the adopted design guide values.

Consequently it is contended that, based on the obtained sound levels from the noise surveys and the application of the sound insulation measures detailed in this report, the existing noise climate in the vicinity of the proposed residential development at Windermere Close should not be regarded as impediment to the granting of planning permission for the proposed residential housing scheme.

Appendix 1. Existing Noise Climate Survey Results

Windermere Close, Openshaw												
Existing noise climate survey												
Afternoon 20 th August 2019. Position 1												
Octave Band Centre Frequency, Hz.		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
1600												
<i>L</i> _{Aeq}		58	65	66	59	57	54	56	49	39	29	22
<i>L</i> _{max}		72	76	79	73	69	71	68	64	55	46	49
<i>L</i> ₁₀		61	67	69	61	59	56	59	51	41	31	21
<i>L</i> ₉₀		53	61	61	56	53	48	50	43	33	22	13
1620												
<i>L</i> _{Aeq}		58	65	66	60	57	53	56	48	40	31	19
<i>L</i> _{max}		69	83	77	69	65	65	66	58	53	55	38
<i>L</i> ₁₀		61	68	69	62	59	56	59	51	43	32	20
<i>L</i> ₉₀		51	60	61	55	51	46	48	41	32	23	13
1640												
<i>L</i> _{Aeq}		57	64	66	61	56	52	55	47	38	27	19
<i>L</i> _{max}		67	78	81	73	65	61	65	55	51	44	44
<i>L</i> ₁₀		60	67	69	63	59	55	58	50	40	29	17
<i>L</i> ₉₀		51	60	61	55	51	46	48	41	31	21	13
1700												
<i>L</i> _{Aeq}		58	64	68	64	57	52	55	49	41	34	22
<i>L</i> _{max}		69	78	85	78	68	61	63	62	55	56	43
<i>L</i> ₁₀		61	67	69	67	60	55	58	51	43	33	23
<i>L</i> ₉₀		51	60	61	56	50	46	48	40	31	20	12
1720												
<i>L</i> _{Aeq}		58	64	65	60	57	53	55	48	40	30	17
<i>L</i> _{max}		76	73	74	70	69	71	75	62	58	52	40
<i>L</i> ₁₀		60	66	68	62	59	55	57	49	41	30	18
<i>L</i> ₉₀		51	60	62	56	51	46	48	41	32	20	12
1740												
<i>L</i> _{Aeq}		58	65	66	61	57	55	55	47	41	36	28
<i>L</i> _{max}		77	74	77	73	65	78	69	63	64	62	55
<i>L</i> ₁₀		61	67	69	63	59	56	58	50	43	36	29
<i>L</i> ₉₀		52	61	61	56	52	47	48	41	33	23	12
1800												
<i>L</i> _{Aeq}		58	64	66	61	56	54	55	48	38	28	19
<i>L</i> _{max}		76	75	76	71	71	72	73	69	56	48	42
<i>L</i> ₁₀		61	67	69	64	59	55	59	50	41	31	19
<i>L</i> ₉₀		50	59	61	55	49	45	48	40	30	20	12
1820												
<i>L</i> _{Aeq}		57	62	64	58	55	52	54	46	37	28	18
<i>L</i> _{max}		72	73	75	66	68	74	65	55	57	53	45
<i>L</i> ₁₀		60	65	67	61	58	54	58	49	41	30	18
<i>L</i> ₉₀		49	58	59	54	49	44	46	38	27	16	11
1840												
<i>L</i> _{Aeq}		57	61	65	59	56	51	55	46	37	27	15
<i>L</i> _{max}		68	71	79	73	71	64	62	56	50	45	32
<i>L</i> ₁₀		60	63	67	61	58	54	58	49	40	30	17
<i>L</i> ₉₀		49	58	59	53	50	44	46	39	30	19	12

Windermere Close, Openshaw												
Existing noise climate survey												
Morning 21 st August 2019. Position 1												
Octave Band Centre Frequency, Hz.		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
0730												
<i>L</i> _{Aeq}		59	64	66	61	57	54	56	50	41	32	24
<i>L</i> _{max}		68	73	79	71	67	63	62	58	60	54	48
<i>L</i> ₁₀		62	67	69	64	60	57	59	53	44	34	24
<i>L</i> ₉₀		51	61	60	55	50	46	48	42	32	23	14
0750												
<i>L</i> _{Aeq}		59	65	68	61	58	54	56	50	43	37	21
<i>L</i> _{max}		73	74	80	71	67	66	70	64	62	60	43
<i>L</i> ₁₀		62	68	70	64	61	57	59	53	46	36	22
<i>L</i> ₉₀		53	61	61	56	52	48	50	43	33	22	13
0810												
<i>L</i> _{Aeq}		59	69	68	62	58	54	55	49	41	35	21
<i>L</i> _{max}		68	78	85	71	70	65	63	56	52	53	38
<i>L</i> ₁₀		62	73	71	64	62	57	59	52	45	38	23
<i>L</i> ₉₀		53	62	62	56	52	48	50	43	34	24	14
0830												
<i>L</i> _{Aeq}		59	66	68	63	58	54	56	51	43	35	29
<i>L</i> _{max}		79	78	85	77	75	78	75	70	66	56	53
<i>L</i> ₁₀		62	68	71	65	61	57	59	53	45	37	26
<i>L</i> ₉₀		53	61	62	57	52	48	49	44	34	23	15
0850												
<i>L</i> _{Aeq}		59	66	68	61	57	54	56	49	41	33	39
<i>L</i> _{max}		70	83	82	71	66	64	65	56	54	49	71
<i>L</i> ₁₀		62	69	71	63	60	57	59	52	45	36	25
<i>L</i> ₉₀		53	61	61	57	52	48	50	44	34	23	13
0910												
<i>L</i> _{Aeq}		58	66	66	61	57	53	55	49	41	31	20
<i>L</i> _{max}		68	80	79	70	67	62	65	59	53	48	38
<i>L</i> ₁₀		61	69	68	63	60	56	59	52	44	35	23
<i>L</i> ₉₀		52	61	61	57	53	48	49	43	35	24	14

Windermere Close, Openshaw												
Existing noise climate survey												
Night time 23 rd - 24 th August 2019. Position 1												
Octave Band Centre Frequency, Hz.	dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k	
2300												
L_{Aeq}	56	57	60	58	52	49	52	48	42	30	22	
L_{max}	73	70	71	75	66	63	68	68	63	52	52	
L_{10}	59	59	63	59	56	53	56	50	41	28	19	
L_{90}	47	53	56	52	45	43	44	36	21	14	13	
2320												
L_{Aeq}	54	59	61	56	54	51	51	44	34	27	21	
L_{max}	71	72	70	69	74	72	61	56	52	55	47	
L_{10}	58	61	63	59	56	53	55	48	38	27	18	
L_{90}	47	55	56	51	46	43	44	36	23	14	12	
2340												
L_{Aeq}	53	58	60	54	52	49	50	44	34	23	18	
L_{max}	65	73	72	63	61	59	62	56	51	44	43	
L_{10}	57	60	63	57	55	52	54	47	39	27	17	
L_{90}	46	54	56	51	46	42	44	35	22	15	12	
0000												
L_{Aeq}	53	58	60	54	52	49	50	44	34	23	18	
L_{max}	65	73	72	63	61	59	62	56	51	44	43	
L_{10}	57	60	63	57	55	52	54	47	39	27	17	
L_{90}	46	54	56	51	46	42	44	35	22	15	12	
0020												
L_{Aeq}	53	58	60	55	52	49	51	44	36	27	20	
L_{max}	69	71	73	67	69	65	64	62	53	46	43	
L_{10}	58	60	62	58	56	53	55	48	39	28	21	
L_{90}	45	54	56	51	45	41	42	33	21	14	13	
0040												
L_{Aeq}	54	57	60	54	52	49	51	44	34	25	22	
L_{max}	66	71	71	61	61	62	64	58	49	41	46	
L_{10}	57	60	62	56	56	53	55	48	38	28	22	
L_{90}	47	53	56	50	45	42	44	36	23	16	12	

Windermere Close, Openshaw												
Existing noise climate survey												
Afternoon 20 th August 2019. Position 2												
Octave Band Centre Frequency, Hz.		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
1610												
<i>L</i> _{Aeq}		54	64	63	59	53	49	51	44	34	23	16
<i>L</i> _{max}		71	77	73	71	69	67	63	67	62	51	45
<i>L</i> ₁₀		56	67	66	62	56	51	53	46	35	23	14
<i>L</i> ₉₀		49	59	59	53	47	44	47	38	25	16	11
1630												
<i>L</i> _{Aeq}		53	62	63	57	51	47	50	44	41	30	15
<i>L</i> _{max}		62	74	71	71	64	53	55	52	52	47	32
<i>L</i> ₁₀		56	64	65	59	52	49	52	46	46	35	18
<i>L</i> ₉₀		50	59	60	53	47	44	47	40	27	16	13
1650												
<i>L</i> _{Aeq}		54	63	63	59	54	50	51	44	36	23	14
<i>L</i> _{max}		69	74	73	77	72	66	56	56	56	43	37
<i>L</i> ₁₀		57	66	65	63	57	51	54	47	37	25	14
<i>L</i> ₉₀		49	58	59	53	46	44	46	39	28	18	12
1710												
<i>L</i> _{Aeq}		54	64	63	60	54	49	51	44	33	22	14
<i>L</i> _{max}		67	79	71	76	71	63	58	53	50	45	40
<i>L</i> ₁₀		57	66	66	62	56	51	54	46	35	23	14
<i>L</i> ₉₀		50	60	60	54	48	45	47	39	27	16	11
1730												
<i>L</i> _{Aeq}		53	62	63	57	51	48	50	43	33	23	15
<i>L</i> _{max}		66	77	73	71	61	64	60	57	51	46	34
<i>L</i> ₁₀		55	64	65	59	53	50	52	46	35	25	17
<i>L</i> ₉₀		49	59	59	53	47	44	46	39	28	16	11
1750												
<i>L</i> _{Aeq}		53	62	62	58	52	47	50	43	33	25	16
<i>L</i> _{max}		68	72	73	70	62	60	66	54	53	43	36
<i>L</i> ₁₀		55	64	65	60	55	49	52	45	35	27	18
<i>L</i> ₉₀		48	58	57	52	46	43	46	38	26	15	11
1810												
<i>L</i> _{Aeq}		55	63	63	57	54	50	51	45	37	35	27
<i>L</i> _{max}		79	76	77	69	68	66	77	71	62	63	54
<i>L</i> ₁₀		57	65	65	60	57	54	53	46	36	28	18
<i>L</i> ₉₀		48	58	58	52	47	43	45	38	26	15	11
1830												
<i>L</i> _{Aeq}		52	61	61	56	54	47	49	42	32	23	14
<i>L</i> _{max}		67	77	77	69	69	65	60	57	53	43	31
<i>L</i> ₁₀		55	63	63	58	57	49	51	45	33	25	16
<i>L</i> ₉₀		46	56	57	52	46	41	44	35	23	13	11
1850												
<i>L</i> _{Aeq}		52	60	64	56	51	45	49	43	34	22	15
<i>L</i> _{max}		66	69	81	69	60	57	62	61	52	47	42
<i>L</i> ₁₀		54	63	65	58	54	48	51	45	33	22	14
<i>L</i> ₉₀		46	56	57	50	45	41	44	36	24	14	11

Windermere Close, Openshaw												
Existing noise climate survey												
Morning 21 st August 2019. Position 2												
Octave Band Centre Frequency, Hz.		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
0740												
<i>L</i> _{Aeq}		52	61	62	56	51	47	49	43	33	25	14
<i>L</i> _{max}		60	70	72	69	60	54	56	50	49	44	36
<i>L</i> ₁₀		55	63	65	58	53	49	52	46	36	27	16
<i>L</i> ₉₀		48	58	58	52	46	43	46	39	27	15	11
0800												
<i>L</i> _{Aeq}		53	63	63	58	54	49	50	43	34	25	16
<i>L</i> _{max}		65	76	74	70	66	62	55	54	56	51	42
<i>L</i> ₁₀		56	65	65	61	57	52	52	46	36	26	15
<i>L</i> ₉₀		50	59	59	53	48	45	47	40	28	16	12
0820												
<i>L</i> _{Aeq}		53	63	62	56	51	48	50	44	36	28	19
<i>L</i> _{max}		64	77	77	69	58	57	55	54	58	53	45
<i>L</i> ₁₀		55	65	65	58	53	49	52	46	37	28	18
<i>L</i> ₉₀		50	58	58	52	48	45	47	40	30	18	12
0840												
<i>L</i> _{Aeq}		53	62	62	57	53	49	50	44	33	22	15
<i>L</i> _{max}		65	71	70	67	65	64	60	51	53	47	37
<i>L</i> ₁₀		56	64	64	59	56	51	52	46	35	24	15
<i>L</i> ₉₀		50	59	59	53	48	46	48	41	28	16	12
0900												
<i>L</i> _{Aeq}		53	62	62	58	53	48	49	44	35	28	18
<i>L</i> _{max}		75	77	73	70	78	73	66	66	60	58	44
<i>L</i> ₁₀		55	64	64	60	54	49	51	46	36	25	17
<i>L</i> ₉₀		49	58	57	52	46	44	46	39	28	16	12
0920												
<i>L</i> _{Aeq}		53	62	62	56	52	48	50	45	37	26	17
<i>L</i> _{max}		65	72	72	66	68	60	58	59	56	50	39
<i>L</i> ₁₀		55	64	64	58	54	49	52	47	40	29	18
<i>L</i> ₉₀		49	58	58	53	47	45	46	40	30	18	12

Windermere Close, Openshaw												
Existing noise climate survey												
Night time 23 rd - 24 th August 2019. Position 2												
Octave Band Centre Frequency, Hz.		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
2310												
<i>L</i> _{Aeq}		49	57	59	57	49	44	46	38	27	20	19
<i>L</i> _{max}		60	68	69	70	62	54	53	48	50	44	47
<i>L</i> ₁₀		52	59	62	58	52	47	49	41	30	21	19
<i>L</i> ₉₀		45	52	56	51	43	41	42	34	20	12	11
2330												
<i>L</i> _{Aeq}		49	57	61	55	47	44	46	40	28	18	17
<i>L</i> _{max}		61	70	79	70	64	53	54	50	40	34	39
<i>L</i> ₁₀		52	61	62	57	49	47	49	43	31	21	17
<i>L</i> ₉₀		45	52	55	50	42	41	42	33	19	12	12
2350												
<i>L</i> _{Aeq}		49	55	58	53	46	43	46	39	28	20	16
<i>L</i> _{max}		60	66	69	68	58	54	55	52	51	45	37
<i>L</i> ₁₀		51	57	60	55	49	45	49	42	30	21	18
<i>L</i> ₉₀		44	51	54	49	42	40	41	32	19	13	12
0010												
<i>L</i> _{Aeq}		48	55	57	52	45	43	46	39	28	21	18
<i>L</i> _{max}		60	67	66	66	60	55	56	52	49	42	44
<i>L</i> ₁₀		51	57	59	54	48	45	49	42	31	23	18
<i>L</i> ₉₀		43	51	53	49	41	39	40	32	18	12	12
0030												
<i>L</i> _{Aeq}		49	55	60	57	48	43	45	39	30	21	22
<i>L</i> _{max}		65	65	77	77	67	54	55	50	51	43	49
<i>L</i> ₁₀		51	58	61	54	49	45	48	42	32	23	19
<i>L</i> ₉₀		43	51	53	48	41	40	40	32	19	12	12
0050												
<i>L</i> _{Aeq}		48	54	56	53	45	43	46	39	27	19	16
<i>L</i> _{max}		63	66	68	69	64	53	58	57	43	39	41
<i>L</i> ₁₀		51	56	58	54	47	45	49	42	30	22	17
<i>L</i> ₉₀		44	51	53	48	42	40	41	33	21	13	12

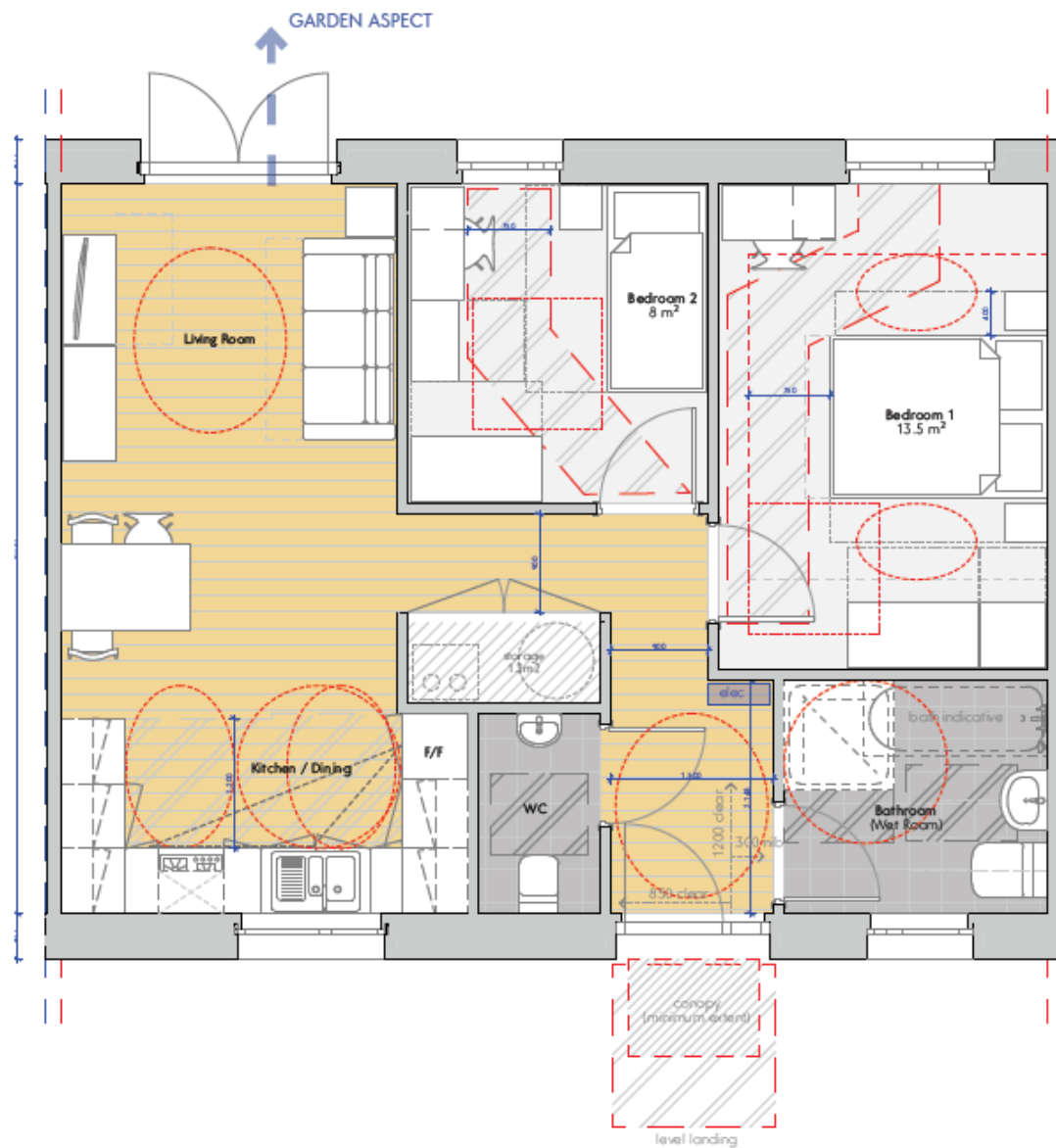
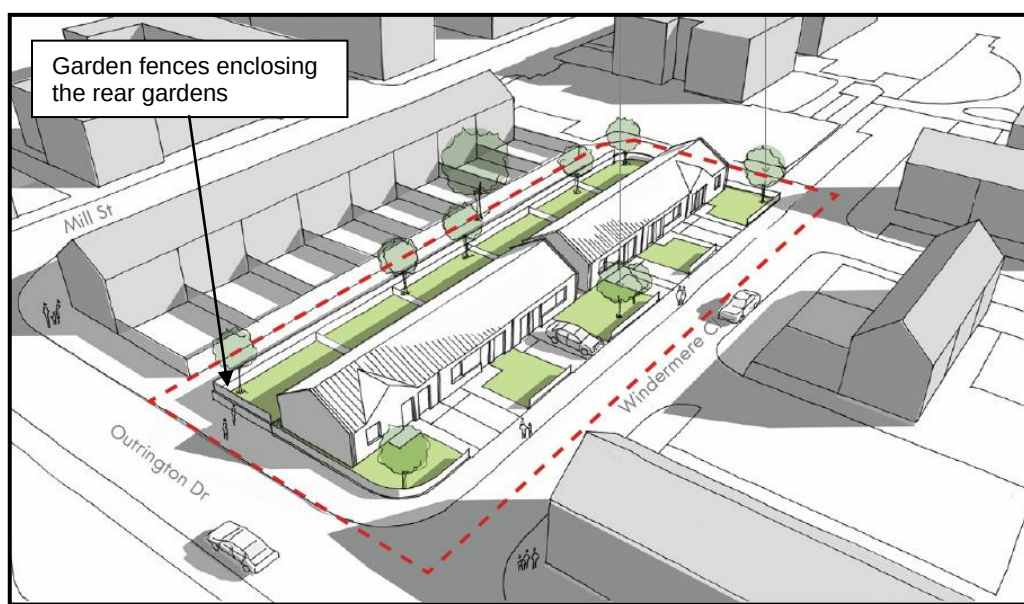
Appendix 2: Proposed residential development details**Figure 1.** Proposed internal arrangement - 2 bedroom, 3 person bungalow

Figure 2. Proposed residential scheme layout**Figure 3.** Proposed development, perspective representation

Appendix 3: Break-in Noise Calculations

Windermere Close, Openshaw														
Break-in Noise Calculations														
L _{Aeq} Assessment, daytime														
2 bedroom, 3 person bungalow (position 1 levels)														
Living room, front elevation														
* Octave Band Centre Frequency, Hz														
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}		59	64	66	61	57	54	56	50	41	32	24	
B	Exposed façade, m ²	9.2		9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	
C	Volume of receiving room, m ³	52.2												
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	
F	Composite SRI			19.0	24.0	29.0	28.3	39.2	47.2	45.4	54.7	59.7	59.7	
G	A + B + E - F		21	42.6	39.6	29.0	26.2	11.8	6.1	1.4	-16.4	-30.1	-38.2	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level		24	45.6	42.6	32.0	29.2	14.8	9.1	4.4	-13.4	-27.1	-35.2	
Glazing: Triple glazing equivalent (4,16,4,16,4)														
Ventilator type: -														
2 bedroom, 3 person bungalow (position 1 levels)														
Living room, gable														
* Octave Band Centre Frequency, Hz														
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}		59	64	66	61	57	54	56	50	41	32	24	
B	Exposed façade, m ²	16.6		12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	
C	Volume of receiving room, m ³	52.2												
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0	
G	A + B + E - F		12	36.2	33.2	22.6	15.1	3.5	-2.2	-12.6	-21.1	-34.8	-42.9	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level		15	39.2	36.2	25.6	18.1	6.5	0.8	-9.6	-18.1	-31.8	-39.9	
Glazing: Triple glazing equivalent (4,16,4,16,4)														
Ventilator type: -														
2 bedroom, 3 person bungalow (position 1 levels)														
Living room, rear elevation														
* Octave Band Centre Frequency, Hz														
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}		59	64	66	61	57	54	56	50	41	32	24	
B	Exposed façade, m ²	7.6		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	
C	Volume of receiving room, m ³	52.2												
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	
F	Composite SRI			14.5	19.5	24.5	23.6	34.6	42.6	40.6	50.4	55.4	55.4	
G	A + B + E - F		24	46.3	43.3	32.7	30.1	15.5	9.8	5.4	-12.9	-26.6	-34.7	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level		27	49.3	46.3	35.7	33.1	18.5	12.8	8.4	-9.9	-23.6	-31.7	
Glazing: Triple glazing equivalent (4,16,4,16,4)														
Ventilator type: -														
Combined noise level, dB(A)														
29														
2 bedroom, 3 person bungalow (position 1 levels)														
Bedroom 2, rear elevation														
* Octave Band Centre Frequency, Hz														
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}		59	64	66	61	57	54	56	50	41	32	24	
B	Exposed façade, m ²	6.8		8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	
C	Volume of receiving room, m ³	19.2												
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
E	10 x Log(RT60/(0.163 x V))			-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	
F	Composite SRI			20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7	
G	A + B + E - F		22	44.6	41.6	31.0	28.0	13.6	7.9	3.2	-14.4	-28.1	-36.2	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level		25	47.6	44.6	34.0	31.0	16.6	10.9	6.2	-11.4	-25.1	-33.2	
Glazing: Triple glazing equivalent (4,16,4,16,4)														
Ventilator type: -														

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<u>L_{Aeq} Assessment, night time</u>													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 2, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		56	57	60	58	52	49	52	48	42	30	22
B	Exposed façade, m ²	6.8		8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
C	Volume of receiving room, m ³	19.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
F	Composite SRI			20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7
G	A + B + E - F		18	36.8	35.2	27.8	23.2	9.1	4.4	1.9	-13.4	-30.4	-38.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		21	39.8	38.2	30.8	26.2	12.1	7.4	4.9	-10.4	-27.4	-35.6
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 1, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		56	57	60	58	52	49	52	48	42	30	22
B	Exposed façade, m ²	7.5		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			18.2	23.2	28.2	27.5	38.4	46.4	44.5	54.0	59.0	59.0
G	A + B + E - F		18	36.8	35.2	27.8	23.4	9.3	4.6	2.2	-13.5	-30.5	-38.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		21	39.8	38.2	30.8	26.4	12.3	7.6	5.2	-10.5	-27.5	-35.7
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 1, gable													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		56	57	60	58	52	49	52	48	42	30	22
B	Exposed façade, m ²	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		8	28.7	27.1	19.7	10.6	-0.7	-5.4	-13.6	-19.8	-36.8	-45.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		11	31.7	30.1	22.7	13.6	2.3	-2.4	-10.6	-16.8	-33.8	-42.0
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
Combined noise level, dB(A)			21										

<u>L_{Amax} Assessment, night time</u>													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 2, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Amax}		73	70	71	75	66	63	68	68	63	52	52
B	Exposed façade, m ²	6.8		8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
C	Volume of receiving room, m ³	19.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
F	Composite SRI			20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7
G	A + B + E - F		33	50.6	46.7	44.9	37.0	22.9	20.1	21.5	7.2	-8.5	-8.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		36	53.6	49.7	47.9	40.0	25.9	23.1	24.5	10.2	-5.5	-5.1
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 1, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Amax}		73	70	71	75	66	63	68	68	63	52	52
B	Exposed façade, m ²	7.5		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			18.2	23.2	28.2	27.5	38.4	46.4	44.5	54.0	59.0	59.0
G	A + B + E - F		33	50.6	46.7	44.9	37.2	23.1	20.3	21.8	7.1	-8.6	-8.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		36	53.6	49.7	47.9	40.2	26.1	23.3	24.8	10.1	-5.6	-5.2
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
2 bedroom, 3 person bungalow (position 1 levels)													
Bedroom 1, gable													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Amax}		73	70	71	75	66	63	68	68	63	52	52
B	Exposed façade, m ²	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		23	42.5	38.6	36.8	24.4	13.1	10.3	6.0	0.8	-14.9	-14.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		26	45.5	41.6	39.8	27.4	16.1	13.3	9.0	3.8	-11.9	-11.5
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
Combined noise level, dB(A)			36										

Windermere Close, Openshaw													
Break-in Noise Calculations													
L _{Aeq} Assessment, daytime													
2 bedroom, 3 person bungalow (position 2 levels)													
Living room, front elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	9.2		9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
C	Volume of receiving room, m ³	52.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3
F	Composite SRI			19.0	24.0	29.0	28.3	39.2	47.2	45.4	54.7	59.7	59.7
G	A + B + E - F		17	40.9	35.9	25.6	22.7	8.5	1.4	-3.3	-20.1	-27.6	-35.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		20	43.9	38.9	28.6	25.7	11.5	4.4	-0.3	-17.1	-24.6	-32.0
Glazing:			Triple glazing equivalent (4,16,4,16,4)										
Ventilator type:			-										
2 bedroom, 3 person bungalow (position 2 levels)													
Living room, gable													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	16.6		12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
C	Volume of receiving room, m ³	52.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		9	34.5	29.5	19.2	11.6	0.2	-6.9	-17.3	-24.8	-32.3	-39.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		12	37.5	32.5	22.2	14.6	3.2	-3.9	-14.3	-21.8	-29.3	-36.7
Glazing:			Triple glazing equivalent (4,16,4,16,4)										
Ventilator type:			-										
2 bedroom, 3 person bungalow (position 2 levels)													
Living room, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	7.6		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³	52.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3
F	Composite SRI			14.5	19.5	24.5	23.6	34.6	42.6	40.6	50.4	55.4	55.4
G	A + B + E - F		21	44.6	39.6	29.3	26.6	12.2	5.1	0.7	-16.6	-24.1	-31.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		24	47.6	42.6	32.3	29.6	15.2	8.1	3.7	-13.6	-21.1	-28.5
Glazing:			Triple glazing equivalent (4,16,4,16,4)										
Ventilator type:			-										
			Combined noise level, dB(A)	26									
2 bedroom, 3 person bungalow (position 2 levels)													
Bedroom 2, rear elevation													
* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L _{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	6.8		8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
C	Volume of receiving room, m ³	19.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
F	Composite SRI			20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7
G	A + B + E - F		19	42.9	37.9	27.6	24.5	10.3	3.2	-1.5	-18.1	-25.6	-33.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		22	45.9	40.9	30.6	27.5	13.3	6.2	1.5	-15.1	-22.6	-30.0
Glazing:			Triple glazing equivalent (4,16,4,16,4)										
Ventilator type:			-										

2 bedroom, 3 person bungalow (position 2 levels)													
<u>Bedroom 1, rear elevation</u>													
<i>* Octave Band Centre Frequency, Hz</i>													
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	7.5		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			18.2	23.2	28.2	27.5	38.4	46.4	44.5	54.0	59.0	59.0
G	A + B + E - F		19	42.9	37.9	27.6	24.7	10.5	3.4	-1.2	-18.2	-25.7	-33.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		22	45.9	40.9	30.6	27.7	13.5	6.4	1.8	-15.2	-22.7	-30.1
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
2 bedroom, 3 person bungalow (position 2 levels)													
<u>Bedroom 1, gable</u>													
<i>* Octave Band Centre Frequency, Hz</i>													
			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		55	63	63	57	54	50	51	45	37	35	27
B	Exposed façade, m ²	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m ³	32.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))			-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		9	34.8	29.8	19.5	11.9	0.5	-6.6	-17.0	-24.5	-32.0	-39.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		12	37.8	32.8	22.5	14.9	3.5	-3.6	-14.0	-21.5	-29.0	-36.4
Glazing: Triple glazing equivalent (4,16,4,16,4)													
Ventilator type: -													
Combined noise level, dB(A)													
22													

<u>L_{Aeq} Assessment, night time</u>														
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 2, rear elevation</u>														
<i>* Octave Band Centre Frequency, Hz</i>			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}	6.8	49	57	61	55	47	44	46	40	28	18	17	
B	Exposed façade, m ²			8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	
C	Volume of receiving room, m ³			19.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
D	Reverb Time, seconds				-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
E	10 x Log(RT60/(0.163 x V))				20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7
F	Composite SRI	14	17	37.7	35.8	25.2	17.4	4.1	-1.8	-6.7	-27.6	-42.6	-43.6	
G	A + B + E - F			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
H	K = 3			17	40.7	38.8	28.2	20.4	7.1	1.2	-3.7	-24.6	-39.6	-40.6
I														
J	Calculated internal noise level													
Glazing:		Triple glazing equivalent (4,16,4,16,4)												
Ventilator type:		-												
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 1, rear elevation</u>														
<i>* Octave Band Centre Frequency, Hz</i>			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}	7.5	49	57	61	55	47	44	46	40	28	18	17	
B	Exposed façade, m ²			8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³			32.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
D	Reverb Time, seconds				-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
E	10 x Log(RT60/(0.163 x V))				18.2	23.2	28.2	27.5	38.4	46.4	44.5	54.0	59.0	59.0
F	Composite SRI	14	17	37.7	35.8	25.2	17.6	4.3	-1.6	-6.4	-27.7	-42.7	-43.7	
G	A + B + E - F			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
H	K = 3			17	40.7	38.8	28.2	20.6	7.3	1.4	-3.4	-24.7	-39.7	-40.7
I														
J	Calculated internal noise level													
Glazing:		Triple glazing equivalent (4,16,4,16,4)												
Ventilator type:		-												
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 1, gable</u>														
<i>* Octave Band Centre Frequency, Hz</i>			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*	
A	Measured L _{Aeq}	11	49	57	61	55	47	44	46	40	28	18	17	
B	Exposed façade, m ²			10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m ³			32.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
D	Reverb Time, seconds				-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
E	10 x Log(RT60/(0.163 x V))				28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
F	Composite SRI	5	8	29.6	27.7	17.1	4.8	-5.7	-11.6	-22.2	-34.0	-49.0	-50.0	
G	A + B + E - F			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
H	K = 3			8	32.6	30.7	20.1	7.8	-2.7	-8.6	-19.2	-31.0	-46.0	-47.0
I														
J	Calculated internal noise level													
Glazing:		Triple glazing equivalent (4,16,4,16,4)												
Ventilator type:		-												
			Combined noise level, dB(A)											
			18											

<u>L_{Amax} Assessment, night time</u>														
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 2, rear elevation</u>														
<i>* Octave Band Centre Frequency, Hz</i>				dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured <i>L_{Amax}</i>	6.8	19.2	65	65	77	77	67	54	55	50	51	43	49
B	Exposed façade, m ²				8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
C	Volume of receiving room, m ³													
D	Reverb Time, seconds				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))				-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
F	Composite SRI			20.1	25.1	30.1	29.6	40.3	48.3	46.7	55.7	60.7	60.7	
G	A + B + E - F		34	45.0	51.8	47.7	37.8	14.0	6.7	4.0	-4.2	-17.0	-11.9	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level			37	48.0	54.8	50.7	40.8	17.0	9.7	7.0	-1.2	-14.0	-8.9
Glazing:				<i>Triple glazing equivalent (4,16,4,16,4)</i>										
Ventilator type:				-										
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 1, rear elevation</u>														
<i>* Octave Band Centre Frequency, Hz</i>				dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured <i>L_{Amax}</i>	7.5	32.4	65	65	77	77	67	54	55	50	51	43	49
B	Exposed façade, m ²				8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m ³													
D	Reverb Time, seconds				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))				-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			18.2	23.2	28.2	27.5	38.4	46.4	44.5	54.0	59.0	59.0	
G	A + B + E - F		34	45.0	51.8	47.7	38.0	14.2	6.9	4.3	-4.3	-17.1	-12.0	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level			37	48.0	54.8	50.7	41.0	17.2	9.9	7.3	-1.3	-14.1	-9.0
Glazing:				<i>Triple glazing equivalent (4,16,4,16,4)</i>										
Ventilator type:				-										
2 bedroom, 3 person bungalow (position 2 levels)														
<u>Bedroom 1, gable</u>														
<i>* Octave Band Centre Frequency, Hz</i>				dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured <i>L_{Amax}</i>	11	32.4	65	65	77	77	67	54	55	50	51	43	49
B	Exposed façade, m ²				10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m ³													
D	Reverb Time, seconds				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V))				-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0	
G	A + B + E - F		25	36.9	43.7	39.6	25.2	4.2	-3.1	-11.5	-10.6	-23.4	-18.3	
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I														
J	Calculated internal noise level			28	39.9	46.7	42.6	28.2	7.2	-0.1	-8.5	-7.6	-20.4	-15.3
Glazing:				<i>Triple glazing equivalent (4,16,4,16,4)</i>										
Ventilator type:				-										