

RESIDENTIAL DEVELOPMENT ON LAND OFF CARR LANE, PRESCOT
ROAD TRAFFIC NOISE IMPACT ASSESSMENT

On behalf of:
Partner Construction Ltd

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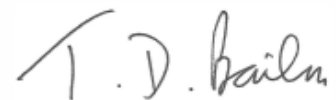
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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by Partner Construction Ltd to carry out a road traffic noise impact assessment in connection with a full planning application for residential development on land off Carr Lane, Prescott. Specifically, this assessment is an update of a previous report (HAL ref P16-225-R01v1, dated July 2016), which was initially produced to support an outline planning application by United Utilities.
- 1.2 The location of the development land is shown in Figure 1. Figure 1 shows that the site extends south-westwards from the roundabout at Carr Lane towards the M57 Motorway, with a relatively small boundary with the motorway. At this point the motorway is elevated on an embankment.
- 1.3 The adjacent land to the north-west, on the other side of Prescott Brook, is a country park with a fishing pond. To the south is a large residential development which was delivered by various housebuilders via various reversed matters applications.
- 1.4 It is proposed to develop the site for residential use with 88 dwellings consisting of 2-4 bedroom semi-detached, detached & mews style houses. Vehicular access to the development will be via Prescott Parkway, the formation of which was granted planning permission in April 2023 (ref. 22/00376/FUL).
- 1.5 The assessment has been based on the latest layout as provided by United Living Group Limited. The proposed layout of the development is shown in Figure 4.
- 1.6 The noise assessment has included:
- An inspection of the site and surrounding area;
 - Measurement of road traffic noise levels during the daytime and at night;
 - Assessment of the potential impact of road traffic noise on the development land;
 - Recommendation of appropriate mitigation measures.
- 1.7 This report is an update of the previous assessment to consider the implications of an acoustic fence off site along the western boundary of M57 Motorway.
- 1.8 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 GUIDANCE AND ACOUSTIC DESIGN CRITERIA

NPPF:2023

- 2.1 Paragraph 191 of the National Planning Policy Framework (NPPF) 2023 states that planning policies and decisions should *“ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;”*

NPSE:2010

- 2.2 The Noise Policy Statement for England (NPSE) 2010, which is referred to in NPPF, includes three aims:
- i. Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
 - ii. Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
 - iii. Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

Local Policy

- 2.3 Knowsley Local Plan Core Strategy January 2016 has two policies which relate to noise. CS19 Design Quality and Accessibility in New Development states:

“The design of new development should avoid unacceptable impacts which affect the amenity and living conditions of occupiers of buildings. Such effects can include generation of noise...”

2.4 Policy ENV2 Noise and Vibration states:

“Where a development would be likely to... be sensitive to an existing noise source, the Council will require that a noise assessment report be submitted as part of the planning application. The proposals will also need to incorporate any necessary measures to reduce noise or disturbance to acceptable levels. Where developments are permitted, 3 conditions may be attached to the planning permission to ensure effective noise insulation or other required mitigation measures are carried out.”

BS 8233:2014

- 2.5 No specific guidance is given in the NPPF on acoustic design criteria, therefore, the guidance discussed below has been used for acoustic design purposes.
- 2.6 Guidance on acceptable noise levels in habitable rooms and private gardens is set out in British Standard 8233: 2014, ‘Guidance on sound insulation and noise reduction for buildings’. BS 8233 recommends that it is desirable that noise from external sources does not exceed the guidelines values that are shown in Table 1 inside habitable rooms for daytime (07:00 – 23:00 hours) and night-time (23:00 – 07:00 hours) periods.

Table 1: BS 8233:2014 recommended acoustic design criteria (dB $L_{Aeq,T}$)

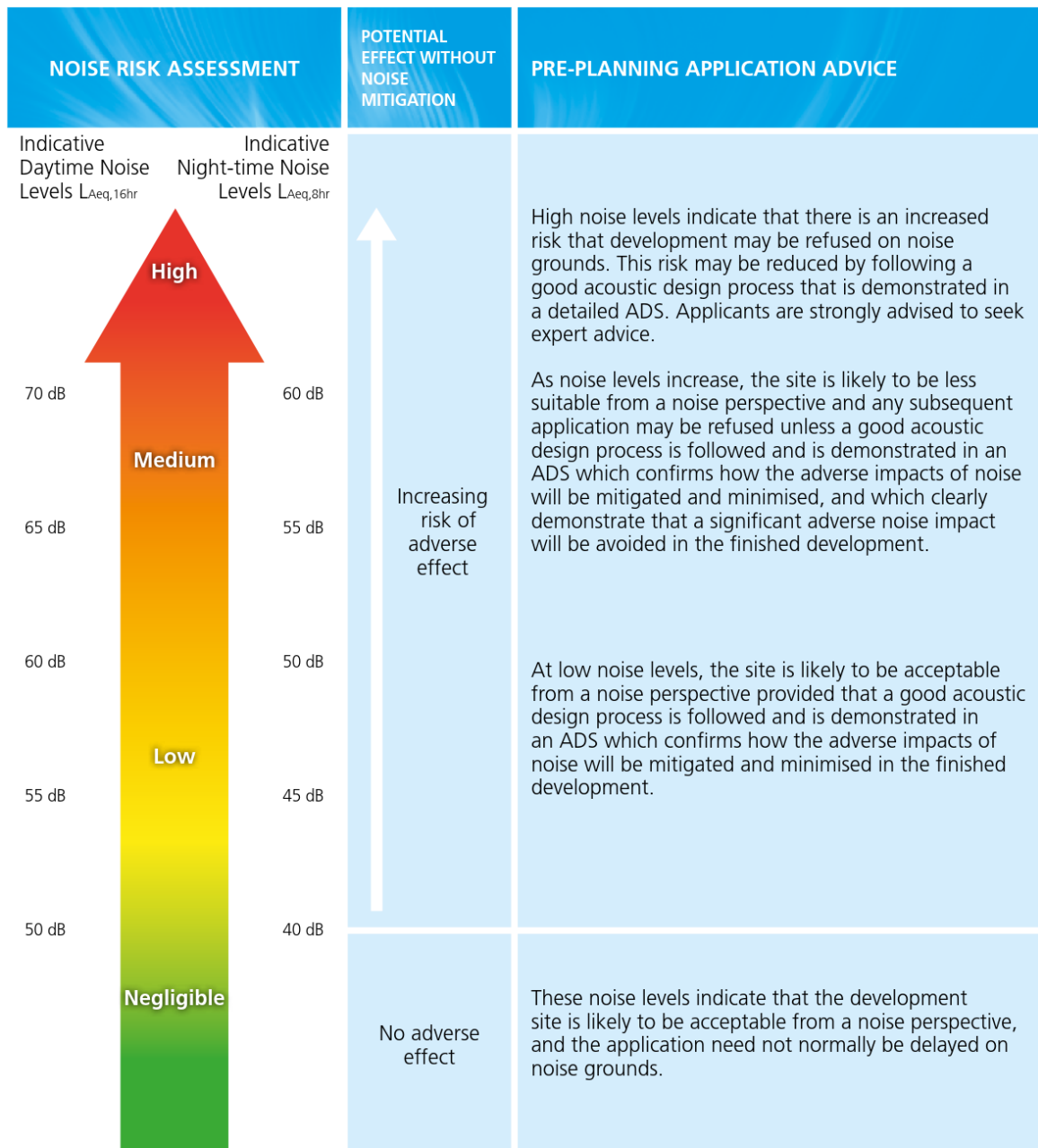
Activity	Location	Daytime 07:00 – 23:00 hours	Night-time 23:00 – 07:00 hours
Resting	Living room	35	-
Dining	Dining room/area	40	-
Sleeping (daytime resting)	Bedroom	35	30

- 2.7 BS 8233 also states that, “where development is considered necessary or desirable ... the internal target levels [i.e. those in Table 1 of this report] may be relaxed by up to 5dB and reasonable internal conditions still achieved”.
- 2.8 BS 8233 also recognises that regular individual noise events at night can cause sleep disturbance. Peaks of noise from individual events are usually described in terms of L_{AFmax} values and these can be highly variable and unpredictable.
- 2.9 For private outdoor amenity spaces of the new houses (e.g. rear gardens) BS8233 states that ‘it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,16hr}$ with an upper guideline value of 55 dB $L_{Aeq,16hr}$ which would be acceptable in noisier environments’. In our experience, most local

planning authorities have traditionally adopted, or accepted, the 55 dB(A) guideline value for rear gardens of proposed new residential developments near busy roads. However, the standard also recognises that these guideline values are not achievable in all circumstances where development might be desirable and in such cases, for sites near to the 'strategic transport network' higher noise levels than 55 dB $L_{Aeq,16hr}$ in gardens may be acceptable.

ProPG

- 2.10 There is also guidance in 'ProPG: Planning & Noise – New Residential Development' (2017), although this guidance does not constitute official government guidance and has no legal standing. The ProPG describes a staged approach to the assessment of noise impact on proposed new residential development sites. Stage 1 is an initial site noise risk assessment, indicating whether the proposed site is considered to pose a negligible, low, medium or high risk from a noise perspective.
- 2.11 The ProPG initial site noise risk assessment criteria are shown in Chart 1.

Chart 1: ProPG Stage 1: Initial Site Noise Risk Assessment Criteria**Figure 1 Notes:**

- Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".
- $L_{Aeq,16hr}$ is for daytime 0700 – 2300, $L_{Aeq,8hr}$ is for night-time 2300 – 0700.
- An indication that there may be more than 10 noise events at night (2300 – 0700) with $L_{Amax,F} > 60$ dB means the site should not be regarded as negligible risk.

2.12 Chart 1 broadly sets out indicative noise levels that define the element of risk of noise impact on proposed residential development land, ranging from 'Negligible' to 'High'.

- 2.13 The guidance states that these noise levels *“should be interpreted flexibly having regard to the locality, the project and the wider context”*.
- 2.14 The ProPG criteria apply to residential development land that is exposed to transportation noise or mixed transportation noise and industrial/commercial noise where the latter is not the dominant noise source. Stage 2 of the ProPG approach is a more detailed assessment in the form of an Acoustic Design Statement (ADS). However, the acoustic design criteria that are specified in ProPG, and which forms the basis of the ADS, are essentially the same as those recommended in BS8233, as summarised previously in Table 1 of this report.
- 2.15 Similarly to BS 8233, ProPG recognises that regular individual noise events at night can cause sleep disturbance. The ProPG guidance suggests that for design purposes, wherever practicable, peaks of noise inside bedrooms from external sources should not exceed 45 dB $L_{A_{fmax}}$ more than 10 times per night’.

Acoustic Design Criteria

- 2.16 For this development we therefore recommend the following noise criteria be adopted in respect of road traffic noise with windows closed and trickle ventilation provided:
- Daytime noise below 35 dB $L_{Aeq,16hr}$ inside living rooms and bedrooms, 40 dB $L_{Aeq,16hr}$ inside dining rooms; and
 - Night-time noise levels not exceeding 30 dB $L_{Aeq,8hr}$ and generally not exceeding 45 dB $L_{A_{fmax}}$ in bedrooms (i.e. no more than 10 times per night).
- 2.17 For this development, we have adopted a design criterion of 55 dB $L_{Aeq,16hr}$ in gardens as far as is practicable.
- 2.18 Our outline noise mitigation recommendations are described in Section 5.0.

3.0 NOISE SURVEY

2016 Road Traffic Noise Survey

- 3.1 Noise measurements have been carried out at a number of locations on the site. The land is not secure and so it was not possible to carry out long-term noise monitoring by installing unattended auto-logging noise meters on the site. Instead 'attended' noise monitoring was carried out for representative periods of the daytime and night/early morning. Some parts of the site are overgrown by vegetation which limited possible locations for noise monitoring.
- 3.2 Noise measurements were carried out at four locations on the site. The purpose of the survey was to measure road traffic noise from the Motorway. The measurement locations are indicated in Figure 1 and are described below:
- Location 1: South-west area – 20m back from capped mine shaft enclosure;
 - Location 2: Central Area North – by overgrown drainage channel;
 - Location 3: Central Area South – by overgrown drainage channel;
 - Location 4: North-Easternmost area near Carr Lane roundabout.
- 3.3 Attended daytime measurements were carried out between approximately 12:00 and 15:40 hours on Friday 20 May 2016. Night-time/early morning noise measurements were taken during the early hours of 29 June 2016 between 04:00 and 07:00 i.e. to include any early morning goods lorries and the noisiest hour of the night (06:00-07:00).
- 3.4 The noise survey was carried out in terms of a series of 15-minute measurements. The noise measurements were taken in 'free-field' conditions and at a microphone height of approximately 1.4m above the ground. Calibration checks were carried out both before and after the measurement periods with no variance in levels noted. Frequency analysis was also carried out.
- 3.5 The results of the noise survey are summarised in Table 2 (overleaf), and the full results along with details of the equipment used, and the weather conditions during the survey periods, are shown in Appendix II.

Table 2: Summary of measured noise levels (dB $L_{Aeq,15mins}$)

Location	Daytime	Night-time
1. South-west Area, 20m from mine cap enclosure	67 – 69	59 – 68
2. Central Area - North	61 – 63	55 – 63
3. Central Area - South	61	51 – 59
4. North-Eastern Area near roundabout	58	52 – 60

- 3.1 Motorway noise was the dominant noise source across the site. At the northern end of the site there was little traffic noise impact from the roundabout on Carr Lane. Other noise noted during the survey was intermittent noise from earthmoving plant and machinery (daytime only), distant aircraft and birdsong.

Updated Daytime Noise Survey

- 3.2 Updated noise measurements were undertaken on the site at the same four locations as indicated in Figure 1 and described above. Attended daytime measurements were carried out between approximately 10:30 and 13:20 hours on Thursday 23 July 2023, and carried out in terms of a series of 5-minute measurements. The noise measurements were taken in ‘free-field’ conditions and at a microphone height of approximately 1.4m above the ground. Calibration checks were carried out both before and after the measurement periods with no variance in levels noted. Frequency analysis was also carried out.
- 3.3 The results of the noise survey are summarised in Table 3, and the full results along with details of the equipment used, and the weather conditions during the survey periods, are shown in Appendix II.

Table 3: Summary of measured noise levels (dB)

Location	$L_{Aeq,5mins}$
1. South-west Area, 20m from mine cap enclosure	64 – 66
2. Central Area - North	55 – 56
3. Central Area - South	56
4. North-Eastern Area near roundabout	55 – 57

- 3.4 Again, motorway road traffic was the dominant noise on site. The measured noise levels are 2-5 dB below the noise levels measured 2016, which is likely to be due to a number of factors including completion of the residential development to the south, fluctuations in vehicle movements, and differences in weather conditions, i.e. wind direction.

- 3.5 However, to provide a robust assessment, the higher road traffic noise levels have been considered in the determination of road traffic noise exposure values, as set out below.

Analysis

- 3.6 Daytime noise levels have been evaluated in accordance with the 'shortened measurement method' described in the Department of Transport document '*Calculation of Road Traffic Noise*' (CRTN), 1988. The memorandum was prepared to enable entitlement under the *Noise Insulation Regulations* 1975 to be determined, but as is stated in the document, the guidance is equally appropriate to the calculation of traffic noise for land use planning purposes.
- 3.7 The CRTN shortened measurement method involves taking noise measurements ($L_{A10,T}$) over representative sample time periods within any three consecutive hours between 10:00 and 17:00. By using the $L_{A10,3hr}$ as the arithmetic mean of the measured $L_{A10,T}$ values, the $L_{A10,18hr}$ value can then be calculated. The correction to obtain the $L_{A10,18hr}$ value from the $L_{A10,3hr}$ level is -1 dB.
- 3.8 The $L_{A10,18hr}$ values have then been converted into the equivalent $L_{Aeq,16hr}$ values by applying a correction of -2 dB in accordance with para. 6.2.2 of British Standard 8233.
- 3.9 The measured night-time $L_{Aeq,T}$ values have been averaged logarithmically to obtain a $L_{Aeq,3hr}$ value which has been taken as a pessimistic estimate of the night-time $L_{Aeq,8hr}$ value. Therefore, the '16 hour' daytime and '8 hour' night-time road traffic noise exposure levels are shown in Table 4.

Table 4: Road Traffic Noise Exposure Levels (dB)

Location	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$
1. South-west Area, 20m from mine cap enclosure	68	65
2. Central Area - North	62	61
3. Central Area - South	61	56
4. North-Eastern Area near roundabout	58	58

- 3.10 The measured short-term peaks of traffic noise at night were up to 73 dB L_{AFmax} on the development land. The results of the noise survey have been used as a basis for calibrating a computerised traffic noise model for the development site, which is described in Section 4.0.
- 3.11 The calculated traffic noise exposure values have been used to determine the type and extent of any noise mitigation measures that are necessary for the proposed development to achieve appropriate noise design criteria. Our outline recommendations for noise mitigation are described in Section 5.0.

4.0 NOISE ASSESSMENT

Computer Noise Model

- 4.1 Noise calculations have been carried out using the CadnaA noise prediction software for daytime (i.e. 07:00 – 23:00 hours) and night-time (i.e. 23:00 – 07:00 hours) periods. The technique uses a 3-dimensional computer model of the topography of the site and the surrounding area as a basis for undertaking automated noise calculations. Geographical data for the site and surroundings (including ground height data) was obtained from available Ordnance Survey data.
- 4.2 The noise calculations have been undertaken using the algorithms set out in the Department of Transport Memorandum 'Calculation of Road Traffic Noise' (CRTN) (1988). The memorandum was prepared to enable entitlement under the Noise Insulation Regulations 1975 to be determined, but it is stated in the document, that the guidance is equally appropriate to the calculation of traffic noise for land use planning purposes.
- 4.3 The measured site noise levels have been used to calibrate the noise model. It should be noted however that, for some parts of the site, the output of the noise model indicates slightly lower noise levels to towards the north and slightly higher to the south compared to the measured noise levels. This is due to a number of factors such as the accuracy of the ground contour data provided and the limitations of the CRTN method of calculation.
- 4.4 The proposed site layout including a proposed acoustic fence along the western, northern boundaries of the site and acoustic fencing around some garden plots. The contour plots of the road traffic noise are shown for the proposed development site in Figures 2 and 3 for daytime ($L_{Aeq,16hrs}$) and night-time ($L_{Aeq,8hrs}$) at 1.5 and 4 metres above the ground respectively.
- 4.5 The results of these calculations have been used to assess the level of impact from road traffic noise across the development site.
- 4.6 It is understood that, following a number of discussions with Knowsley Council, in relation to acoustic fences it is proposed for the Council to construction an acoustic fence along the western boundary of the Motorway to control noise levels from road traffic. The position and height of the proposed fence is determined by non-acoustic issues with the acoustic fence installed to replace an existing chain link fence on the land to the west of the Motorway.

- 4.7 Therefore, a number of scenarios have been investigated to determine the height and extent of the acoustic fence and therefore the noise contour plots (shown in Figures 2 and 3) now include an acoustic fence 4 metres in height to the west of the Motorway. The position of the acoustic fence is indicated in Figure 4.

Initial Noise Risk Assessment

- 4.8 The road traffic noise exposure levels on the facades of the dwellings in the western area of the site fall below the 'Medium' risk category of ProPG in the daytime, this reduces to 'Low' in parts of the site further away from the Motorway. At night, the closest dwellings in the southwest corner of the site are exposed to noise levels 'High' risk category with the rest of the site within the 'Medium' risk category.
- 4.9 It is considered that traffic noise levels do not impose any significant constraints to residential development of the site, however traffic noise levels in areas nearest to the Motorway do need to be taken into account and adequate noise mitigation provided where necessary.
- 4.10 Our outline noise mitigation recommendations are described in Section 5.0.

5.0 NOISE MITIGATION SCHEME

5.1 Our outline noise mitigation recommendations are described below.

Acoustic Fence along Western Boundary

5.2 It was initially proposed to install acoustic bund/fence barriers along the western and northern boundaries of the site. However, during a meeting with Knowsley Council in September 2023 concerns were raised about non-acoustic matters around safety and isolation. Furthermore, constraints relating to the protection of trees etc has instigated a redesign of the proposed screening in order to be considerate of the non-acoustic factors associated with the site while also protecting residential amenity as far as practical.

5.3 Further concerns were raised by Knowsley Council in April 2024 relating to the control of noise at the facades of the dwellings most exposed to Motorway noise. The Council have stated that “...all reasonable measures in place to reduce the noise level as much as possible...”. Given that the noise contours now include the most feasible acoustic fence along the western side of the Motorway, it is considered that this demonstrates the lowest feasible noise levels have been achieved on the development site.

Gardens

5.4 The proposed on-site mitigation scheme incorporates 2.1 metre acoustic fencing around the most exposed garden plots. The current site layout with the positioning of buildings so the majority of rear gardens will be located away from the motorway to be screened by the houses themselves. Hence, noise levels in the majority of rear gardens will be below the 55 dB $L_{Aeq,16hr}$ criterion.

5.5 However, a small number (i.e. five) of gardens are exposed to noise levels up to 57 dB $L_{Aeq,16hr}$. These plots can be optimised with acoustic fencing to reduce noise as far as practical. Although this is above the guideline value of 55 dB $L_{Aeq,16hr}$, BS8233 recognises that this guideline value may not be achievable in all circumstances.

5.6 In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces. It is generally accepted that a change of 3 dBA is the minimum perceptible under normal circumstances. Therefore, with the acoustic fence in place noise levels in garden plots would not be unacceptable.

- 5.7 The proposed acoustic fencing must be imperforate (i.e. have no holes or gaps), have a surface mass no less than 10 kg/m² and be at least 20mm thick and include appropriate gravel boards.
- 5.8 Suppliers of proprietary acoustic fences include GRAMM Barrier Systems Ltd (www.grammbarriers.com) Jacksons Fencing (www.jacksons-fencing.co.uk), Guardian Fencing (www.guardianfencing.com) and Ransfords (www.ransfords.co.uk).

Glazing

- 5.9 Of the 88 dwellings proposed there are 14 no. which are exposed to noise levels above 60 dB $L_{Aeq,8hr}$ Break in calculations have been carried out for the most exposed plots and provided in the Appendix at the end of this report.
- 5.10 We recommend the bedrooms most exposed to road traffic noise are fitted with 29 dB $R_w + C_{tr}$ specification of double glazing (ass a minimum). The following are examples of this specification:
- 6.4mm Solaglas 'Stadip Silence' laminated glass - nominal (8-20mm) cavity - 4mm glass; or
 - 6mm glass - nominal (8-20mm) cavity - 4mm glass.
- 5.11 For all other bedrooms, and all other living rooms, on the development (i.e. those not referred to above), we recommend standard double glazing of 4mm glass - nominal (10-16mm) cavity - 4mm glass (25 dB $R_w + C_{tr}$).
- 5.12 Due care and attention must be taken to ensure that all glazing is well-fitted.

Ventilation

- 5.13 All living rooms and bedrooms most exposed to road traffic noise, as indicated in Figure 2, will require an acoustically treated means of ventilation, instead of standard window frame slot vents, to achieve the internal noise criteria. The ventilation system should achieve a performance of above 40 dB $D_{n,e,w}$ The following are examples of trickle and through wall ventilators which meet this specification:
- Aereco EHA2 Acoustic Trickle Ventilator with acoustic canopy and sleeve (44 dB $D_{n,e,w}$); or
 - Rytons AAC125HP Super Acoustic Controllable LookRyt AirCore Ventilator (43 dB $D_{n,e,w}$); or
 - Another ventilation system with a good acoustic performance.
- 5.14 Ventilation proposals will need to be agreed with the Council at an early stage.

Planning Condition

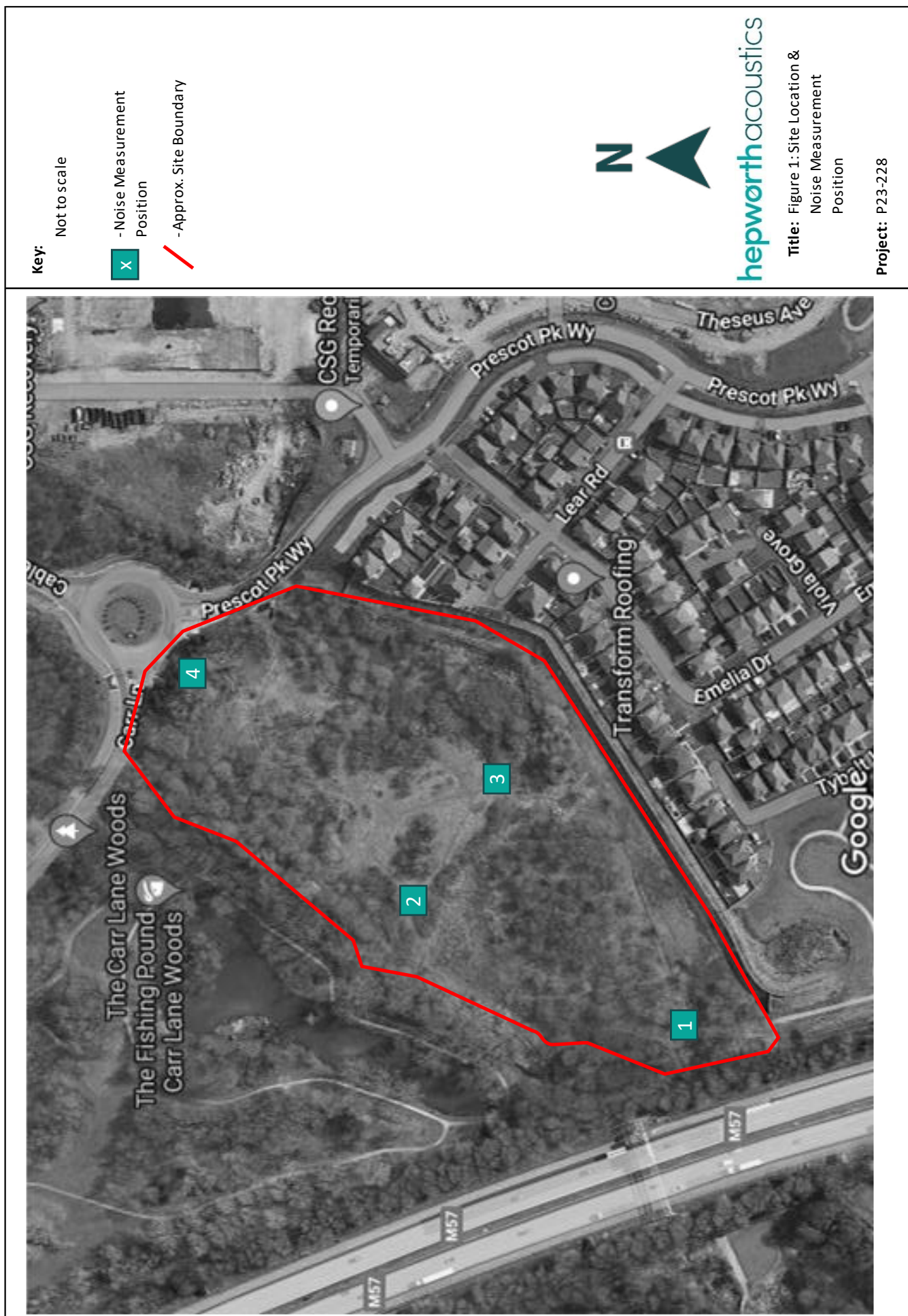
- 5.15 The need to ensure that an adequate scheme of noise mitigation is implemented can be formalised by an appropriately worded planning condition that requires a scheme of noise mitigation measures as described in this report to be implemented prior to occupation of relevant dwellings.

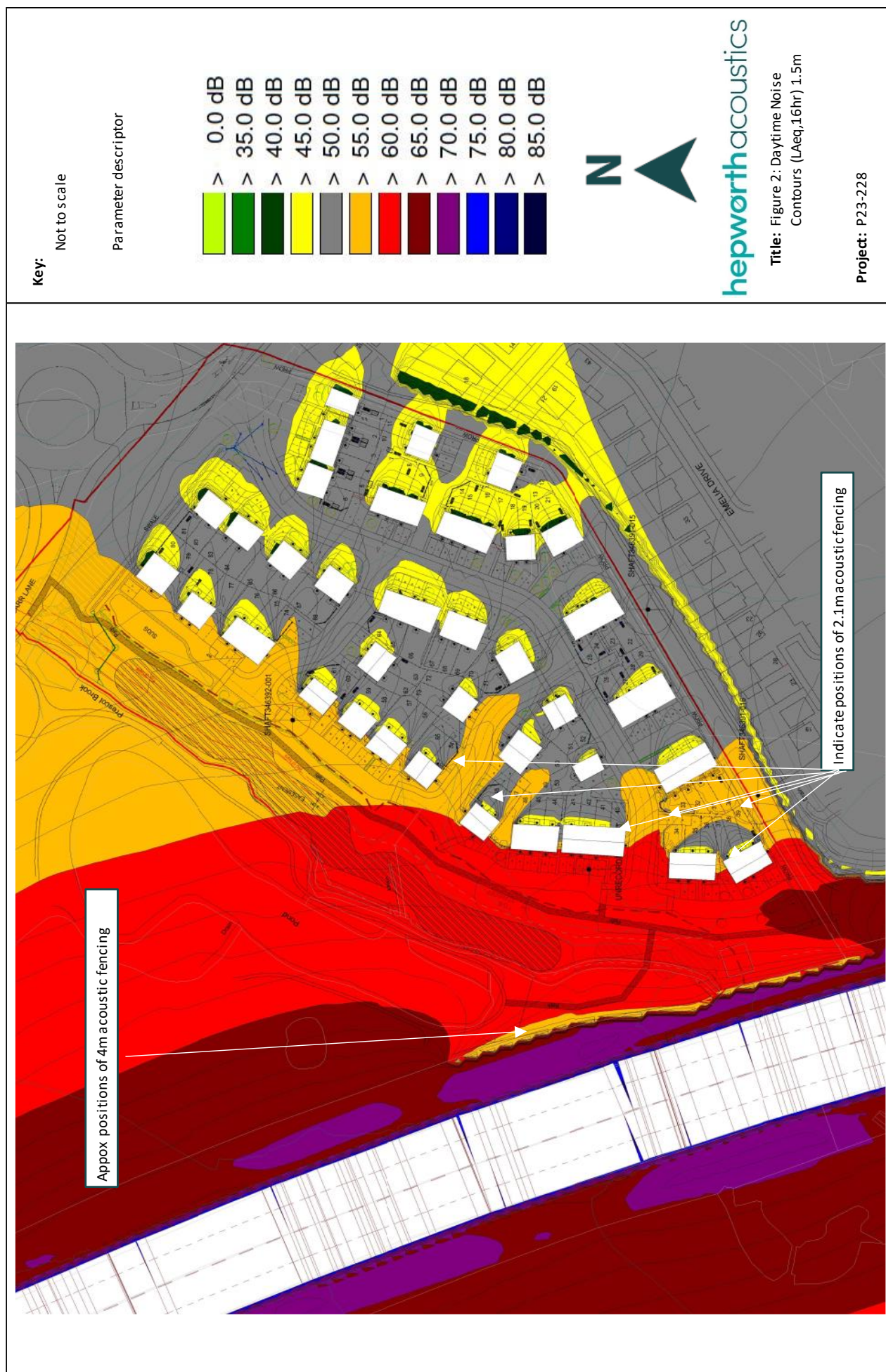
Conclusion

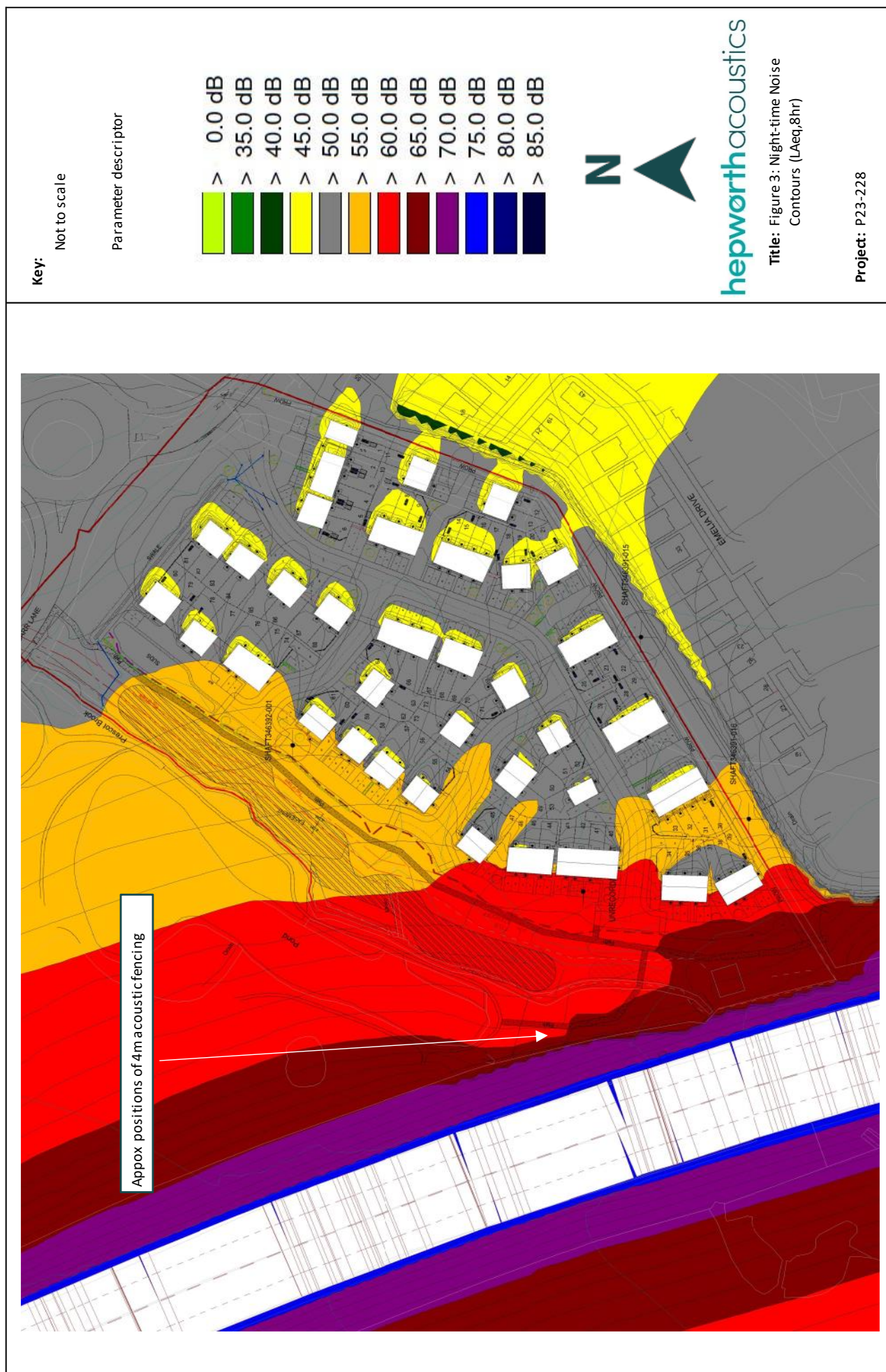
- 5.16 Subject to the recommendations for mitigation measures made above we conclude that potential noise impact from road traffic would not result in any unacceptable harm to residential amenity by reason of noise disturbance.
- 5.17 Furthermore, 'significant adverse impacts' would be avoided and 'adverse impacts' would be mitigated/minimised, bringing the development in line with the aims of the Noise Policy Statement for England (NPSE) 2010 and local policy.

6.0 SUMMARY

- 6.1 The impact of road traffic noise has been assessed for the proposed residential development on land off Carr Lane, Prescott.
- 6.2 Road traffic noise levels have been measured at a sample of locations on the development land during representative periods of the daytime and night/early morning. As one would expect, the noise levels from the nearby M57 motorway were found to be significant.
- 6.3 Including the proposed Motorway acoustic fence the road traffic noise exposure levels at the proposed positions of dwellings on the site fall in to, and between, the 'Low' and 'Medium' risk categories of ProPG in the daytime, with a small area falling into the 'High' category at night. The rest of the site falls into the 'Medium' category at night.
- 6.4 We have recommended that an appropriate scheme of sound insulation is implemented for the new houses that will protect the amenity of the new residents.
- 6.5 The implementation of an adequate scheme of noise mitigation measures can be ensured by the use of an appropriately worded planning condition.









Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

- C_{tr} This is an A-weighted urban traffic noise spectrum, which can be added to $D_{nT,w}$ or R_w in some standards to take into account different source spectra such as low frequency sound.
- R This is the 'Sound Reduction Index' as measured in a laboratory, and is a measure of the sound insulation properties of a building element in a stated frequency band.
- R_w This is the 'Weighted Sound Reduction Index', and is a single figure quantity of R , the laboratory measured Sound Reduction Index.
- $D_{n,e,w}$ This is the weighted element normalized level difference as measured in a laboratory, and is a measure of the sound insulation properties of small building elements such as ventilators.
- $L_{Aeq,T}$ This is the A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, $L_{Aeq,T}$ is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.
- L_{AFmax} This is the maximum A-weighted noise level that was recorded during the measurement period in terms of 'Fast' time weighting.
- $L_{A10,T}$ This is the A-weighted noise level exceeded for 10% of the time period. $L_{A10,T}$ is usually used as a measure of traffic noise.
- $L_{A90,T}$ This is the A-weighted noise level exceeded for 90% of the time period. $L_{A90,T}$ is used as a measure of background noise.

Appendix II: 2016 Noise Survey Results

Date(s):	Daytime – 20 May 2016 Night/Early AM – Early hours of 29 June 2016
Equipment	Rion NA-27 'Type 1' sound analyser (serial no. 10632001), B&K 2260 'Type 1' sound analyser (serial no. 2520468) with tripod and associated calibrator
Weather	Daytime – Dry, sunny periods and mainly 3/8-4/8 cloud but 8/8 cloud by 14:50, light W breeze generally 1-2m/s, mild 14-17°C. Night/Early AM– Dry, calm to light SW breeze 0-1m/s, 4/8 to 7/8 cloud, mild 10-13°C.

All levels in dB(A)

Location 1: Westernmost area, 20m from capped mineshaft enclosure

Daytime

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
12:23	12:38	74.4	68.9	67.0	64.1	Mainly motorway traffic, intermittent distant construction works, birds.
13:41	13:56	75.5	69.1	67.3	64.7	Motorway traffic, birds, construction works & beepers.
14:46	15:01	74.2	70.1	68.5	66.4	Motorway traffic, construction site engines, rattles. Birds.

Night/Early Morning

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
04:03	04:18	68.8	62.3	58.7	52.0	Birdsong, intermittent motorway traffic.
05:00	05:15	69.6	65.5	62.2	56.3	Traffic, birds.
05:39	05:54	72.1	68.8	66.5	62.8	Traffic, birds.
06:18	06:33	73.1	69.9	68.3	66.2	Traffic, birds.

Location 2: Central Area, North – by overgrown drainage channel**Daytime**

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
13:05	13:20	69.3	63.4	61.6	59.4	Motorway traffic, birds.
14:11	14:36	66.3	62.5	60.8	58.8	Motorway traffic, birds, intermittent construction works.
15:05	15:20	70.0	64.7	63.0	60.9	Motorway traffic, birds, distant aircraft

Night/Early Morning

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
04:24	04:39	64.2	57.2	54.9	51.3	Traffic, birds.
05:20	05:35	62.7	59.7	58.1	55.9	Traffic, birds.
05:59	06:14	68.7	63.9	62.2	60.2	Traffic, birds.
06:40	06:55	68.0	64.5	63.2	61.8	Traffic.

Location 3: Central Area, South – by overgrown drainage channel**Daytime**

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
13:23	13:38	68.8	63.3	60.7	57.1	Motorway, birds, distant aircraft.
14:28	14:43	66.0	62.3	60.8	59.0	Motorway, birds.
15:22	15:37	66.8	63.0	61.2	59.1	Motorway, construction plant, birds.

Night/Early Morning

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
04:41	04:56	62.4	53.3	51.1	47.8	Traffic, birds, distant aircraft
05:04	05:19	57.6	53.8	51.7	48.8	Reversing siren. Motorway dominant. Birdsong. Wagon tipping.
05:40	05:55	64.3	58.8	57.2	54.8	Motorway dominant. Birdsong
06:26	06:41	65.2	59.6	58.5	56.6	Motorway traffic. Birdsong.

Location 4: North-Easternmost Area, near Carr Lane Roundabout**Daytime**

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
12:47	13:02	69.8	59.7	57.9	55.2	Mainly distant motorway, intermittent traffic on roundabout, int. construction works, distant aircraft, birds.

Night/Early Morning

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
04:09	04:26	62.7	54.4	52.2	48.6	Motorway traffic dominant. Birdsong. One car on roundabout
05:22	05:37	67.2	58.4	56.3	52.8	Motorway traffic dominant, Birdsong. 3 cars on roundabout
05:59	06:14	67.1	61.2	59.7	57.4	Motorway traffic dominant. 5 cars on roundabout. Birdsong.
06:45	07:00	73.1	61.4	60.0	58.0	Motorway traffic dominant. Regular cars on roundabout (inc HGV). Leaf Rustle.

Appendix III: 2023 Noise Survey Results

Date(s):	Thursday 23 July 2023
Equipment	B&K 2250 'Class 1' sound analyser (serial no. 3011706) with tripod and associated calibrator
Weather	Dry, ~13°C, clear skies, and calm wind speed <3 m/s

All levels in dB(A)

Location 1: Westernmost area, 20m from capped mineshaft enclosure

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
10:29	10:34	70.94	67.19	65.11	62.47	Road traffic, birdsong
10:34	10:39	71.39	66.83	64.44	61.17	
10:39	10:44	69.90	67.20	65.41	62.58	
10:55	11:00	70.11	67.85	65.70	62.94	
11:00	11:05	70.29	67.38	65.36	62.09	
11:05	11:10	70.69	67.94	65.42	62.28	

Location 2: Central Area, North – by overgrown drainage channel

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
11:31	11:36	60.48	56.90	55.29	53.32	Road traffic, birdsong
11:36	11:41	57.54	56.22	55.12	53.67	
11:45	11:50	59.19	57.16	55.69	53.42	
11:50	11:55	64.28	58.12	56.58	54.45	
11:55	12:00	62.15	56.91	55.57	53.95	

Location 3: Central Area, South – by overgrown drainage channel

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
12:22	12:27	59.66	56.91	55.73	54.32	Road traffic, birdsong
12:27	12:32	59.71	57.25	55.69	53.43	
12:32	12:37	61.31	56.78	55.55	54.28	

Location 4: North-Easternmost Area, near Carr Lane Roundabout

Time		Measured Noise Levels (dB)				Comments
Start	End	L_{AFmax}	$L_{A10,T}$	$L_{Aeq,T}$	$L_{A90,T}$	
12:41	12:46	59.49	56.75	54.85	52.50	Road traffic, birdsong
12:46	12:51	61.99	58.04	55.43	51.98	
12:51	12:56	62.92	58.59	56.13	52.36	
13:06	13:11	64.22	58.67	57.00	54.81	
13:11	13:16	63.45	57.82	56.35	54.06	

Appendix IV: Break-in Calculations

BS8233 Calculation of Noise Breakin

The expected precision of this calculation is ±2 dB

Site	Carr Lane
Period	Night
Room	Plot 37 Bedroom 3 (F113)

Term	Term Description	Value
S	Facade area (incl. window) (m ²)	5.5
S _{wl}	Area of the windows (m ²)	1.6
S _{ew}	Area of the external wall (m ²)	4.0
x	Room Dimension x (m)	3.0
y	Room Dimension y (m)	2.1
z	Room Dimension z (m)	2.3

RT	Receiving Room RT
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A	Outside Room
A	Outside Room

D _{1/2}	Insulation of the Acoustic Vents	Aereco EHA with acoustic canopy and sleeve (EAR206 + AEA851)
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R _w	SRI of the window	4:12-6.4 mm Stadip Silence
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R _{ew}	SRI of the external wall	BS8233 Example - Brick and block external wall
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F	= 10 log (b + c + d)
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G	= 10 x log (S*RT/0.161*v)
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L _{max}	Inside Room (A + F + 3dB façade correction)
L _{eq}	Inside Room (A + F + G + 3dB façade correction)

A-weighting

L _{max}	Inside Room
L _{Aeq}	Inside Room

hepworthacoustics

Octave Band Centre Frequency					
125	250	500	1000	2000	
0.5	0.4	0.4	0.4	0.4	0.4

73	71	72	69	62	62
61	55	60	62	55	55

41	42	38	45	47	47
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24	22	29	40	44	44
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40	44	45	51	56	56
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$$B = \frac{A_0}{S} 10^{-\frac{d_{0,e}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{-\frac{Re_w}{10}}$$
$$D = \frac{S_{ew}^{0.17} (0.161 v)^{0.17}}{S} 10^{-\frac{Re_w}{10}}$$

-29	-27	-32	-40	-43	-43
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1	0	-1	-1	-1	-1
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47	46	43	32	21	21
36	31	31	24	15	15

-16	-9	-3	0	1	1
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31	37	40	32	22	22
20	22	28	24	16	16

BS 8233 RESULT		
L _{max}	43	
L _{Aeq}	30	

BS8233 Calculation of Noise Breakin

The expected precision of this calculation is ±2 dB

Site	Carr Lane
Period	Night
Room	Plot 39 Bedroom 1 (F114)

Term	Term Description	Value
S	Façade area (incl. window) (m²)	10.6
S _{wi}	Area of the windows (m²)	3.1
S _{ew}	Area of the external wall (m²)	7.5
x	Room Dimension x (m)	4.2
y	Room Dimension y (m)	2.7
z	Room Dimension z (m)	2.3

RT	Receiving Room RT
----	-------------------

A	Outside Room
A	Outside Room

D _{h,e}	Insulation of the Acoustic Vents	Aeroco EHA with acoustic canopy and sleeve (EAR206 + AEA851)
R _{w,i}	SRI of the window	4;12-6.4 mm Stadip Silence
R _{ew}	SRI of the external wall	BS8233 Example - Brick and block external wall

F	= 10 log (b + c + d)
---	----------------------

G	= 10 x log (S*RT/0.161*V)
---	---------------------------

L _{max}	Inside Room (A + F + 3dB façade correction)
L _{eq}	Inside Room (A + F + G + 3dB façade correction)

A-weighting

L _{Amax}	Inside Room
L _{Aeq}	Inside Room



Octave Band Centre Frequency					
125	250	500	1000	2000	
0.5	0.4	0.4	0.4	0.4	0.4

73	71	72	69	62	62
61	55	60	62	55	55

41	42	38	45	47	
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24	22	29	40	44	
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40	44	45	51	56	
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$$B = \frac{A_0}{S} 10^{\frac{-D_{h,e}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{\frac{-Re_w}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{\frac{-Re_w}{10}}$$

-29	-27	-33	-42	-45	
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1	0	-1	-1	0	
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47	46	42	30	19	
36	31	30	23	13	

-16	-9	-3	0	1	
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31	37	39	30	20	
20	22	27	23	14	

BS 8233 RESULT	
L _{Amax}	42
L _{Aeq}	30

BS8233 Calculation of Noise Break-in

The expected precision of this calculation is ±2 dB

Site	Carr Lane
Period	Day
Room	Plot 39 Living Room (F114)

Term	Term Description	Value
S	Façade area (incl. window) (m²)	5.8
S _{wi}	Area of the windows (m²)	1.3
S _{ew}	Area of the external wall (m²)	4.4
x	Room Dimension x (m)	3.9
y	Room Dimension y (m)	2.1
z	Room Dimension z (m)	2.3

RT	Receiving Room RT
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A	L _{eq}	Outside Room
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D _{n,e}	Insulation of the Acoustic Vents	Aereco EHA with acoustic canopy and sleeve (EAR206 + AEA851)
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R _{wi}	SRI of the window	4:12:6.4 mm Stadip Silence
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R _{ew}	SRI of the external wall	BS8233 Example - Brick and block external wall
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F	= 10 log (b + c + d)	
---	----------------------	--

G	= 10 x log (S*RT/0.161*v)	
---	---------------------------	--

L _{eq}	Inside Room (A + F + G + 3dB façade correction)	
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A-weighting	
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L _{Aeq}	Inside Room	
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Octave Band Centre Frequency						
125	250	500	1000	2000		
0.5	0.4	0.4	0.4	0.4	0.4	0.4

62	58	63	65	58
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41	42	38	45	47
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24	22	29	40	44
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40	44	45	51	56
----	----	----	----	----

$$B = \frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{\frac{-R_{e,w}}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{\frac{-R_{e,w}}{10}}$$

-29	-28	-32	-41	-44
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0	-1	-2	-2	-1
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35	32	32	26	16
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-16	-9	-3	0	1
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19	23	29	26	17
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BS 8233 RESULT	
L _{Aeq}	32

BS8233 Calculation of Noise Break-in

The expected precision of this calculation is ±2 dB

Site	Carr Lane
Period	Day
Room	Plot 48 Living Room (F112)

Term	Term Description	Value
S	Façade area (incl. window) (m²)	6.9
S _{wil}	Area of the windows (m²)	1.3
S _{ew}	Area of the external wall (m²)	5.6
x	Room Dimension x (m)	3.2
y	Room Dimension y (m)	2.7
z	Room Dimension z (m)	2.3

RT	Receiving Room RT
----	-------------------

L _{eq}	Outside Room
-----------------	--------------

D _{n,e}	Insulation of the Acoustic Vents	Aereco EHA with acoustic canopy and sleeve (EAR206 + AEA851)
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R _{wil}	SRI of the window	4:12:6.4 mm Stadip Silence
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R _{ew}	SRI of the external wall	BS8233 Example - Brick and block external wall
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F	$= 10 \log (b + c + d)$
---	-------------------------

G	$= 10 \times \log (S * RT / 0.161 * V)$
---	---

L _{eq}	Inside Room (A + F + G + 3dB façade correction)
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A-weighting

L _{Aeq}	Inside Room
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hepworthacoustics

Octave Band Centre Frequency					
125	250	500	1000	2000	
0.5	0.4	0.4	0.4	0.4	0.4

59	54	59	61	54	54
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41	42	38	45	47	
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24	22	29	40	44	
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40	44	45	51	56	
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$$B = \frac{A_0}{S} 10^{\frac{-D_{0,e}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{\frac{-R_{e,w}}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{\frac{-R_{e,w}}{10}}$$

-30	-29	-33	-42	-44	
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0	-1	-1	-1	-1	
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33	27	28	21	12	
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-16	-9	-3	0	1	
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17	18	25	21	13	
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BS 8233 RESULT	
L _{Aeq}	27

BS8233 Calculation of Noise Breakin

The expected precision of this calculation is ±2 dB

Site	Carr Lane
Period	Night
Room	Plot 48 Bedroom 3 (F112)

Term	Term Description	Value
S	Façade area (incl. window) (m²)	5.5
S _{wi}	Area of the windows (m²)	1.7
S _{ew}	Area of the external wall (m²)	3.8
x	Room Dimension x (m)	2.8
y	Room Dimension y (m)	2.2
z	Room Dimension z (m)	2.3

RT	Receiving Room RT
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A	L _{max}	Outside Room
A	L _{eq}	Outside Room

D _{n,e}	Insulation of the Acoustic Vents	Aereco EHA with acoustic canopy and sleeve (EAP206 + AEA851)
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R _{wi}	SRI of the window	4:12:6.4 mm Stadip Silence
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R _{ew}	SRI of the external wall	BS8233 Example - Brick and block external wall
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F	= 10 log (b + c + d)	
---	----------------------	--

G	= 10 x log (S*RT/0.161*V)	
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L _{max}	Inside Room (A + F + 3dB façade correction)	
L _{eq}	Inside Room (A + F + G + 3dB façade correction)	

A-weighting	
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L _{amax}	Inside Room
L _{aeq}	Inside Room



Octave Band Centre Frequency				
125	250	500	1000	2000
0.5	0.4	0.4	0.4	0.4

70	68	69	66	59
58	52	57	59	52

41	42	38	45	47
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24	22	29	40	44
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40	44	45	51	56
----	----	----	----	----

$$B = \frac{A_b}{S} 10^{-\frac{D_{n,e}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$

-28	-27	-31	-40	-43
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1	0	-1	-1	0
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44	44	40	29	18
33	28	28	21	12

-16	-9	-3	0	1
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28	35	37	29	19
17	19	25	21	13

BS 8233 RESULT	
L _{amax}	40
L _{aeq}	28