

Residential re-development of former Hoyle Dye Works, Manchester Road, Linthwaite:

Noise Assessment

Highstone Building Services

Echo Acoustics
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EXECUTIVE SUMMARY

The results of a noise measurement survey and desk-based assessment are presented, with respect to the proposed residential re-development of former Hoyle Dye Works, Manchester Road, Linthwaite, Yorkshire.

The assessment shows that:

- The site is dominated by traffic noise, from Manchester Road, during the day and night time. The traffic travelling on the road includes a large number of diesel-engined heavy goods/delivery vehicles
- Noise levels affecting external amenity areas i.e. rear gardens of the bungalows, will be below the recommended guideline values due to the significant acoustic screening provided by the buildings.
- Upgraded glazing is required for all habitable rooms as a result of which, the assessment shows that, with windows closed, suitable internal noise levels will be achieved.
- The opening of windows for ventilation may result in levels above the guideline values. Consequently, alternative means of providing both background and cooling ventilation will be required for habitable rooms, thereby negating the need to open windows for that purpose.

The assessment concludes that, with the provision of these mitigation measures, the site can be suitably developed for residential use and that noise need not be a reason for refusal of planning permission.

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1 INTRODUCTION AND SITE DESCRIPTION

- 1.1 Echo Acoustics was commissioned by Highstone Building Services to undertake an assessment of noise affecting the proposed residential re-development of former Hoyle Dye Works, Manchester Road, Linthwaite, Yorkshire.
- 1.2 The site is a derelict former Dye Works located at the junction of Manchester Road and Hoyle Ing, which define the site's north-western and south-western boundaries, respectively; Manchester Road is a major transportation route across the Pennines.
- 1.3 The surrounding uses are residential to the south-east and east with a small local retail shop on the opposite side of Manchester Road and a larger commercial/light industrial area located to the south of the site. The site and its surroundings are shown in Figure 1.

Figure 1 : Site location and surroundings



- 1.4 The site is principally affected by traffic noise from Manchester Road including the passage of numerous buses and diesel-engined heavy goods/delivery vehicles. Very little noise was observed from the commercial use to the south of the site.
- 1.5 The proposals, presented in Figure 2, are for the demolition of the larger (main) building on the site to enable the construction of 9 apartments and 4 bungalows, alongside conversion of the smaller building, adjacent Hoyle Ing, to provide 2 maisonettes.

2 GUIDANCE

Noise – national and local policy guidance

- 2.1 Planning policies are set at both a national and local level. With respect to national policy, assessment of the suitability of a site for residential development is guided by the National Planning Policy Framework (NPPF), issued in March 2012 and amended in 2018, 2019 and 2021.
- 2.2 With regard to noise, the NPPF (“the Framework”) does not provide specific noise policies or defined noise limits, but rather is intended to enable the planning system to support the Government’s aims and objectives with respect to sustainable development, and provides *“a framework within which locally-prepared plans for housing and other development can be produced”* and *“requires that applications for planning permission be determined in accordance with the development plan, unless material considerations indicate otherwise”*.
- 2.3 None of the current local or national planning policies preclude residential development of the site.
- 2.4 Additional national planning guidance is provided in the Government’s Noise Policy Statement for England (NPSE – “the Noise Policy”), to which the Framework makes specific reference as the main source of national guidance specifically on planning and noise.
- 2.5 The Noise Policy has a long term vision to *“Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development”*. The vision is supported by three key aims intended to promote sustainable development with respect to noise so that *“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
 - *avoid significant adverse impacts on health and quality of life;*
 - *mitigate and minimise adverse impacts on health and quality of life; and*
 - *where possible, contribute to the improvement of health and quality of life”*.
- 2.6 Health is defined by the World Health Organisation as *“a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, and recognises the enjoyment of the highest attainable standard of health as one of the fundamental rights of every human being”* and the Noise Policy makes *“a distinction between ‘quality of life’ which is a subjective measure that refers to people’s emotional, social and physical well being and ‘health’ which refers to physical and mental well being”*.
- 2.7 However, the Noise Policy recognises that it is not currently possible to define a single objective noise level having specific effects on people, hence the emphasis on “promoting” improvements to health and quality of life through effective management of noise, considered in the context of the wider environment and factors other than noise.
- 2.8 Additional guidance is given in the Planning Practice Guidance Note (PPG) on noise, issued in March 2014, alongside the NPPF and updated in 2018 and July 2019. This *“advises on how planning can manage potential noise impacts in new development”*. The PPG suggests the following noise exposure hierarchy, based on average responses to noise:

Table 1: PPG noise exposure and response hierarchy

Perception	Examples of outcomes	Increasing effect level	Action
<i>No Observed Effect Level (NOEL)</i>			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
<i>Lowest Observed Adverse Effect Level (LOAEL)</i>			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
<i>Significant Observed Adverse Effect Level (SOAEL)</i>			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non- auditory	Unacceptable Adverse Effect	Prevent

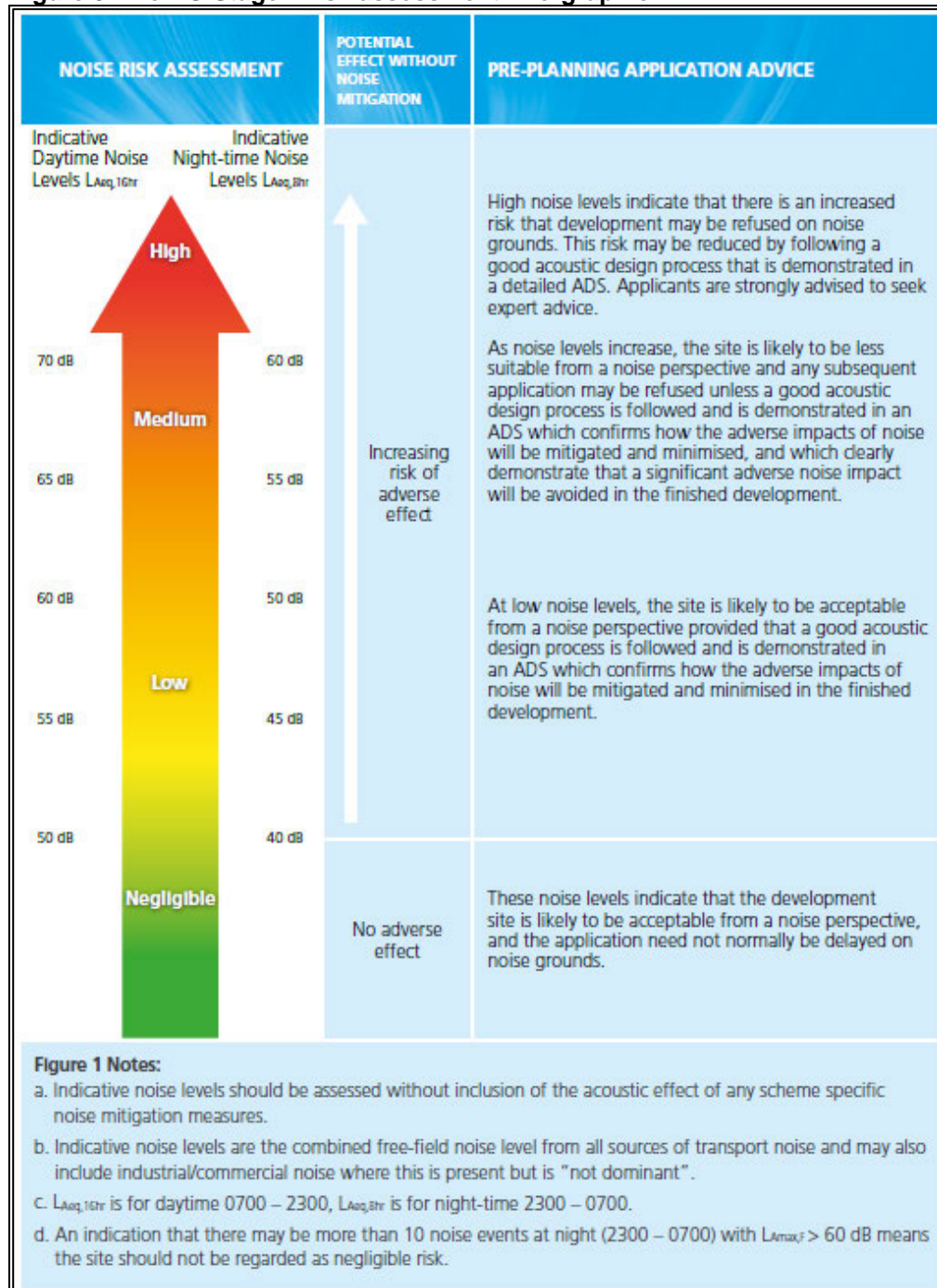
- 2.10 Beyond this, however, the guidance is relatively generic. It avoids specifying ‘acceptable’ environmental noise levels as the acceptability of a source of is both subjective and context-dependant.

External (environmental) noise – technical guidance

- 2.11 In May 2017, a Working Group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH) produced a Professional Practice Guidance (Pro PG) document¹. The guidance was produced “to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England” and “which encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise”. Its primary aim is “to assist the delivery of sustainable development by promoting good health and wellbeing through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise”.
- 2.12 The guidance identifies that “Good acoustic design is about more than the numbers. It is a holistic design process that creates places that are both comfortable and attractive to live in, where acoustics is considered integral to the living environment.
- Good acoustic design can involve, for example, careful site layouts and better orientation of rooms within dwellings. Good acoustic design does not mean “gold plating” or significantly increasing costs. This guidance seeks to encourage and promote design outcomes that are proportionate and reasonable in the particular circumstances of each development site”.*
- 2.13 It should be noted that the Pro PG “does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy on which users should take their own advice as appropriate”.
- 2.14 The guidance “advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging”. The two sequential stages are:
- Stage 1 – an initial noise risk assessment of the proposed development site; and
 - Stage 2 – a systematic consideration of four key elements.
- 2.15 Figure 1 of the guidance provides a useful graphical overview of the Stage 1 risk assessment considerations, reproduced as Figure 3.

¹ ANC, IOA & CIEH (2017) *Pro PG: Planning & Noise Professional Practice Guidance on Planning & Noise: New Residential Development*

Figure 3: Pro PG Stage 1 risk assessment info-graphic



2.16 The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1 – demonstrating a “*Good Acoustic Design Process*”;
- Element 2 – observing internal “*Noise Level Guidelines*”;
- Element 3 – undertaking an “*External Amenity Area Noise Assessment*”; and
- Element 4 – consideration of “*Other Relevant Issues*”.

2.17 “*The approach is underpinned by the preparation and delivery of an “Acoustic Design Statement” (ADS). An ADS for a site assessed as high risk should be more detailed than for*

a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk”.

2.18 With respect to noise affecting residential amenity, BS 8233: 2014 *Guidance on sound insulation and noise reduction for buildings* gives recommendations for internal noise levels for residential dwellings in order to protect residential amenity, based on health-based research, as follows:

- Living rooms during the day 35 dB $L_{Aeq,16hour}$
- Dining rooms during the day 40 dB $L_{Aeq,16hour}$
- Bedrooms during the day 35 dB $L_{Aeq,16hour}$
- Bedrooms during the night 30 dB $L_{Aeq,8hour}$

2.19 These values can be taken to be broadly equivalent with the LOAEL in the PPG. Note that these are not specific criteria or ‘target’ noise levels, merely indicative recommendations which will be context-dependant. However, most Local Authorities tend to apply the recommended noise levels as strict criteria.

2.20 In most standard modern properties, the walls and roof provide relatively high levels of sound insulation of greater than 40 dB; the weakest part of a building facade, with respect to noise, is generally the windows. Modern construction methods for new residential properties incorporate standard thermal double-glazing which, the standard suggests, will provide approximately 33 dB R_w of sound attenuation when closed. The standard does not specifically give sound attenuation values for partially open windows, although the worked example (G.1) at Annex G of the Standard indicates that a partially open window would provide 15 dB of sound attenuation.

2.21 With regard to maximum (L_{AFmax}) noise levels, BS 8233 (Note 4) states the following:

“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values”.

2.22 A study undertaken by Vallet & Vernet (1991)² suggests that for good sleep, indoor sound pressure levels in bedrooms should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night. The findings of this research, which was concerned with aircraft noise, are conventionally accepted as being suitable for use in the assessment of other forms of noise including from road traffic.

² Vallet M. & Vernet I. (1991) *Night noise index for aircraft noise and sleep disturbance*. Proceedings Internoise 1991, Sydney, Vol. 1 pp 207-210

3 METHODOLOGY

- 3.1 The assessment incorporated a noise measurement survey comprising the use of a sound level meter located close to the junction of Manchester Road and Hoyle Ing, 5 metres from the edge of Manchester Road, as shown in Figure 4 and 5.

Figure 4: Noise measurement locations



Figure 5: View from measurement position to Manchester Road



- 3.2 The meter recorded consecutive 1-second and 5-minute data between 2:30pm on Wednesday 20 April and 10:55am on Friday 22 April 2022.
- 3.3 The meter used was a Casella CEL633C, Class 1 (IEC 61672: 2012) integrating, averaging sound level meter. This was placed in a locked, weatherproof enclosure with the microphone mounted on a tripod in a 'free-field' position. The microphone was protected by a proprietary wind-shield.
- 3.4 The meter was field-calibrated before and after the survey and no significant variation in calibration tone was observed.
- 3.5 The quantitative measurement data were supplemented by qualitative observation of the nature and character of the ambient noise affecting the site during the day time.
- 3.6 The weather during the surveys was warm and dry with south-easterly to easterly winds; the winds were negligible at the start of the survey but gradually strengthened throughout the survey to reach an average of 3 to 4 metres per second ($m.s^{-1}$) on the Friday morning. Detailed examination of the data showed that the increase in wind speeds did not significantly affect the data gathered.
- 3.7 The assessment, undertaken with reference to the Pro PG and BS 8233, utilised the measured data to determine:
- The noise affecting external amenity areas.
 - Internal noise through a closed window; for this, the 'free-field data were converted to 'façade' data, as prescribed in BS 8233.
 - Internal noise through a partially open window, using the free-field data.
- 3.8 The data gathered spanned 2 whole nights (11:00pm to 7:00am), 1 whole day (7:00am to 11:00pm) and 2 partial day. For the purposes of the assessment: with respect to ambient (L_{Aeq}) noise, the median day and night time values were calculated to provide a single day and night time value; with respect to maximum (L_{Amax}) noise levels, the highest recorded night time maximum value was used.
- 3.9 Additionally, as the measurement position was 5 metres from the edge of the carriageway and 8.5 metres from the effective source of traffic noise (3.5 meters in from the edge of the carriageway) the data was adjusted to account for the difference in distance between the measurement position and the proposed property facades, as follows:
- Apartments:
 - Apartments closest to road, closest bedroom window will be 3.5m from edge of carriageway, **7.0m from source of traffic**. Distance correction: **+0.8 dB L_{Aeq}** and **+1.7 dB L_{Amax}** .
 - Apartments further back from road, closest bedroom window will be 15.0m from edge of carriageway, **18.5m from source of traffic**. Distance correction: **-5.6 dB L_{Aeq}** and **+11.4 dB L_{Amax}**
 - Bungalows: 7.0m from edge of carriageway (allowing for car parking bays in front of the site), **10.5m from source of traffic** (3.5m from edge of carriageway). Distance correction: **-0.9 dB L_{Aeq}** and **-1.8 dB L_{Amax}** .
 - Maisonettes: 21.0m from edge of carriageway, **24.5m from source of traffic**. Distance correction: **-4.6 dB L_{Aeq}** and **-9.9 dB L_{Amax}** .

4 RESULTS, ASSESSMENT AND DISCUSSION

Measurement survey data

- 4.2 The median measured noise data, derived as in paragraph 3.8, are presented in Table 2 whilst Table 3 provides the adjusted data at each assessed receptor façade, derived as described in paragraph 3.9. The full 5-minute data is presented at Appendix B; the 1-second data, which were used for detailed post-measurement analysis, are too numerous to be included in the report but are available on request.

Table 2: Summarised day and night time noise measurement data

Time	Measured noise (dB)	
	L _{Aeq}	L _{AFmax}
Day (07:00 - 23:00)	63.9	84.4
Night (23:00 - 07:00)	57.7	

Table 3: Distance adjusted data

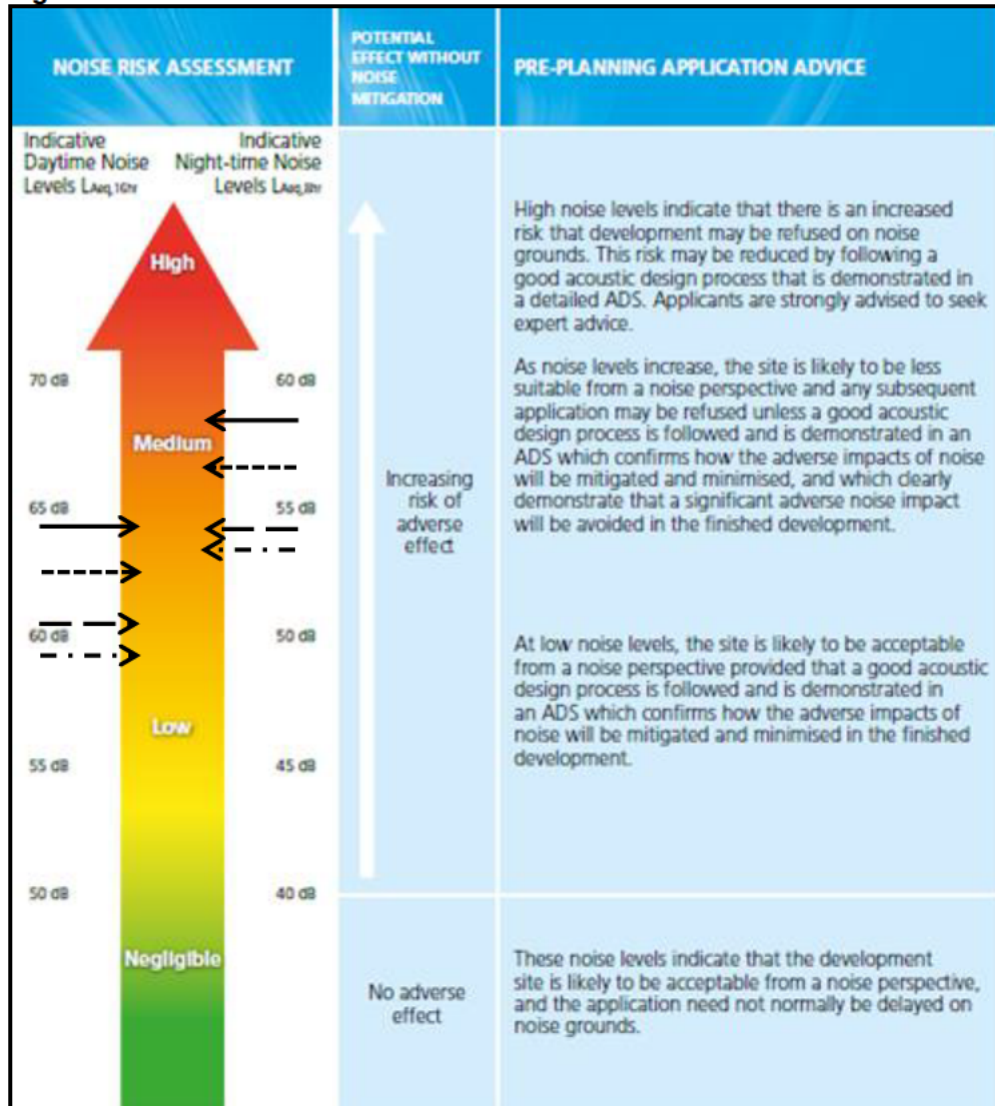
Time	Adjusted noise (dB)	
	L _{Aeq}	L _{AFmax}
• Apartments closest windows (3.5m from road)		
Day (07:00 - 23:00)	64.7	-
Night (23:00 - 07:00)	58.5	86.1
• Apartments set-back windows (15.0m from road)		
Day (14:30 - 23:00)	60.5	-
Night (23:00 - 07:00)	54.3	77.6
• Bungalows (7.0m from road)		
Day (07:00 - 23:00)	63.0	-
Night (23:00 - 07:00)	56.7	82.6
• Maisonettes (21.0m from road)		
Day (07:00 - 23:00)	59.3	-
Night (23:00 - 07:00)	53.1	75.2

Pro-PG risk assessment

- 4.3 With respect to the Pro PG Stage 1 risk assessment (Figure 6) and based on the data in Table 3, the various facades of the development are shown to be as follows:
- Apartments closest to road (solid arrow Figure 6): **low** to **medium** risk during the day time and **medium** risk during the night time.
 - Apartments set-back from road (long-dashed arrow Figure 6): **low** risk during the day time and **low** to **medium** risk during the night time.
 - Bungalows (short-dashed arrow Figure 6): **low** to **medium** risk during the day time and **medium** risk during the night time.
 - Maisonettes (dot-and-dash arrow Figure 6): **low** risk during the day time and **low** to **medium** risk during the night time.
- 4.4 In view of these findings, it is appropriate that further detailed, technical assessment is undertaken to ensure a good design process and that residential amenity for future occupants of the development can be assured.

4.5 This assessment is provided as the Acoustic Design Statement (ADS) for the development.

Figure 6: Site ProPG risk assessment levels



NB: solid black line = position 1, dashed black line = position 2

BS8233 external noise assessment

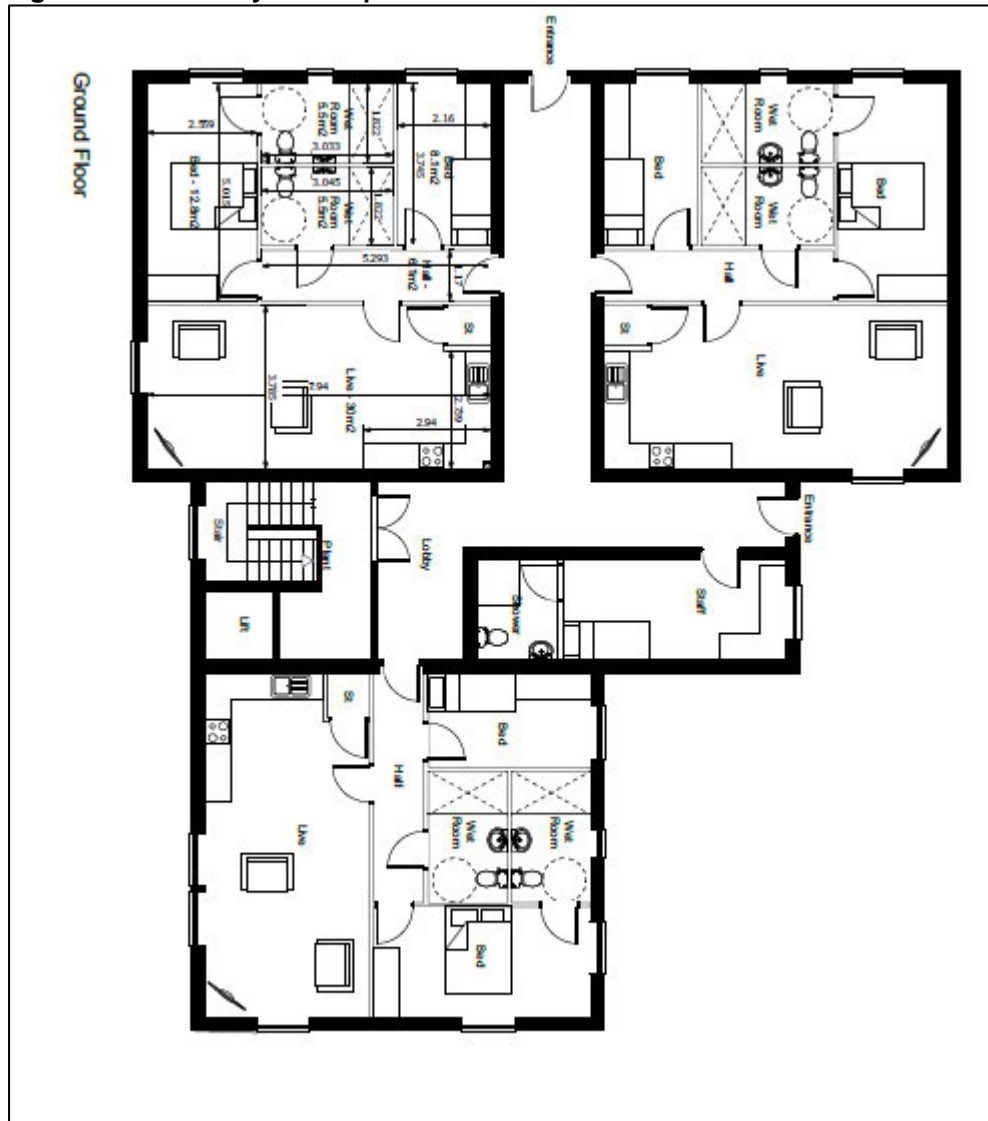
4.6 With respect to the rear garden areas for the bungalows, these are set back behind the properties and, consequently, will be largely screened from traffic noise; noise levels would be expected to be at least 20 dB lower, giving rise to day time noise levels of 43 dB $L_{Aeq,16h}$ or lower, significantly below the 50 dB L_{Aeq} lower guideline level suggested in BS 8233.

4.7 No additional mitigation of day time traffic noise will be required.

BS8233 internal noise assessment

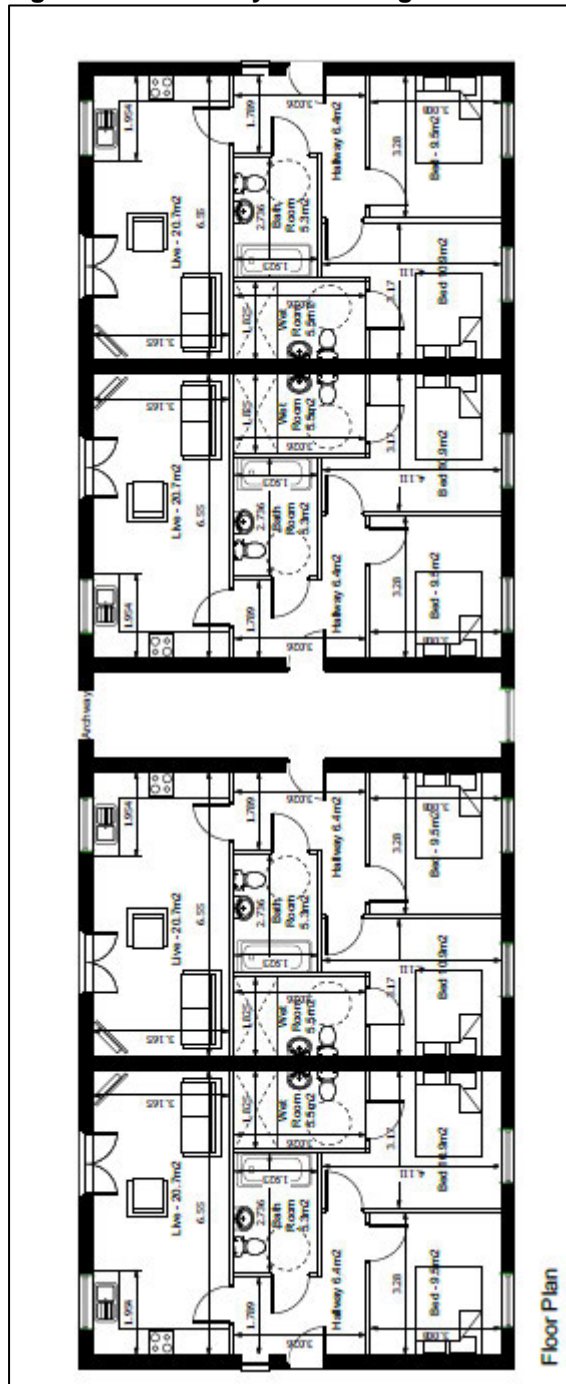
4.8 The internal layouts of the buildings are presented in Figures 7 to 9; Manchester Road is to the left of each image. For Figures 7 and 9, the 'front' of the building facing the internal road/car parking area, is at the top of the image. The bungalows have entrances at the sides and their 'front' is facing Manchester Road.

Figure 7: Internal layout of apartments



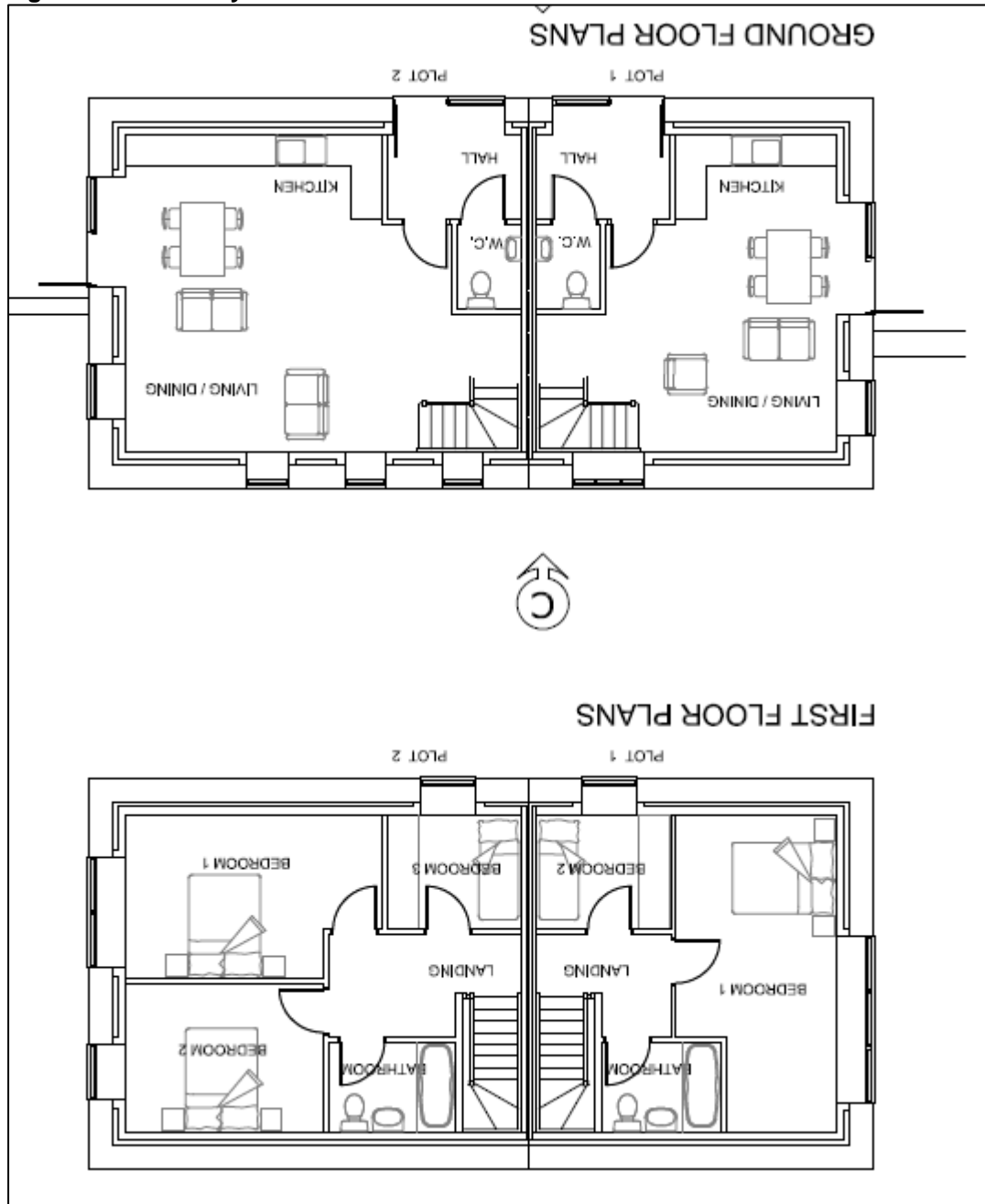
- 4.9 Figure 7 indicates that the apartments at the 'front' of the building (top of image) will have bedroom windows approximately 5 metres, 10 metres, 15 metres and 20 metres from the edge of Manchester Road.
- 4.10 At the rear of the building, facing Hoyle Ing, Figure 7 indicates the presence of a bedroom window approximately 10 metres from the edge of Manchester Road.

Figure 8: Internal layout of bungalows



4.11 Figure 8 shows that there are no bungalow bedroom windows facing Manchester Road.

Figure 9: Internal layout o maisonettes



- 4.12 Figure 9 indicates that Plot 2 of the maisonettes will have 2 bedroom windows facing Manchester Road, approximately 20 metres from the edge of the road.
- 4.13 The data from Table 3, were used to calculate internal noise levels in habitable rooms with windows directly, or obliquely, facing Manchester Road; the results of this are presented in Table 4.
- 4.14 The calculation assumed 15 dB and 33 dB R_w of sound attenuation through an open and closed window, respectively; for calculation of the external noise level with respect to transmission of noise through a closed window, a 3 dB addition was added to the measured value to allow for façade-reflected sound energy (Annex G.2 of BS 8233).

Table 4: Calculated internal noise levels in habitable rooms

Time	Calculated noise (dB)	
	L _{Aeq}	L _{AFmax}
Apartments closest to road		
<i>Windows closed</i>		
Day (07:00 - 23:00)	34.7	-
Night (23:00 - 07:00)	28.5	56.1
<i>Windows open</i>		
Day (07:00 - 23:00)	49.7	-
Night (23:00 - 07:00)	43.5	71.1
Apartments set back from road		
<i>Windows closed</i>		
Day (07:00 - 23:00)	30.5	-
Night (23:00 - 07:00)	24.3	47.6
<i>Windows open</i>		
Day (07:00 - 23:00)	45.5	-
Night (23:00 - 07:00)	39.3	62.6
Bungalows		
<i>Windows closed</i>		
Day (07:00 - 23:00)	33.0	-
Night (23:00 - 07:00)	26.7	52.6
<i>Windows open</i>		
Day (07:00 - 23:00)	48.0	-
Night (23:00 - 07:00)	41.7	67.6
Maisonettes (Plot 2)		
<i>Windows closed</i>		
Day (07:00 - 23:00)	29.3	-
Night (23:00 - 07:00)	23.1	45.2
<i>Windows open</i>		
Day (07:00 - 23:00)	44.3	-
Night (23:00 - 07:00)	38.1	60.2

- 4.15 The data in Table 4 indicate that, with windows closed, the BS 8233 guideline for ambient (L_{Aeq}) noise levels would be achieved in all habitable rooms.
- 4.16 The maximum guideline night time level of 45 dB L_{Amax} was calculated to have been exceeded in every bedroom with a window facing Manchester Road; detailed examination of the 5-minute showed that the number of exceedences at each was:
- Apartments (façade closest to Manchester Road): 44 times on Wednesday night and 38 times on Thursday night. Maximum exceedance of guideline was 11.1 dB.
 - Apartments (set-back from Manchester Road): 13 times on Wednesday night and 8 times on Thursday night. Maximum exceedance of guideline was 6.0 dB
 - Maisonettes (façade facing Manchester Road): 9 times on Wednesday and 5 times on Thursday night. Maximum exceedance of guideline was 4.8 dB.

- Night time maximum noise levels in bedrooms of the bungalows are not of concern as, located at the rear of the building, they are entirely screened from the road.

4.17 Consequently, glazing for bedrooms windows directly, or obliquely, facing Manchester Road, will need to be upgraded, as follows:

- For the apartments closest to Manchester Road, namely the front left apartment and the rear apartment in Figure 12, it was calculated that glazing providing a sound reduction of **43 dB $R_w + C_{tr}$** will be required for bedroom windows, directly or obliquely facing Manchester Road; C_{tr} is a 'correction factor' that takes account of the increased occurrence of low-frequency sound energy in traffic noise where diesel engine heavy vehicles are present. Based on the 5-minute measurement data for the Wednesday, this glazing specification was calculated, to lead to an exceedance of the 45 dB L_{Amax} guideline value only twice, and then only by 0.2 dB. An example glazing specification is provided at Appendix C.
- For the apartments set further back from Manchester Road, it was calculated that glazing providing a sound reduction of **39 dB $R_w + C_{tr}$** will be required for bedroom windows; based on the 5-minute measurement data for the Wednesday, this glazing specification was calculated to lead to no exceedance of the 45 dB L_{Amax} guideline value. An example glazing specification is provided at Appendix C.
- Additionally, irrespective of night time maximum noise levels, it is recommended that bedroom windows at the rear of the property and windows of other habitable rooms i.e. living/dining rooms, be provided with glazing providing **33 dB $R_w + C_{tr}$** of sound attenuation, to negate disturbance caused by diesel-engine vehicles etc.

4.18 Figure 10 presents the various glazing requirements for the apartments.

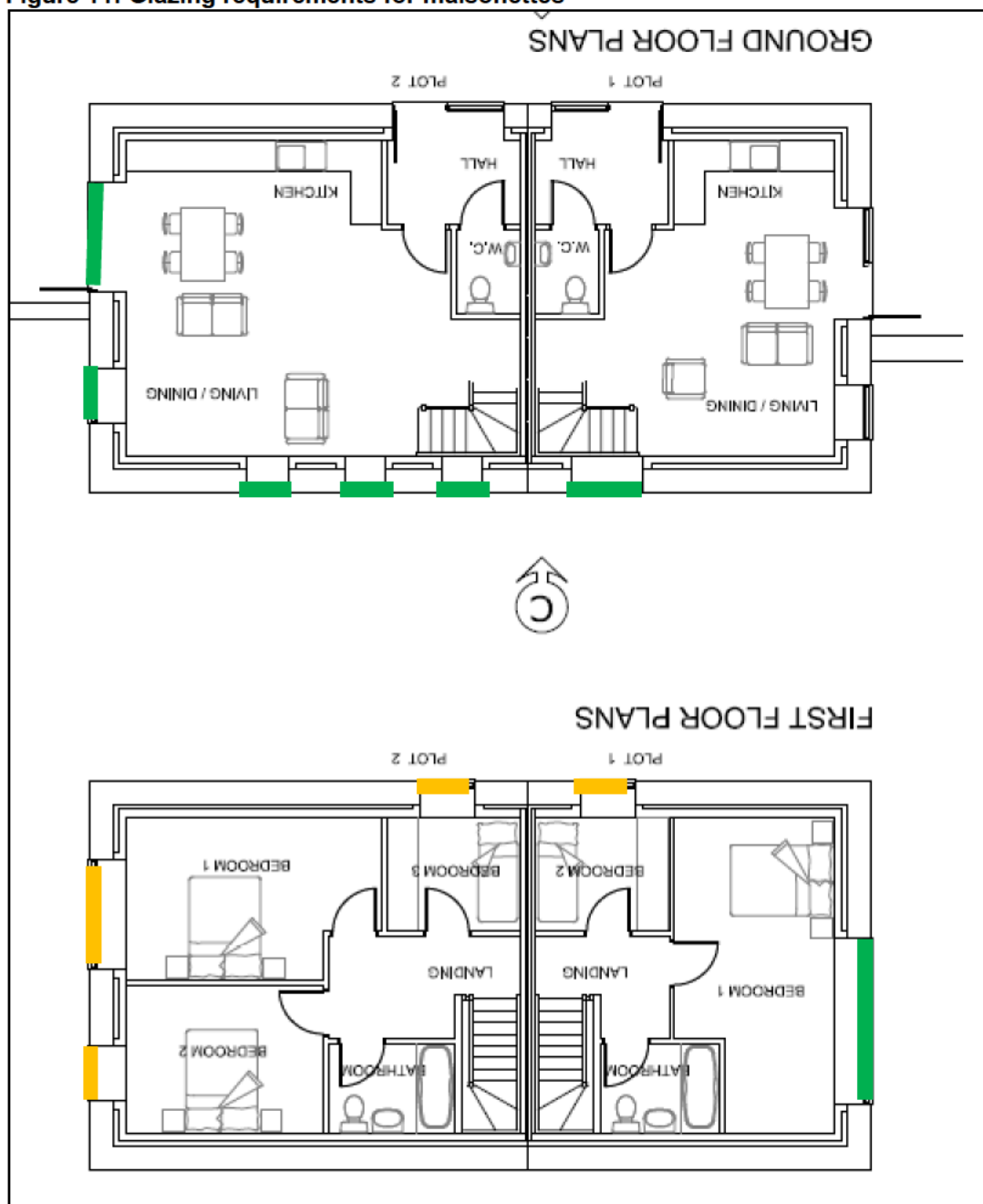
Figure 10: Glazing specifications for apartments



Key: **Red** = 43 dB $R_w + C_{tr}$ // **Orange** = 39 dB $R_w + C_{tr}$ // **Green** = 33 dB $R_w + C_{tr}$

- For the maisonettes, it was calculated that glazing providing a sound reduction of **38 dB $R_w + C_{tr}$** will be required for windows in all the bedrooms in Plot 2 and for bedroom 2 of Plot 1; based on the 5-minute measurement data for the Wednesday, this glazing specification was calculated to lead to no exceedance of the 45 dB L_{Amax} guideline value B. An example glazing specification is provided at Appendix C.

Figure 11: Glazing requirements for maisonettes



Key: Orange = 38 dB $R_w + C_{tr}$ // Green = 33 dB $R_w + C_{tr}$

- 4.19 Additionally, irrespective of night time maximum noise levels, it is recommended that all other habitable room windows be provided with glazing providing **33 dB $R_w + C_{tr}$** of sound attenuation, to negate day or night time disturbance caused by the movement of diesel-engined delivery vehicles.
- 4.20 The data in Table 3 also show that, with windows open, the BS 8233 guideline values would be exceeded in all habitable rooms directly, or obliquely, facing Manchester Road. It is also likely that sudden or percussive noises, such as emergency sirens, car horns, the clattering of heavy goods vehicle bodywork passing over imperfections in the road surface, would lead to disturbance even in habitable rooms not directly or obliquely facing the road.

- 4.21 Consequently, in order to achieve the BS 8233 guideline values and prevent disturbance, particularly sleep disturbance at night, the assessment shows that it will be necessary to keep habitable room windows closed.
- 4.22 Therefore, alternative means of providing both background and cooling ventilation will be required in all habitable rooms, negating the need to open windows for this purpose. This is typically achieved through the provision of whole-house passive input ventilation (PIV) or mechanical ventilation, either as whole-house systems (MVHR) or as through-wall solutions in individual rooms.
- 4.23 Note that, in all cases, window should be capable of being opened.
- 4.24 The assessment concludes that with the provision of up-rated glazing and the provision of alternative ventilation for all habitable rooms, suitable residential amenity will be achieved for the future residents of the development.

5 SUMMARY & CONCLUSION

5.1 The assessment shows that:

- The site is dominated by traffic noise, from Manchester Road, during the day and night time. The traffic travelling on the road includes a large number of diesel-engined heavy goods/delivery vehicles
- Noise levels affecting external amenity areas i.e. rear gardens of the bungalows, will be below the recommended guideline values due to the significant acoustic screening provided by the buildings.
- Upgraded glazing has been specified for all habitable rooms as a result of which, the assessment shows that, with windows closed, suitable internal noise levels will be achieved.
- The opening of windows for ventilation may result in levels above the guideline values. Consequently, alternative means of providing both background and cooling ventilation will be required for habitable rooms, thereby negating the need to open windows for that purpose.

5.2 The assessment concludes that, with the provision of these mitigation measures, the site can be suitably developed for residential use and that noise need not be a reason for refusal of planning permission.

6 APPENDICES

Appendix A: Glossary of acoustic terms

Ambient noise: the noise from all sources, both near and far, at any given time. Conventionally defined using the A-weighted equivalent continuous noise level (L_{Aeq}) [see below].

Background noise level (dB L_{A90}): In the UK, the 90th percentile noise level (L_{A90}) is generally used to define 'background' noise. This is a statistical parameter describing the noise level that is exceeded for 90% of the measurement or assessment time. Its value lies in the fact that it is a statistical value, towards the lower end of a measured range of data, and which is relatively 'stable' i.e. not adversely affected by occasional high-energy noise events.

Decibel (dB): a unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 micro-Pascals (μPa), the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB(A) / A-weighting: decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change (in steady noise) of 3 dB(A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to halving or doubling the *loudness* of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

$L_{Aeq,T}$: the equivalent continuous sound level - the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). L_{Aeq} is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} : the maximum single-event noise level attained during a measurement period.

Noise: any audible sound. Often defined as unwanted sound. Can be damaging to hearing if it is too loud or can be just annoying if it interferes with the normal enjoyment of others.

Sound / sound pressure: a fluctuation in air pressure over the static ambient pressure.

Sound pressure level: the sound pressure relative to a standard reference pressure of 20 μPa (20×10^{-6}) on the decibel scale.

Appendix B: Minute measurement data

Table 5: 5-minute measurement data

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
20/04/2022	14:30	66.8	88.9
20/04/2022	14:35	63.6	79.6
20/04/2022	14:40	66.0	81.1
20/04/2022	14:45	63.6	77.7
20/04/2022	14:50	65.2	84.1
20/04/2022	14:55	64.9	81.6
20/04/2022	15:00	63.4	82.7
20/04/2022	15:05	64.3	77.5
20/04/2022	15:10	64.9	81.7
20/04/2022	15:15	63.4	76.6
20/04/2022	15:20	64.4	81.9
20/04/2022	15:25	63.6	79.1
20/04/2022	15:30	64.2	79.8
20/04/2022	15:35	64.5	77.8
20/04/2022	15:40	63.6	76.4
20/04/2022	15:45	64.0	75.6
20/04/2022	15:50	63.3	73.7
20/04/2022	15:55	64.6	81.3
20/04/2022	16:00	63.7	76.5
20/04/2022	16:05	65.2	83.8
20/04/2022	16:10	63.7	76.1
20/04/2022	16:15	63.6	75.2
20/04/2022	16:20	63.4	77.1
20/04/2022	16:25	64.6	77.5
20/04/2022	16:30	65.7	80.7
20/04/2022	16:35	64.4	76.9
20/04/2022	16:40	63.8	76.4
20/04/2022	16:45	64.4	81.7
20/04/2022	16:50	63.7	74.1
20/04/2022	16:55	64.8	77.4
20/04/2022	17:00	64.2	87.4
20/04/2022	17:05	65.4	80.1
20/04/2022	17:10	64.4	75.9
20/04/2022	17:15	69.8	91.7
20/04/2022	17:20	63.7	81.1
20/04/2022	17:25	64.0	76.5
20/04/2022	17:30	64.3	83.3
20/04/2022	17:35	64.9	82.5
20/04/2022	17:40	64.0	75.3

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
20/04/2022	17:45	63.1	75.4
20/04/2022	17:50	63.1	72.7
20/04/2022	17:55	64.7	82.6
20/04/2022	18:00	63.3	78.7
20/04/2022	18:05	65.8	81.6
20/04/2022	18:10	65.4	82.2
20/04/2022	18:15	62.8	73.7
20/04/2022	18:20	63.1	75.8
20/04/2022	18:25	63.2	73.7
20/04/2022	18:30	61.8	73.1
20/04/2022	18:35	64.9	84.2
20/04/2022	18:40	63.8	76.6
20/04/2022	18:45	63.1	74.2
20/04/2022	18:50	63.0	78.2
20/04/2022	18:55	62.7	75.1
20/04/2022	19:00	62.5	75.6
20/04/2022	19:05	62.3	72.8
20/04/2022	19:10	61.7	77.5
20/04/2022	19:15	66.0	87.6
20/04/2022	19:20	64.8	81.4
20/04/2022	19:25	63.3	75.0
20/04/2022	19:30	64.8	84.8
20/04/2022	19:35	62.9	78.7
20/04/2022	19:40	62.7	73.0
20/04/2022	19:45	62.6	77.4
20/04/2022	19:50	64.8	85.5
20/04/2022	19:55	62.0	73.0
20/04/2022	20:00	66.8	88.8
20/04/2022	20:05	61.7	75.4
20/04/2022	20:10	61.8	73.9
20/04/2022	20:15	60.6	74.5
20/04/2022	20:20	60.7	77.0
20/04/2022	20:25	61.1	75.8
20/04/2022	20:30	60.4	73.3
20/04/2022	20:35	62.8	85.8
20/04/2022	20:40	61.8	82.5
20/04/2022	20:45	60.9	73.1
20/04/2022	20:50	60.6	75.4
20/04/2022	20:55	62.3	80.1
20/04/2022	21:00	56.7	72.3
20/04/2022	21:05	59.5	71.2
20/04/2022	21:10	60.4	72.7

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
20/04/2022	21:15	60.4	73.1
20/04/2022	21:20	61.8	76.3
20/04/2022	21:25	67.3	90.9
20/04/2022	21:30	60.6	74.6
20/04/2022	21:35	59.8	72.8
20/04/2022	21:40	60.2	73.8
20/04/2022	21:45	60.5	75.9
20/04/2022	21:50	61.1	74.2
20/04/2022	21:55	61.2	77.6
20/04/2022	22:00	61.9	73.6
20/04/2022	22:05	63.4	79.2
20/04/2022	22:10	58.8	73.7
20/04/2022	22:15	58.8	73.8
20/04/2022	22:20	61.2	76.1
20/04/2022	22:25	58.5	73.9
20/04/2022	22:30	61.3	77.4
20/04/2022	22:35	57.6	74.4
20/04/2022	22:40	57.7	72.1
20/04/2022	22:45	56.0	71.3
20/04/2022	22:50	59.4	76.7
20/04/2022	22:55	59.3	76.4
20/04/2022	23:00	59.9	77.9
20/04/2022	23:05	60.0	78.4
20/04/2022	23:10	58.8	76.5
20/04/2022	23:15	56.9	72.6
20/04/2022	23:20	55.0	71.9
20/04/2022	23:25	56.6	75.2
20/04/2022	23:30	57.3	75.8
20/04/2022	23:35	52.4	71.9
20/04/2022	23:40	60.2	83.3
20/04/2022	23:45	56.4	73.2
20/04/2022	23:50	59.2	82.0
20/04/2022	23:55	60.4	83.0
21/04/2022	00:00	56.6	75.0
21/04/2022	00:05	54.9	75.1
21/04/2022	00:10	55.0	70.4
21/04/2022	00:15	58.2	77.1
21/04/2022	00:20	54.7	74.6
21/04/2022	00:25	48.9	67.0
21/04/2022	00:30	52.1	70.6
21/04/2022	00:35	53.6	72.3
21/04/2022	00:40	51.5	73.6

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	00:45	57.2	76.4
21/04/2022	00:50	58.1	79.1
21/04/2022	00:55	49.7	71.3
21/04/2022	01:00	56.3	74.0
21/04/2022	01:05	38.9	42.1
21/04/2022	01:10	50.7	68.5
21/04/2022	01:15	39.4	50.3
21/04/2022	01:20	47.6	71.6
21/04/2022	01:25	54.8	75.3
21/04/2022	01:30	42.5	59.9
21/04/2022	01:35	49.1	70.7
21/04/2022	01:40	49.7	70.0
21/04/2022	01:45	54.6	75.5
21/04/2022	01:50	54.8	78.4
21/04/2022	01:55	50.5	72.5
21/04/2022	02:00	53.5	72.8
21/04/2022	02:05	52.4	71.2
21/04/2022	02:10	51.0	72.9
21/04/2022	02:15	49.8	69.9
21/04/2022	02:20	54.2	73.3
21/04/2022	02:25	54.8	74.0
21/04/2022	02:30	52.5	75.8
21/04/2022	02:35	48.4	71.5
21/04/2022	02:40	50.0	71.9
21/04/2022	02:45	48.3	71.0
21/04/2022	02:50	45.1	59.8
21/04/2022	02:55	38.9	42.5
21/04/2022	03:00	38.8	41.8
21/04/2022	03:05	48.6	70.3
21/04/2022	03:10	49.3	71.3
21/04/2022	03:15	38.8	41.2
21/04/2022	03:20	49.1	72.0
21/04/2022	03:25	38.9	42.0
21/04/2022	03:30	38.9	41.7
21/04/2022	03:35	39.0	42.0
21/04/2022	03:40	58.7	78.4
21/04/2022	03:45	52.6	73.1
21/04/2022	03:50	56.1	76.6
21/04/2022	03:55	58.4	78.8
21/04/2022	04:00	39.3	43.3
21/04/2022	04:05	39.0	41.6
21/04/2022	04:10	54.5	72.1

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	04:15	49.8	77.5
21/04/2022	04:20	51.1	72.5
21/04/2022	04:25	39.6	48.8
21/04/2022	04:30	51.7	74.0
21/04/2022	04:35	53.6	71.3
21/04/2022	04:40	57.7	76.2
21/04/2022	04:45	52.9	71.4
21/04/2022	04:50	45.6	57.1
21/04/2022	04:55	54.0	71.2
21/04/2022	05:00	55.9	71.5
21/04/2022	05:05	58.3	77.3
21/04/2022	05:10	60.7	80.2
21/04/2022	05:15	59.6	75.8
21/04/2022	05:20	57.7	73.0
21/04/2022	05:25	56.9	72.6
21/04/2022	05:30	61.5	79.7
21/04/2022	05:35	62.7	79.6
21/04/2022	05:40	61.4	76.7
21/04/2022	05:45	62.4	77.8
21/04/2022	05:50	61.4	74.8
21/04/2022	05:55	62.5	76.8
21/04/2022	06:00	59.8	74.6
21/04/2022	06:05	63.1	75.5
21/04/2022	06:10	62.2	76.6
21/04/2022	06:15	64.8	82.6
21/04/2022	06:20	61.6	79.5
21/04/2022	06:25	62.5	76.8
21/04/2022	06:30	62.4	74.5
21/04/2022	06:35	66.5	84.4
21/04/2022	06:40	63.6	74.7
21/04/2022	06:45	65.8	82.1
21/04/2022	06:50	63.9	77.5
21/04/2022	06:55	64.5	83.2
21/04/2022	07:00	63.8	78.2
21/04/2022	07:05	62.7	75.1
21/04/2022	07:10	64.7	79.6
21/04/2022	07:15	65.7	81.2
21/04/2022	07:20	65.8	86.9
21/04/2022	07:25	66.4	80.1
21/04/2022	07:30	65.3	76.7
21/04/2022	07:35	64.1	75.5
21/04/2022	07:40	66.1	79.2

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	07:45	65.8	79.8
21/04/2022	07:50	64.2	79.8
21/04/2022	07:55	63.7	74.8
21/04/2022	08:00	65.0	77.4
21/04/2022	08:05	64.4	77.2
21/04/2022	08:10	65.1	77.9
21/04/2022	08:15	64.4	76.3
21/04/2022	08:20	66.0	85.6
21/04/2022	08:25	63.3	75.4
21/04/2022	08:30	67.8	85.6
21/04/2022	08:35	63.0	74.0
21/04/2022	08:40	64.4	77.5
21/04/2022	08:45	64.3	77.1
21/04/2022	08:50	64.4	77.4
21/04/2022	08:55	63.4	75.6
21/04/2022	09:00	63.8	79.0
21/04/2022	09:05	63.9	79.3
21/04/2022	09:10	64.5	78.6
21/04/2022	09:15	64.6	78.1
21/04/2022	09:20	61.6	72.7
21/04/2022	09:25	65.6	82.2
21/04/2022	09:30	66.0	82.8
21/04/2022	09:35	64.9	80.7
21/04/2022	09:40	63.6	78.0
21/04/2022	09:45	64.3	75.0
21/04/2022	09:50	66.5	86.0
21/04/2022	09:55	64.9	76.8
21/04/2022	10:00	63.7	77.7
21/04/2022	10:05	62.2	74.4
21/04/2022	10:10	65.3	83.0
21/04/2022	10:15	63.7	76.0
21/04/2022	10:20	65.7	80.8
21/04/2022	10:25	63.7	76.6
21/04/2022	10:30	64.2	77.4
21/04/2022	10:35	63.2	76.0
21/04/2022	10:40	65.6	80.5
21/04/2022	10:45	64.7	85.8
21/04/2022	10:50	64.9	77.5
21/04/2022	10:55	65.1	80.6
21/04/2022	11:00	63.2	76.2
21/04/2022	11:05	64.9	76.5
21/04/2022	11:10	62.8	76.0

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	11:15	64.6	83.5
21/04/2022	11:20	63.3	79.2
21/04/2022	11:25	65.7	82.9
21/04/2022	11:30	63.4	76.4
21/04/2022	11:35	65.6	78.8
21/04/2022	11:40	65.2	82.4
21/04/2022	11:45	64.1	79.2
21/04/2022	11:50	66.1	83.4
21/04/2022	11:55	64.2	79.7
21/04/2022	12:00	64.6	86.1
21/04/2022	12:05	65.1	80.0
21/04/2022	12:10	65.4	80.8
21/04/2022	12:15	62.2	76.0
21/04/2022	12:20	64.7	78.7
21/04/2022	12:25	65.5	82.3
21/04/2022	12:30	63.3	76.7
21/04/2022	12:35	64.0	77.3
21/04/2022	12:40	62.8	80.1
21/04/2022	12:45	63.1	75.2
21/04/2022	12:50	65.0	79.6
21/04/2022	12:55	65.9	82.4
21/04/2022	13:00	63.2	75.2
21/04/2022	13:05	64.7	82.7
21/04/2022	13:10	65.0	83.5
21/04/2022	13:15	63.5	76.9
21/04/2022	13:20	63.6	78.3
21/04/2022	13:25	62.9	77.2
21/04/2022	13:30	63.5	75.8
21/04/2022	13:35	64.1	74.5
21/04/2022	13:40	65.6	88.1
21/04/2022	13:45	64.7	82.6
21/04/2022	13:50	65.7	85.2
21/04/2022	13:55	63.8	80.0
21/04/2022	14:00	64.7	84.7
21/04/2022	14:05	63.9	75.8
21/04/2022	14:10	67.3	91.1
21/04/2022	14:15	63.5	80.6
21/04/2022	14:20	63.5	80.6
21/04/2022	14:25	62.3	72.6
21/04/2022	14:30	71.6	92.1
21/04/2022	14:35	63.3	75.3
21/04/2022	14:40	65.6	84.5

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	14:45	63.0	76.9
21/04/2022	14:50	62.9	75.8
21/04/2022	14:55	63.0	73.2
21/04/2022	15:00	63.5	76.1
21/04/2022	15:05	64.1	77.3
21/04/2022	15:10	65.9	86.8
21/04/2022	15:15	63.0	77.1
21/04/2022	15:20	64.1	74.8
21/04/2022	15:25	64.0	82.7
21/04/2022	15:30	64.8	79.9
21/04/2022	15:35	64.0	80.2
21/04/2022	15:40	63.3	74.7
21/04/2022	15:45	62.4	73.1
21/04/2022	15:50	62.8	74.2
21/04/2022	15:55	63.6	76.5
21/04/2022	16:00	63.5	78.0
21/04/2022	16:05	63.8	77.2
21/04/2022	16:10	66.1	79.6
21/04/2022	16:15	63.7	75.7
21/04/2022	16:20	62.7	74.1
21/04/2022	16:25	62.6	77.7
21/04/2022	16:30	63.1	79.6
21/04/2022	16:35	64.5	85.7
21/04/2022	16:40	63.9	74.7
21/04/2022	16:45	62.8	71.7
21/04/2022	16:50	63.4	74.0
21/04/2022	16:55	62.0	73.1
21/04/2022	17:00	63.3	77.8
21/04/2022	17:05	63.5	72.4
21/04/2022	17:10	62.8	79.4
21/04/2022	17:15	62.7	76.6
21/04/2022	17:20	62.8	72.8
21/04/2022	17:25	68.1	87.8
21/04/2022	17:30	62.9	76.2
21/04/2022	17:35	61.7	72.1
21/04/2022	17:40	62.9	77.4
21/04/2022	17:45	62.8	72.2
21/04/2022	17:50	63.9	75.8
21/04/2022	17:55	63.5	76.7
21/04/2022	18:00	64.0	74.0
21/04/2022	18:05	63.0	73.8
21/04/2022	18:10	63.4	74.3

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	18:15	65.5	87.8
21/04/2022	18:20	61.2	75.3
21/04/2022	18:25	63.5	74.3
21/04/2022	18:30	63.1	77.4
21/04/2022	18:35	61.2	73.2
21/04/2022	18:40	63.1	75.1
21/04/2022	18:45	62.4	72.6
21/04/2022	18:50	62.5	71.8
21/04/2022	18:55	61.9	72.0
21/04/2022	19:00	61.9	72.8
21/04/2022	19:05	62.9	79.8
21/04/2022	19:10	63.5	78.1
21/04/2022	19:15	61.5	74.6
21/04/2022	19:20	63.4	78.2
21/04/2022	19:25	60.8	73.6
21/04/2022	19:30	62.7	77.2
21/04/2022	19:35	60.9	72.4
21/04/2022	19:40	61.0	74.2
21/04/2022	19:45	63.4	73.6
21/04/2022	19:50	63.3	80.8
21/04/2022	19:55	71.8	99.7
21/04/2022	20:00	61.5	74.5
21/04/2022	20:05	61.1	72.1
21/04/2022	20:10	62.5	72.3
21/04/2022	20:15	61.9	72.4
21/04/2022	20:20	58.7	73.7
21/04/2022	20:25	61.4	75.5
21/04/2022	20:30	63.8	81.0
21/04/2022	20:35	58.5	71.0
21/04/2022	20:40	63.9	85.2
21/04/2022	20:45	61.2	75.2
21/04/2022	20:50	60.3	72.4
21/04/2022	20:55	61.1	74.0
21/04/2022	21:00	61.3	74.5
21/04/2022	21:05	60.7	76.3
21/04/2022	21:10	61.7	72.6
21/04/2022	21:15	58.8	73.0
21/04/2022	21:20	60.8	72.3
21/04/2022	21:25	60.4	75.5
21/04/2022	21:30	58.2	71.6
21/04/2022	21:35	61.1	72.9
21/04/2022	21:40	61.1	80.5

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
21/04/2022	21:45	60.9	76.4
21/04/2022	21:50	61.5	81.0
21/04/2022	21:55	61.2	73.1
21/04/2022	22:00	60.3	73.7
21/04/2022	22:05	63.2	75.6
21/04/2022	22:10	63.6	81.3
21/04/2022	22:15	58.6	71.6
21/04/2022	22:20	59.2	74.2
21/04/2022	22:25	59.6	72.4
21/04/2022	22:30	57.9	72.4
21/04/2022	22:35	57.1	70.9
21/04/2022	22:40	58.3	73.6
21/04/2022	22:45	53.8	71.1
21/04/2022	22:50	58.9	78.1
21/04/2022	22:55	57.4	73.4
21/04/2022	23:00	56.8	73.1
21/04/2022	23:05	59.6	82.1
21/04/2022	23:10	60.6	81.2
21/04/2022	23:15	58.2	75.2
21/04/2022	23:20	57.0	74.5
21/04/2022	23:25	55.7	70.4
21/04/2022	23:30	56.8	72.0
21/04/2022	23:35	57.4	74.1
21/04/2022	23:40	58.0	75.1
21/04/2022	23:45	56.0	75.3
21/04/2022	23:50	56.9	73.0
21/04/2022	23:55	55.2	72.9
21/04/2022	00:00	51.1	69.5
22/04/2022	00:05	51.0	68.8
22/04/2022	00:10	56.2	71.8
22/04/2022	00:15	59.0	77.2
22/04/2022	00:20	56.0	74.5
22/04/2022	00:25	55.9	74.7
22/04/2022	00:30	57.3	76.7
22/04/2022	00:35	58.9	80.6
22/04/2022	00:40	52.0	70.2
22/04/2022	00:45	54.2	73.6
22/04/2022	00:50	55.3	74.0
22/04/2022	00:55	55.7	74.5
22/04/2022	01:00	51.8	73.1
22/04/2022	01:05	56.0	79.0
22/04/2022	01:10	53.8	76.8

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
22/04/2022	01:15	53.9	75.4
22/04/2022	01:20	53.3	69.7
22/04/2022	01:25	56.2	73.5
22/04/2022	01:30	53.1	72.7
22/04/2022	01:35	51.2	69.8
22/04/2022	01:40	51.0	69.9
22/04/2022	01:45	48.0	69.9
22/04/2022	01:50	53.5	74.3
22/04/2022	01:55	49.4	69.5
22/04/2022	02:00	50.6	71.5
22/04/2022	02:05	51.8	72.2
22/04/2022	02:10	48.2	71.0
22/04/2022	02:15	47.8	65.0
22/04/2022	02:20	50.1	70.4
22/04/2022	02:25	47.1	68.8
22/04/2022	02:30	55.9	76.3
22/04/2022	02:35	45.0	65.9
22/04/2022	02:40	51.4	72.6
22/04/2022	02:45	52.2	72.4
22/04/2022	02:50	37.7	43.0
22/04/2022	02:55	50.0	67.3
22/04/2022	03:00	52.9	75.7
22/04/2022	03:05	52.5	73.6
22/04/2022	03:10	37.8	48.1
22/04/2022	03:15	37.1	39.4
22/04/2022	03:20	51.0	72.3
22/04/2022	03:25	37.3	41.1
22/04/2022	03:30	37.3	41.6
22/04/2022	03:35	38.0	47.1
22/04/2022	03:40	50.7	73.2
22/04/2022	03:45	37.2	42.9
22/04/2022	03:50	42.6	60.6
22/04/2022	03:55	53.9	71.3
22/04/2022	04:00	53.0	71.7
22/04/2022	04:05	52.7	72.3
22/04/2022	04:10	50.9	70.1
22/04/2022	04:15	38.3	49.2
22/04/2022	04:20	46.8	69.3
22/04/2022	04:25	55.9	77.8
22/04/2022	04:30	55.3	75.0
22/04/2022	04:35	49.1	72.0
22/04/2022	04:40	52.6	70.6

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
22/04/2022	04:45	56.1	72.3
22/04/2022	04:50	53.0	73.1
22/04/2022	04:55	52.9	75.2
22/04/2022	05:00	56.5	76.2
22/04/2022	05:05	55.5	75.2
22/04/2022	05:10	58.3	72.2
22/04/2022	05:15	56.5	73.6
22/04/2022	05:20	60.3	75.1
22/04/2022	05:25	59.8	75.8
22/04/2022	05:30	55.7	71.0
22/04/2022	05:35	61.2	76.9
22/04/2022	05:40	60.0	74.0
22/04/2022	05:45	61.4	75.1
22/04/2022	05:50	62.1	75.0
22/04/2022	05:55	62.7	79.5
22/04/2022	06:00	59.2	73.3
22/04/2022	06:05	60.9	80.0
22/04/2022	06:10	65.2	79.8
22/04/2022	06:15	60.4	76.7
22/04/2022	06:20	62.2	78.1
22/04/2022	06:25	61.0	74.8
22/04/2022	06:30	62.6	77.2
22/04/2022	06:35	59.0	73.1
22/04/2022	06:40	62.1	74.0
22/04/2022	06:45	62.3	76.6
22/04/2022	06:50	62.2	75.9
22/04/2022	06:55	64.4	79.7
22/04/2022	07:00	62.2	74.8
22/04/2022	07:05	64.5	81.3
22/04/2022	07:10	62.7	77.4
22/04/2022	07:15	62.8	74.8
22/04/2022	07:20	63.3	74.7
22/04/2022	07:25	63.3	75.0
22/04/2022	07:30	65.6	81.6
22/04/2022	07:35	64.1	75.0
22/04/2022	07:40	64.6	78.1
22/04/2022	07:45	64.1	77.9
22/04/2022	07:50	69.4	95.3
22/04/2022	07:55	64.0	75.6
22/04/2022	08:00	65.3	84.3
22/04/2022	08:05	65.7	81.6
22/04/2022	08:10	63.1	75.3

Date	Time	Measured noise (dB)	
		L _{Aeq}	L _{AFmax}
22/04/2022	08:15	63.4	77.4
22/04/2022	08:20	64.1	73.5
22/04/2022	08:25	68.0	89.2
22/04/2022	08:30	64.5	86.8
22/04/2022	08:35	63.4	78.9
22/04/2022	08:40	64.5	79.5
22/04/2022	08:45	63.7	76.9
22/04/2022	08:50	64.7	76.7
22/04/2022	08:55	62.7	73.0
22/04/2022	09:00	63.5	83.3
22/04/2022	09:05	64.2	79.0
22/04/2022	09:10	64.4	75.1
22/04/2022	09:15	64.1	77.1
22/04/2022	09:20	64.5	77.6
22/04/2022	09:25	63.3	76.4
22/04/2022	09:30	65.4	81.3
22/04/2022	09:35	64.0	75.9
22/04/2022	09:40	64.2	76.4
22/04/2022	09:45	64.8	86.7
22/04/2022	09:50	63.9	75.2
22/04/2022	09:55	63.4	78.5
22/04/2022	10:00	65.4	81.7
22/04/2022	10:05	62.7	73.2
22/04/2022	10:10	64.3	74.8
22/04/2022	10:15	63.3	75.5
22/04/2022	10:20	63.9	77.5
22/04/2022	10:25	63.0	73.2
22/04/2022	10:30	63.9	79.8
22/04/2022	10:35	63.7	76.6
22/04/2022	10:40	64.7	80.2
22/04/2022	10:45	64.8	80.1
22/04/2022	10:50	68.5	86.6

Appendix C: Example glazing specifications

Figure 12: Example glazing specification providing 43 dB $R_w + C_{tr}$

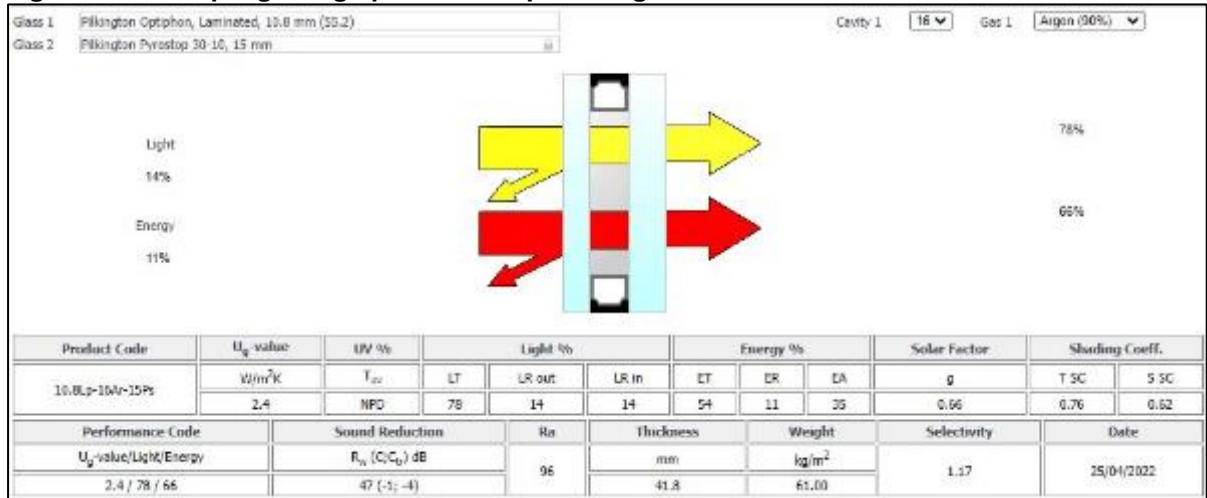


Figure 13: Example glazing specification providing 39 dB $R_w + C_{tr}$

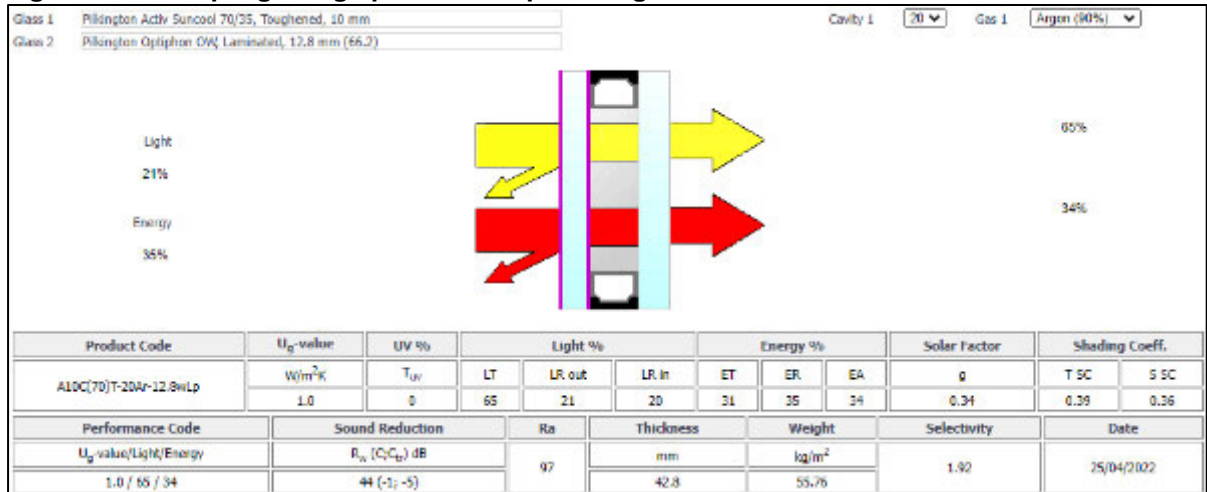


Figure 14: Example glazing specification providing 38 dB $R_w + C_{tr}$

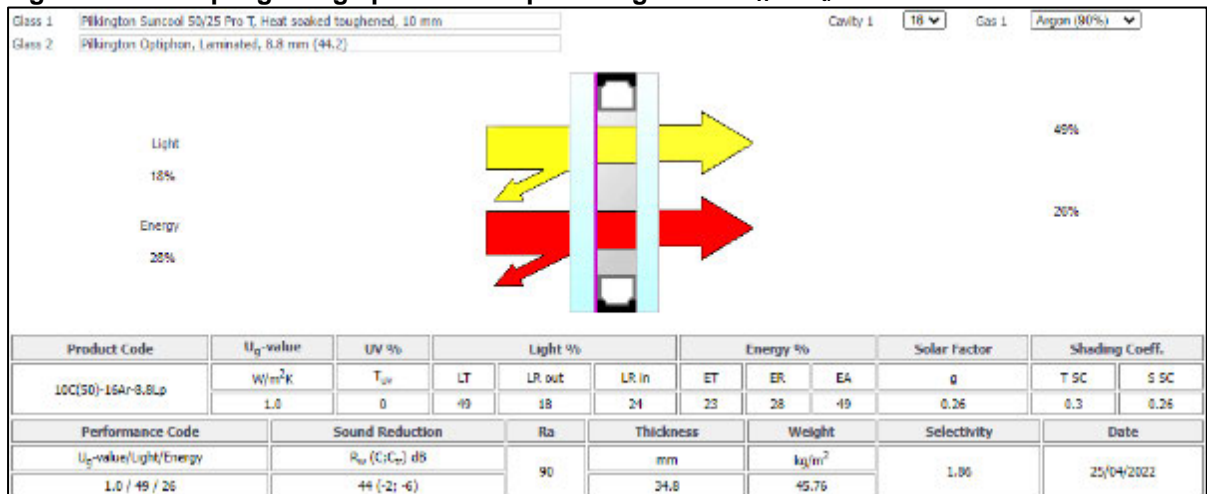


Figure 15: Example glazing specification providing 33 dB $R_w + C_{tr}$

