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## **WILLIS CONSTRUCTION LIMITED**

### **NOISE IMPACT ASSESSMENT REPORT**

#### **FORMER OPEN HEARTH PUBLIC HOUSE, HENDRE FARM DRIVE, RINGLAND, NEWPORT NP19 9LH**

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Client: Willis Construction Limited

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## 1 INTRODUCTION

1.1.1 By instruction from Willis construction Limited ('the client'), NoiseAir was commissioned to conduct a noise impact assessment (NIA) for a proposed residential development at the former Open Hearth Public House site located at: Hendre Farm Drive, Ringland, Newport NP19 9LH, herein referred to as the 'development site'.

1.1.2 The NIA is prepared to assist in the planning process and assesses the results of a noise survey conducted in accordance with current guidance. It includes recommendations and mitigation, as appropriate.

1.1.3 General limitations with respect to this NIA are presented in **Appendix A**.

### 1.2 Site Description

1.2.1 At the time of writing, the development site is an open brownfield site.

1.2.2 The development site is located in a predominantly suburban area approximately 4.5 kilometres east of Newport city centre. The site is flanked to the north by Hendre Farm Drive which is a two way road typically accommodating cars and buses at speeds of up to 30 miles per hour (MPH).

1.2.3 Flanking the east of the development site there is a residential housing estate.

1.2.4 To the south lies the A48 which is a dual carriageway accommodating cars, vans, heavy goods vehicles (HGVs) and light goods vehicles (LGVs) travelling up to 50 MPH.

1.2.5 To the west the site is also flanked by a residential housing estate.

1.2.6 **Figure 1** presents an aerial photograph of the proposed development site with respect to the local area and its context.



**Figure 1: Site aerial photograph.**

### **1.3 Development Proposals**

- 1.3.1 Documentation provided at the time of writing indicate proposals for the development site is to construct 32 residential units to include outdoor amenity areas and car parking facilities. The documentation also indicates there to be a proposed access road to the new units originating from Hendre Farm Drive.
- 1.3.2 Figure 2 presents a Trucco Design Architecture drawing available at the time of writing illustrates a plan view of the proposals.

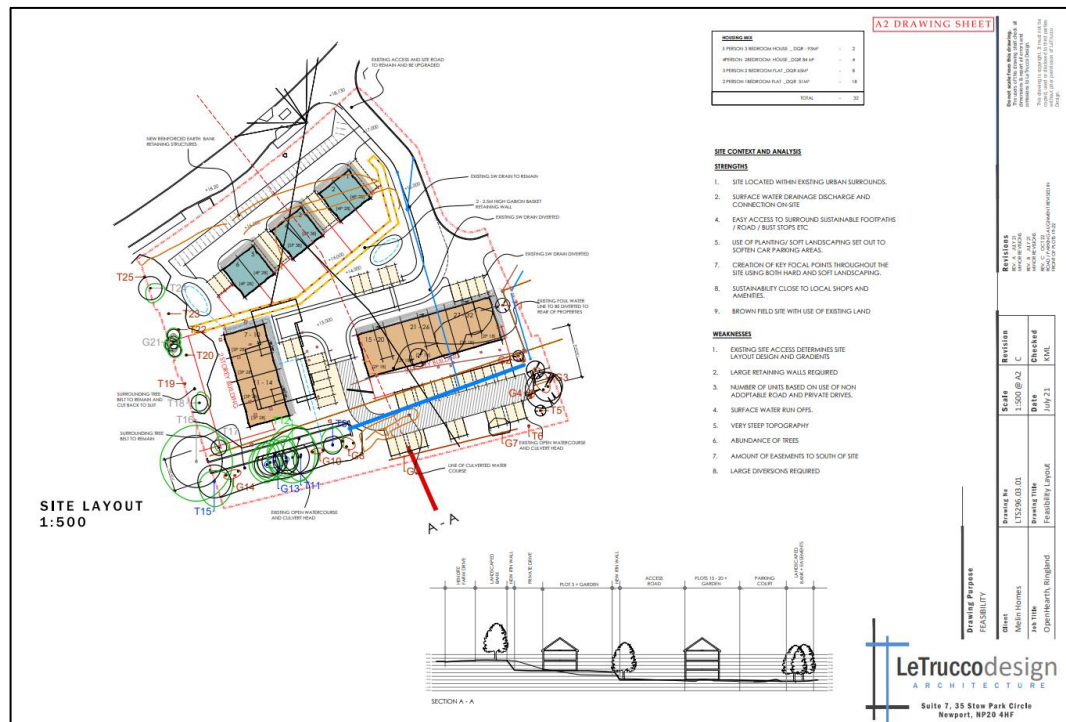


Figure 2: Plan view of proposed development.

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## 2 ASSESSMENT METHODOLOGY AND SCOPE OF WORKS

### 2.1 Planning Guidance and Noise

2.1.1 This acoustic report has been prepared in support of a proposed planning application and therefore it is considered that reference should be made to the appropriate planning guidance documentation, specifically:

- Planning Policy Wales – Edition 10 (PPW), 2018; and,
- Planning Guidance (Wales) – Technical Advice Note 11 - Noise (TAN11), 1997.

2.1.2 A summary of the relevant planning documentation and its relevance with respect to noise is provided below.

#### ***Planning Policy Wales [PPW 2018]***

2.1.3 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs), Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales.

2.1.4 The primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation.

2.1.5 Section 6.7 of the PPW outlines planning policy with respect to Air Quality and Noise. PPW outlines that the planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution alongside action to tackle high pollution hotspots. In doing so, it should consider the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment and identify and pursue any opportunities to reduce, or at least, minimise population exposure to air and noise pollution, and improve soundscapes, where it is practical and feasible to do so.

2.1.6 PPW also aligns with the agent of change principle which says that a business or person responsible for introducing a change is responsible for managing that change. In practice, for example, this means a developer would have to ensure that solutions to address air

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quality or noise from nearby pre-existing infrastructure, businesses or venues can be found and implemented as part of ensuring development is acceptable.

2.1.7 In proposing new development, planning authorities and developers must, therefore:

- address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors
- not create areas of poor air quality or inappropriate soundscape; and
- seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes.

2.1.8 Furthermore, PPW states that the potential impacts of noise pollution arising from existing development (be this commercial, industrial, transport related or cultural venues i.e., music venues, theatres or arts centres), must be fully considered to ensure the effects on new development can be adequately controlled to safeguard amenity. Any necessary measures and controls should be incorporated as part of the proposed new development. This will help to prevent the risk of restrictions or possible closure of existing premises or adverse impacts on transport infrastructure due to noise and other complaints from occupiers of new developments. It will be important that the most appropriate level of information is provided, and assessment undertaken.

#### ***Technical Advice Note (Wales) - Noise [TAN 11 1997]***

2.1.9 TAN 11 was introduced in 1997 and sets out guidance on the assessment of noise in Wales. It should be noted however that this document is currently under review.

2.1.10 TAN 11 sets out a series of Noise Exposure Categories (NECs) which have been derived to assist local planning authorities in their consideration of planning applications for residential development near transport related noise sources. The NECs are set out in Annex A of TAN 11.

2.1.11 Measures introduced to control the source of, or limit exposure to, noise should be proportionate and reasonable, and may include:

- engineering: reduction of noise at point of generation (e.g., using quiet machines and/or quiet methods of working); containment of noise generated (e.g., insulating buildings which house machinery and/or providing purpose-built barriers around sites); protection of surrounding noise-sensitive buildings (e.g., improving sound insulation in these buildings and/or screening them by purpose-built barriers);

- 
- layout: adequate distance between noise source and noise-sensitive building or area; screening by natural barriers, other buildings, or non-critical rooms in a building;
  - administrative: limiting operating time of noise source; restricting activities allowed on the site; specifying an acceptable noise limit.

2.1.12 Annex B of TAN 11 outlines guidance of assessment of noise from different sources. When considering noise from industrial and commercial developments TAN 11 outlines the following guidance.

2.1.13 The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS 4142: 1990. Tonal or impulsive characteristics of the noise are likely to increase the scope for complaints and this is taken into account by the "rating level" defined in BS 4142. This "rating level" should be used when stipulating the level of noise that can be permitted. The likelihood of complaints is indicated by the difference between the noise from the new development (expressed in terms of the rating level) and the existing background noise. The Standard states that, 'A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance'. Since background noise levels vary throughout a 24 hour period it will usually be necessary to assess the acceptability of noise levels for separate periods (e.g., day and night) chosen to suit the hours of operation of the proposed development. Similar considerations apply to developments that will emit significant noise at the weekend as well as during the week. In addition, general guidance on acceptable noise levels within buildings can be found in BS 8233:1987

2.1.14 It should be noted that the British standard documents referenced in TAN 11 have been superseded, specifically BS4142 the latest main issue being in 2014, BS4142:2014 is therefore considered the appropriate assessment document for assessment of noise from commercial and industrial sites.

## **2.2 Consultation and Scope of Works**

2.2.1 It is considered that a detailed NIA is required to assess the likely impact of noise breakout with respect to the proposed development. The NIA presented in this report is based on site specific data collected at the development site and assesses the likely impacts of the proposals with respect to existing local noise sources.

2.2.2 Initial investigations indicate the following likely dominant noise source:

- Road traffic on the A48.

## 2.3 Assessment Criteria

2.3.1 It is considered that the noise assessment and subsequent criteria should be conducted in accordance with Pro-PG:2017 Planning and Noise a summary of which is provided below.

### *Pro-PG:2017 – Planning & Noise [Pro-PG 2017]*

2.3.2 Pro-PG:2017 Planning and Noise provides professional practice guidance in relation to new residential development exposed to noise from transport sources. It provides practitioners with a recommended approach to the management of noise within the planning system in England.

2.3.3 The guidance reflects the Government’s overarching National Planning Policy Framework, the Noise Policy Statement for England, and Planning Practice Guidance (including PPG-Noise) and draws on other authoritative sources of guidance. It provides advice for Local Planning Authorities and developers, and their professional advisers, on achieving good acoustic design in and around new residential developments.

2.3.4 Pro-PG:2017 adopts a two-stage approach to assessment:

- **Stage 1** – an initial noise risk assessment of the proposed development site; and,
- **Stage 2** – a systematic consideration of four key elements.

2.3.5 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.

2.3.6 Internal noise level guidelines are set out in Figure 2 of Pro-PG:2017 which have been reproduced in **Table 1**.

<b>Table 1: Summary of internal noise guidelines.</b>			
<b>Activity</b>	<b>Location</b>	<b>07:00 – 23:00 hours</b>	<b>23:00 – 07:00 hours</b>
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room / area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB $L_{AFmax}$

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2.3.7 There are multiple notes outlined within Pro-PG:2017 with respect to **Table 1** which should be considered in full however the main points for consideration are outlined below:

- The table provides recommended internal  $L_{Aeq,T}$  target levels for overall noise in the design of a building. These are the sum total of structure-borne noise and airborne noise sources.
- The internal  $L_{Aeq,T}$  target levels shown in the table are based on the existing guidelines issued by the World Health Organisation (WHO) and assume normal diurnal fluctuation in external noise.
- The internal  $L_{Aeq,T}$  target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.
- Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. In most circumstances in noise-sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB  $L_{AFmax}$  more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.
- Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g., trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal  $L_{Aeq}$  target levels should not normally be exceeded.
- Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal  $L_{Aeq}$  target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

2.3.8 The guidelines presented in **Table 1** reflect and extend current practice contained in BS 8233:2014.

2.3.9 In terms of external amenity noise assessment, Pro-PG:2017 again draws upon guidelines set and presented by the WHO and also presented in BS 8233:2014.

2.3.10 BS 8233:2014 states that "the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally

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not be above the range 50 – 55 dB  $L_{Aeq,16hr}$ ". The standard continues... "These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited."

### 3 ACOUSTIC SURVEY

#### 3.1 Acoustic Survey Details

3.1.1 NoiseAir conducted primarily unattended fixed position noise monitoring between the 19<sup>th</sup> of January 2023 and the 20<sup>th</sup> of January 2023 at the development site (ML1).

3.1.2 ML1 is presented in **Figure 3** and described in **Table 2**.



**Figure 3: Site layout plan and noise monitoring location – ML1.**

Table 2: Summary of Noise Monitoring Locations				
Monitoring Location Number	Location Description	Time Period Monitored		Attended or Unattended Monitoring
		Start	End / Duration	
ML1	Microphone was tripod mounted 1.5 m above ground level in free field conditions at the southern boundary of the development site.	14:00 19/01/23	12:45 20/01/23	Unattended

3.1.3 ML1 was positioned to be representative of the ambient noise levels at the approximate location of the proposed development site.

3.1.4 The noise measurements were made using a Class 1, integrating sound level meter (SLM).

3.1.5 The acoustic equipment was calibrated to comply with Section 4.2 of BS 7445-1:2003<sup>1</sup>, before and after the noise monitoring periods.

3.1.6 Details of the SLM and associated field calibration are presented in **Table 3**.

Table 3: Summary of the SLM used for survey and associated field calibration					
SLM (Serial Number)	Preamp (Serial Number)	Microphone (Serial Number)	Start Calibration	End Calibration	Drift
NOR140 (1403057)	NOR1209 (12320)	NOR1225 (72835)	-26.8	-26.7	-0.1

3.1.7 The weather conditions were noted to be as presented in **Table 4** during the site visits at the start and end of the monitoring period.

Table 4: Summary of weather conditions noted at the start and end of the monitoring duration.		
Parameter	19 <sup>th</sup> of January 2023	20 <sup>th</sup> of January 2023
Roads (Wet / Dry)	Dry	Dry
Temperature (°C)	4	5
Wind speed (ms-1) / direction	2.2 (SE)	1.3 (SE)
Cloud Cover (Approx. %)	50	20
Humidity (%)	77	72

3.1.8 A-weighted<sup>2</sup>  $L_{eq}^3$  and  $L_{Fmax}^4$  noise levels were measured at ML1 to comply with the requirements of BS 8233:2014. A-weighted<sup>5</sup>  $L_{90}^6$  was also measured to provide further information. The measured noise levels are presented in full in **Appendix B**.

3.1.9 Attending the development site at the start and end of the survey monitoring period provided opportunity for observations and detailed notes to be made of the significant noise sources, which contribute to the measured levels.

<sup>1</sup> BS 7445-2003 "Description and measurement of environmental noise – Part 1: Guide to quantities and procedures.

<sup>2</sup> An electronic filter in a sound level meter which mimics the human ear's response to sounds at different frequencies under defined conditions.

<sup>3</sup> Equivalent continuous noise level; the steady sound pressure which contains an equivalent quantity of sound energy as the time-varying sound pressure levels.

<sup>4</sup> The instantaneous maximum noise level recorded for a measurement period.

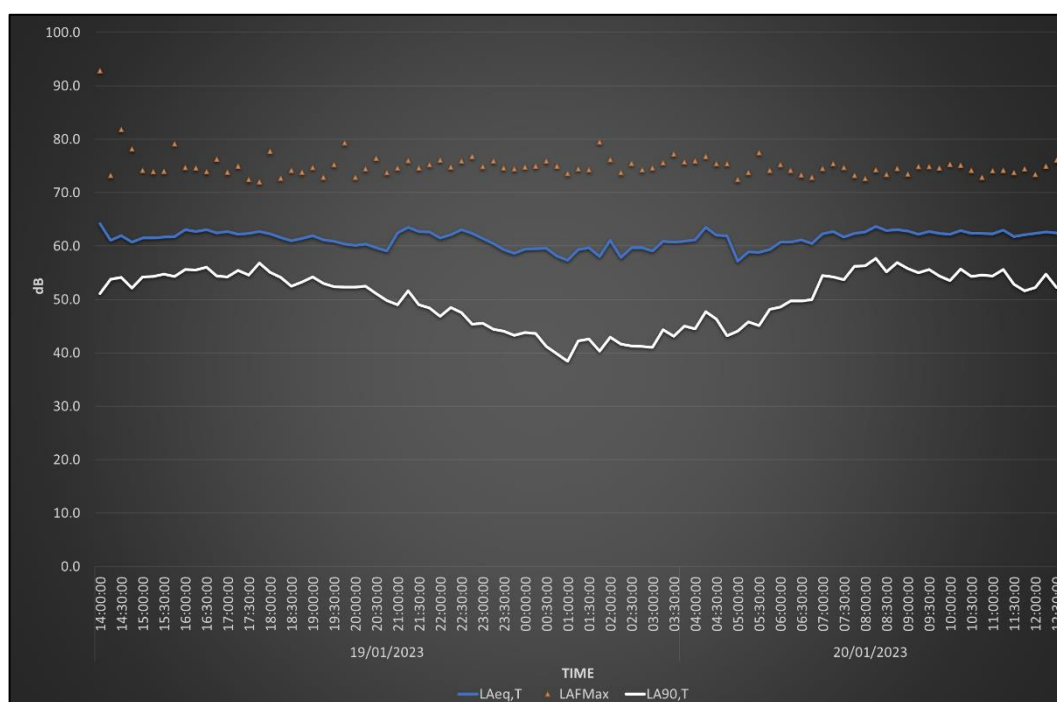
<sup>5</sup> An electronic filter in a sound level meter which mimics the human ear's response to sounds at different frequencies under defined conditions.

<sup>6</sup> The noise level which is exceeded for 90% of the measurement period.

**ML1**

Dominant noise was that from road traffic on the A48 accommodating cars, vans, HGVs and LGVs.

3.1.10 Data presented in **Figure 4** details a level vs time graph of the recorded  $L_{Aeq,T}$ ,  $L_{AFMax}$  and  $L_{A90,T}$  sound levels over 15-minute time periods for the entire monitoring duration at ML1.



**Figure 4: Level vs. time graph presenting  $L_{Aeq,T}$ ,  $L_{AFMax}$  and  $L_{A90,T}$  sound levels – ML1.**

3.1.11 The results for ML1 are presented in **Table 5**.

Table 5: Average Measured Daytime / Night-time Noise Levels				
Monitoring Location	Time	Measured Noise Level		
		dB $L_{Aeq,16hour}$ / $L_{Aeq,8hour}$	dB $L_{Aeq,1hour}$ / $L_{Aeq,15mins}$	dB $L_{A90,1hour}$ / $L_{A90,15 mins}$
ML1	07:00-23:00	62.0 – 62.5	59.9 – 63.1	47.1 – 56.5
	23:00-07:00	60.1	57.2 – 63.5	38.4 – 50.0

3.1.12 The maximum noise level exceeded more than 10 times recorded during a single night-time period, is presented in **Table 6**.

**Table 6: Summary of the Maximum Night-time Noise Levels Exceeded More than 10 times in one Night-Time Period**

<b>Monitoring Location</b>	<b>Measured Maximum Noise Level Exceeded More than 10 times in one night-time period dB (<math>L_{AFmax}</math>)</b>
ML1	75.0

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## 4 3D SOUND MODEL

### 4.1 Introduction

4.1.1 At the time of writing, the proposals for the development site are at planning stage and therefore in order to accurately conduct a NIA with respect to the new proposed development, it is considered that a 3D sound model should be utilised to calculate the likely noise propagation across the development site.

### 4.2 3D Sound Models

4.2.1 A 3D sound model has been constructed in SoundPLAN™ to calculate the predicted sound pressure levels across the development site. The model uses the calculation method from ISO 9613-2:1996<sup>7</sup> to account for the distance between the source and receiver and any screening or reflections provided by the surrounding buildings. The model is predominantly based on and calibrated against measured data.

~~4.2.2 At the time of writing detailed proposals of the development were not available to NoiseAir and therefore three different receptors have been selected to investigate the incident noise levels at three potential locations for a southernmost façade.~~

~~4.2.3 A typical size house was modelled such that the centre of the southern façade was located at the 3 receptors presented in **Figure 8**. The dimensions of the house modelled is 7m × 10m × 8m high. An outdoor amenity receptor is also modelled at an approximate distance of 3.7 m from the northern façade and at a height of 1.5m from local ground level.~~

4.2.4 Initial investigations into the noise levels within the amenity areas proposed predicts elevated levels with respect to the thresholds at which the WHO:1999 describe as moderately annoying and seriously annoying to residents.

4.2.5 Given this, the 3D model has been constructed to include a 3 m high acoustic barrier to the perimeter of the development site to investigate whether this provides the required attenuation.

4.2.6 The 3D noise model specifically includes noise breakout from the following source:

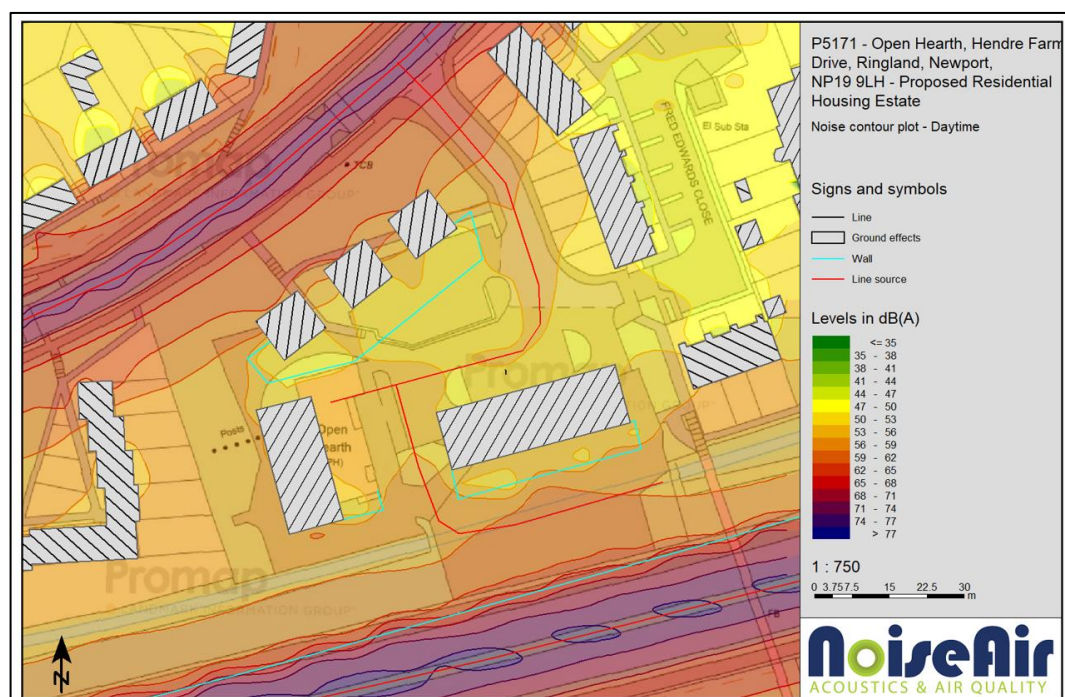
- **Road traffic noise breakout from the A48** – modelled as a line source at 0.5 m from local ground level and calibrated to measured data at ML1.

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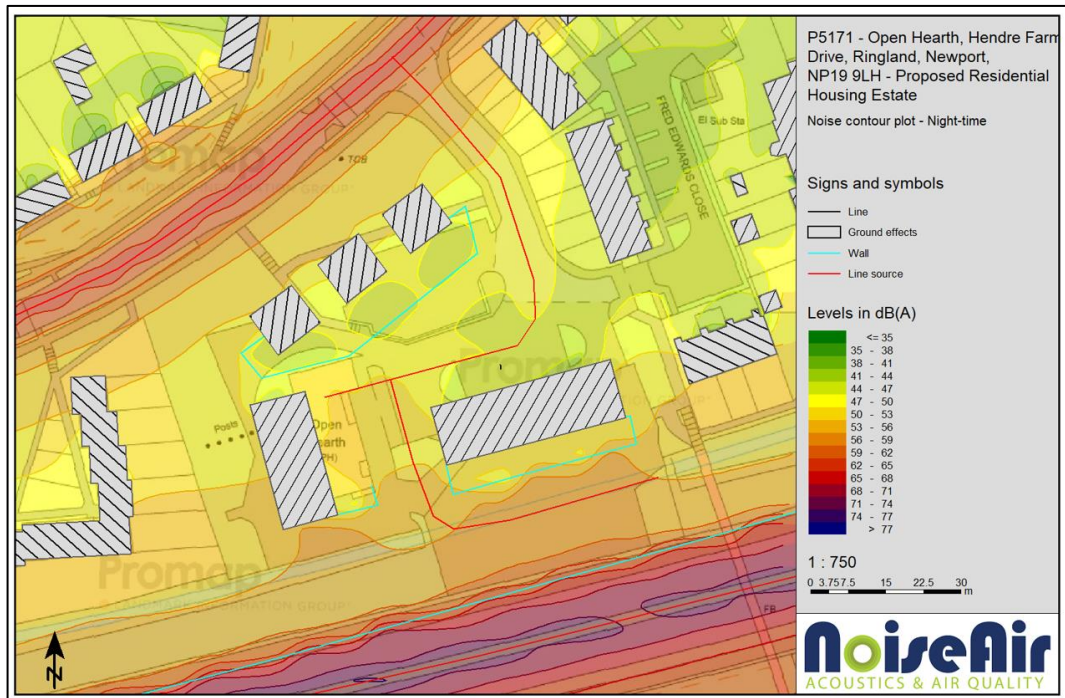
<sup>7</sup> ISO9613-2:1996 “Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation”

- **Road traffic noise breakout from Hendre Farm Drive** – modelled as a line source at 0.5 m from local ground level. The noise levels are calibrated based on a combination of the Department of Transport road traffic count traffic count 805239 (a count of traffic of a road accommodating similar traffic volumes / types) and previous NoiseAir road traffic  $L_{AE}$  data and  $L_{AFmax}$ .
- **Road traffic noise breakout from the proposed access road** – modelled as a line source at 0.5 m from local ground level. Given the number of car parking spaces on the proposed drawings, it is reasoned that there is likely to be a traffic count for the access road originating from Hendre Farm Drive which is equal to double the amount of parking spaces during the daytime and 6 vehicle movements during the night. This access road has a further access road that provides access to the properties on the southeast of the new development. A traffic count for this road is based on double the car parking spaces that are shown to the south of the development site during the daytime and 4 vehicle movements during the night. The road is also modelled on  $L_{AE}$  and  $L_{AFMax}$  data adopted from the NoiseAir library.

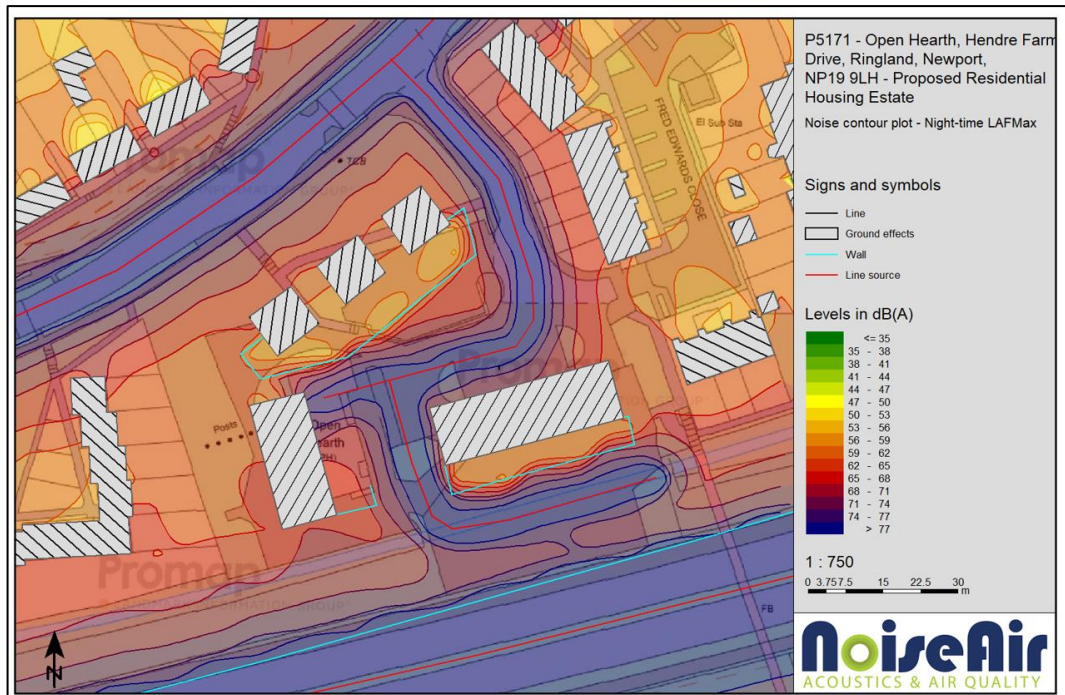
4.2.7 Noise contour plots illustrating the propagation of sound from source during the daytime and night-time ( $L_{Aeq,16hour}$  /  $L_{Aeq,8hour}$  /  $L_{AFMax}$ ) condition is presented in **Figure 5** to **Figure 7**



**Figure 5: Noise contour plot illustration of the predicted propagation of sound from the A48 for Daytime.**

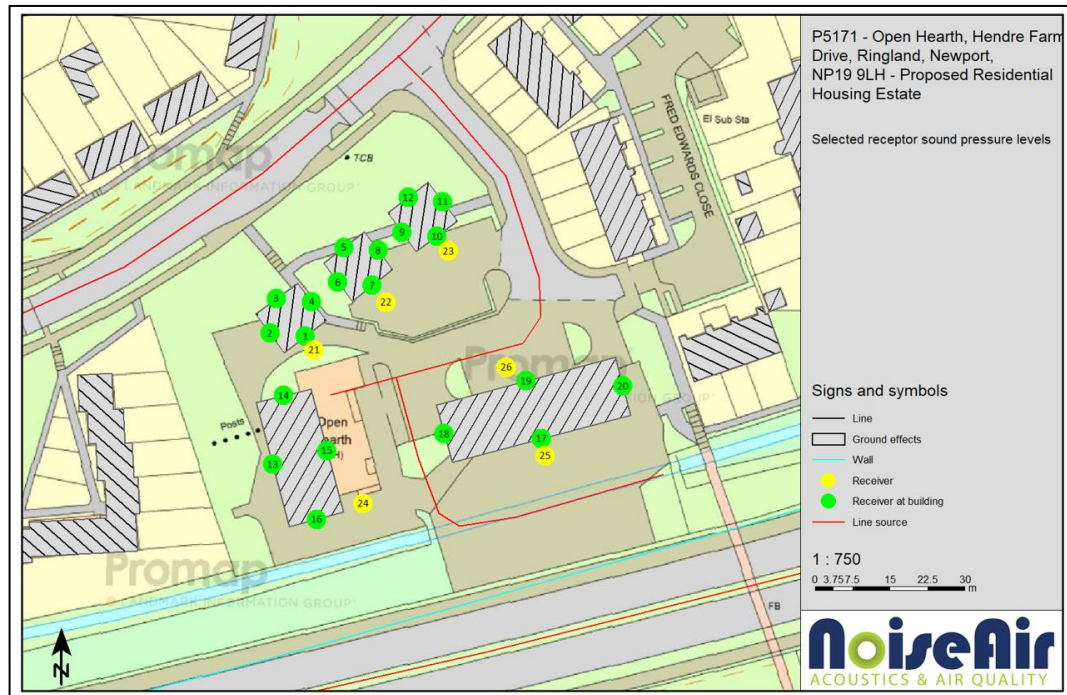


**Figure 6: Noise contour plot illustration of the predicted propagation of sound from the A48 for Night-time.**



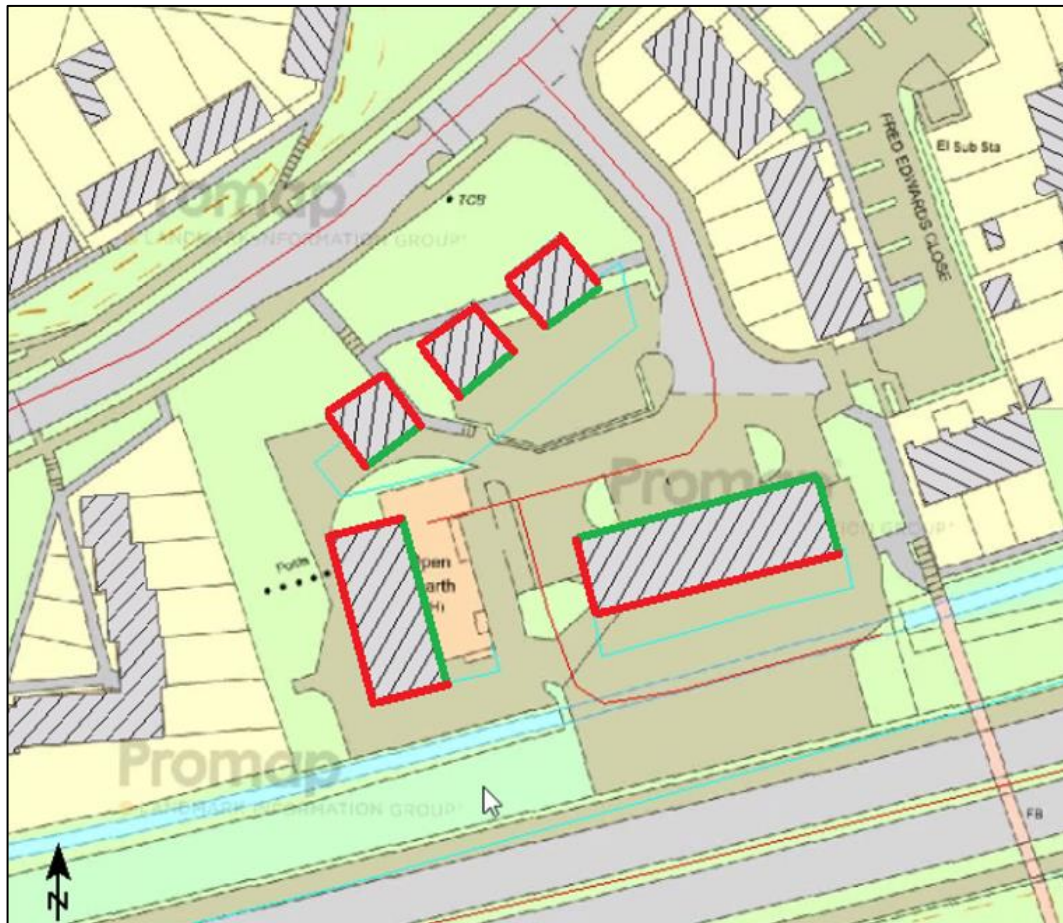
**Figure 7: Noise contour plot illustration of the predicted propagation of sound from the A48 for Night-time  $L_{AFMax}$ .**

4.2.8 Selected façade and outdoor amenity receptors are presented in **Figure 8**.



**Figure 8: Illustration of the 3D sound model selected receptors.**

4.2.9 Further to the 3D model, the results of the worst case predicted noise levels during the daytime and night-time periods have been colour coded in **Figure 9** and presented in **Table 13** presented in **Appendix D**.



**Figure 9: Colour coded plan view of the proposed development site**

4.2.10 **Table 7** details the predicted worst case noise levels for each colour coded facade. The table also presents the calculated noise levels at the outdoor amenity receptors.

<b>Table 7: Predicted Façade Receptor Noise Levels for the Three Receptors</b>			
<b>Façade colour / Rec #</b>	<b>Worst Case Daytime dB</b>	<b>Worst Case Night-time dB</b>	<b>Worst Case Night-time dB <math>L_{AFMax}</math></b>
Red	61	57	72
Green	54	52	69
21	49	N/A	N/A
22	50	N/A	N/A
23	50	N/A	N/A
24	49	N/A	N/A
25	52	N/A	N/A

## 5 SITE NOISE RISK ASSESSMENT

### 5.1 Pro-PG:2017 Stage 1 Assessment

5.1.1 In accordance with Pro-PG:2017, a Site Noise Risk Assessment (SNRA) has been conducted. The SNRA assesses the initial risk of noise to have an adverse impact on a proposed development based on the overall measured levels with no mitigation in place.

<b>Façade colour</b>	<b>Daytime Noise Level, dB (<math>L_{Aeq,16hours}</math>)</b>	<b>Risk of Adverse Effect</b>	<b>Night-time Noise Level, dB (<math>L_{Aeq,8hours}</math>)</b>	<b>Risk of Adverse Effect</b>
Red	61	Low / Medium	57	Medium
Green	54	Low	52	Low / Medium

5.1.2 **Table 8** indicates that during the daytime and night-time periods, the development site receptor ranges from ‘**Low**’ to ‘**Medium**’ risk of adverse effect.

5.1.3 Pro-PG:2017 states that:

*‘At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.’*

*‘As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.’*

5.1.4 The Site Noise Risk Assessment indicates that local noise mitigation and good acoustic design will be required to ensure that the potential risk of the noise impact is minimised, and guideline internal and external noise levels are achieved.

5.1.5 In accordance with Pro-PG:2017, a Stage 2 full noise assessment, which includes an acoustic design statement, is required to ensure future residents are protected and a good acoustic design has been implemented.

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## 5.2 Pro-PG:2017 Stage 2 Assessment

5.2.1 The results of the Pro-PG:2017 Stage 1: Initial Site Noise Risk Assessment indicates that across the proposed development site for daytime and night-time is likely to be at a **'Negligible / Low'** to **'Medium'** risk of experiencing an adverse noise impact, with no mitigation in place. Therefore, an assessment against the criteria BS 8233:2014 has been conducted with reference to the general sound levels at the site.

5.2.2 This section forms the Stage 2 Acoustic Design Statement of Pro-PG:2017.

## 5.3 WHO Assessment of Daytime Noise Levels in Outdoor Living Areas

5.3.1 Given the documentation provided at the time of writing indicates the proposal for outdoor amenity spaces, an assessment of the noise levels in these areas is required.

5.3.2 The WHO:1999 states that the noise levels exceeding 50 dB(A) in amenity outdoor space is considered likely to be moderately annoying to residents. Further to this, noise levels exceeding 55 dB(A) are considered likely to be seriously annoying to residents.

5.3.3 The calculated noise levels at receptors 21 to 24 are calculated to not exceed the aforementioned lower threshold of 50 dB(A).

5.3.4 The calculated noise level at receptor 25 is 51.7 dB(A) during the daytime which exceeds the lower threshold, however, does not exceed the upper threshold.

5.3.5 While BS 8233:2014 does discuss how these levels may not always be achievable and in some cases, residents may compromise higher noise levels for other desirable factors associated with the local area.

5.3.6 It is reasoned that given the proximity of the development site to Newport centre and given the exceedance of noise levels at receptor 25 above the upper threshold is minimal, occupants are likely to make the compromises discussed in section 5.3.5.

## 5.4 WHO:1999 and BS 8233:2014 Assessment of Noise Levels in Living Rooms and Bedrooms

5.4.1 The predicted noise levels at the façades of the proposed building structures, as detailed in **Table 7** for the daytime and night-time period, together with the level of attenuation required in accordance with BS 8233: 2014 and WHO:1999 are presented in **Table 9**.

<b>Table 9: Level of Attenuation Required to Achieve the Internal Noise Guideline Levels.</b>			
<b>Façade Colour</b>	<b>Daytime (<math>L_{Aeq,16hours}</math>) / Night-Time (<math>L_{Aeq,8hours}</math> / <math>L_{AFmax}</math>)</b>	<b>Worst Case Noise Level at the Façade of the Property</b>	<b>Worst Case Level of Attenuation Required</b>
Red	Daytime	61	26
	Night-Time	57	27
	Night-Time $L_{AFmax}$	72	27
Green	Daytime	54	19
	Night-Time	52	22
	Night-Time $L_{AFmax}$	69	24*
*Worst case level attenuation required due to LAFmax events.			

## 6 SOUND INSULATION SCHEME

### 6.1 Building Envelope Requirements – Windows Closed

- 6.1.1 Proposals for the development site at the time of writing outline residential use, however at the time of writing layout plans were not available to NoiseAir.
- 6.1.2 It has been assumed that noise sensitive rooms are proposed to the south and north facing facades of the proposed houses. Therefore, internal noise levels are required to not exceed 35 dB  $L_{Aeq,16hours}$  during the daytime hours in all rooms and 30 dB  $L_{Aeq,8hours}$  and 45 dB  $L_{AFmax}$  during the night-time hours in bedrooms.
- 6.1.3 When assessing sound levels in habitable areas of the proposed development, the sound attenuation provided by the overall building facade should be considered. To mitigate sound levels, the composition of the building facade can be designed to provide the level of attenuation required. Glazing is generally the building element which attenuates noise the least, so the proportion of glazing in a building facade is an important consideration when assessing overall sound attenuation. Additionally, any façade penetrations should also be considered such as for ventilation, i.e., trickle ventilation.
- 6.1.4 Given that at the time of writing details of the room parameters are not available, worst case façade attenuation calculations have been conducted based on a typical bedroom/ living room and in accordance with BS EN ISO 12354-3:2017. The following assumed room parameters have been adopted for the calculations:
- Room dimensions 4 m × 5 m × 2.5 m high (total volume 50 m<sup>3</sup>); and,
  - Façade area 12.5 m<sup>2</sup> including window area of 5 m<sup>2</sup>.
- 6.1.5 Full details of the calculations conducted are presented in **Appendix C**.
- 6.1.6 Calculations indicate that to achieve a reasonable internal acoustic environment in habitable rooms as specified within BS 8233:2014, the building envelope constructions should be selected to achieve the sound reduction index (SRI) values presented in **Table 10** and **Table 11**.

**Table 10 Summary of Building Envelope Performance Requirements – Red Facades**

Walls	50 dB $R_w+C_{tr}$	Typical Example: 100 mm brick exterior wall, 100 mm cavity with 60 mm 10 kg / m <sup>3</sup> fiberglass insulation, 100 mm lightweight concrete block / breeze block and two layers of plasterboard.
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Table 10 Summary of Building Envelope Performance Requirements – Red Facades		
Glazing	34 dB $R_w+C_{tr}$	Typical Example Pilkington Optiphon: 6.0 mm pane unit, cavity 16.0 mm argon, <sup>8</sup> 6.8 mm pane unit.
Roof	42 dB $R_w+C_{tr}$	Typical Example: Pitched roof with 270 mm wool on plasterboard ceiling consisting of 2 x 12.5mm plasterboard.
Acoustically treated ventilator	34 dB $D_{ne,w}+C_{tr}$ (Up to 2 no. acoustically treated ventilators per room)	Typical Example – Titon TA5220 (SF Xtra Vent) + TA5202 (C25) 2500 EA trickle ventilator. Other supplier may be used, must achieve minimum 34 $D_{ne,w}+C_{tr}$ when open.
NOTE: where a mechanical ventilation system is adopted (i.e., MVHR) and natural ventilation is not required (i.e., no acoustically treated ventilators) the glazing specification can be relaxed to a worst case of 27 dB.		

Table 11 Summary of Building Envelope Performance Requirements – Green Facades		
Walls	50 dB $R_w+C_{tr}$	Typical Example: 100 mm brick exterior wall, 100 mm cavity with 60 mm 10 kg / m <sup>3</sup> fiberglass insulation, 100 mm lightweight concrete block / breeze block and two layers of plasterboard.
Glazing	31 dB $R_w+C_{tr}$	Typical Example: BS 12354:2017, Table B.1 - 10.0 mm pane unit, cavity 6.0 to 16.0 mm air filled <sup>9</sup> 6.0 mm pane unit.
Roof	42 dB $R_w+C_{tr}$	Typical Example: Pitched roof with 270 mm wool on plasterboard ceiling consisting of 2 x 12.5mm plasterboard.
Acoustically treated ventilator	31 dB $D_{ne,w}+C_{tr}$ (Up to 2 no. acoustically treated ventilators per room)	Typical Example – Titon TA5220 (SF Xtra Vent) + TA5005 (SF418) 2500 EA trickle ventilator. Other supplier may be used, must achieve minimum 31 $D_{ne,w}+C_{tr}$ when open.
NOTE: where a mechanical ventilation system is adopted (i.e., MVHR) and natural ventilation is not required (i.e., no acoustically treated ventilators) the glazing specification can be relaxed to a worst case of 25 dB		

## 6.2 Building Envelope Performance – Windows Open

6.2.1 The sound performance requirements for bedrooms, living and dining rooms at the development during the daytime and night-time in rooms with windows closed are summarised in Section 6.1.

<sup>8</sup> Glazing acoustic values are based on those presented in BS12758:2011. Specialist glazing advice should be sought.

<sup>9</sup> Glazing acoustic values are based on those presented in BS12758:2011. Specialist glazing advice should be sought.

6.2.2 However, with windows open, the attenuation provided by the façade will be up to 15 dB(A). This would potentially allow the recommended internal noise limit to be exceeded in most rooms at the development during certain parts of a typical day/ night.

6.2.3 With reference to the predicted incident noise levels and internal levels based on a partially open window presented in **Table 13**, **Table 12** presents a summary of those receptors calculated to achieve internal noise levels with windows partially open.

Table 12: Summary of Internal Noise Levels with Windows Partially Open (based on a Partially Open Window Providing up to 15 dB(A) Attenuation).							
Façade Colour	Receptor / Floor	Room Type	Day / Night	Calculated Internal Level (dB) ( $L_{Aeq,16hours} / L_{Aeq,8hours}$ )	Calculated Internal Level (dB) ( $L_{AFmax}$ )	Excess (dB(A))	Required Internal Levels Achieved (Yes / No)
Red	17 / GF	Living/ Dining/ Kitchen Room	Day	35	N/A	0	Yes
Green	1 / GF	Living/ Dining/ Kitchen Room	Day	34	N/A	-1	Yes
		Bedroom	Night	30	41	0	Yes
	7 G/F	Living/ Dining/ Kitchen Room	Day	34	N/A	-1	Yes
		Bedroom	Night	30	44	0	Yes
	10 / GF	Living/ Dining/ Kitchen Room	Day	34	N/A	-1	Yes
		Bedroom	Night	30	41	0	Yes
	19 / GF	Living/ Dining/ Kitchen Room	Day	35	N/A	0	Yes

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- 6.2.4 As presented in **Table 12**, it is calculated that all red facades with the exception of receptor 17 ground floor during the daytime are likely to require some form of alternative form of ventilation which does not rely on partially open windows.
- 6.2.5 It is calculated that all green facades with the exception of ground floor receptors 1, 7, 10 and 19 during the daytime and 1, 7 and 10 during the night-time are likely to require some form of alternative form of ventilation which does not rely on partially open windows.
- 6.2.6 All remaining facades are calculated to exceed the internal required noise levels with windows in the partially open position and are therefore likely to require an alternative form of ventilation that does not rely on partially open windows.

### **6.3 Ventilation Requirements**

- 6.3.1 It is recommended that the acoustic ventilation proposed at the site should, as a minimum, comply with Building Regulations 2000 Approved Document F1 Means of Ventilation and British Standard BS 5925 1991: "Code of Practice for Ventilation Principles and Designing for Natural Ventilation". Acoustic ventilation is recommended for noise sensitive rooms, which are bedrooms and living/ dining rooms where ventilation via partially open windows is not sufficient.
- 6.3.2 The implementation of the recommended glazing together with appropriate ventilation would ensure that the required internal daytime and night-time noise limits are achieved.
- 6.3.3 As detailed above, it is likely that noise levels in all noise sensitive rooms within the proposed dwellings will rely on the windows being in the closed position and therefore appropriate ventilation design should be completed. It should be noted however that ventilation requirements for future occupants of the proposed development are outside the scope of this report.
- 6.3.4 From a technical perspective, acceptable internal noise levels can be achieved adopting a ventilation design that relies on acoustically treated passive ventilators at all facades investigated.
- 6.3.5 It should be further noted that the glazing and ventilation configurations within this report are for guidance only. Similar products to those used in NoiseAir calculations may achieve a similar level of sound reduction, however this should be verified by the manufacturer.

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- 6.3.6 Where mechanical ventilation may be the preferred choice for noise sensitive rooms the system should have a total noise output within each habitable room which complies with NR25  $L_{eq}$  noise rating curve.

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## 7 CONCLUSIONS

- 7.1.1 NoiseAir has conducted a noise impact assessment with respect to a proposed residential development at the former Open Hearth Public House site located at: Hendre Farm Drive, Ringland, Newport NP19 9LH.
- 7.1.2 The results of the noise survey and initial site noise risk assessment in accordance with Pro-PG:2017 indicate that without mitigation, a worst case for daytime and night-time at receptor 1 (worst case receptor) ranges from 'Low' to 'High' risk of adverse effect.
- 7.1.3 Building performance requirements with windows in the closed position are based on the glazing design as presented in **Table 10**, the designs are summarised as follows:
- Red Facades**
- glazing achieving at least 34 dB  $R_w+C_{tr}$  with acoustically treated ventilators achieving at least 34  $D_{ne,w}+C_{tr}$ .
- Green Facades**
- glazing achieving at least 31 dB  $R_w+C_{tr}$  with acoustically treated ventilators achieving at least 31  $D_{ne,w}+C_{tr}$ .

## **APPENDIX A - REPORT LIMITATIONS**

This Report is presented to Willis Construction Limited may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this report.

Notwithstanding anything to the contrary contained in the report, NoiseAir Limited is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Willis Construction Limited and NoiseAir shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by NoiseAir Limited. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from who it has been requested and that such information is accurate. Information obtained by NoiseAir Limited has not been independently verified by NoiseAir Limited unless otherwise stated in the report and should be treated accordingly.

Where assessments of works or costs identified in this report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Where / if estimates and projects are made within this report, are made based on reasonable assumptions as of the date of this report, such statements however by their very nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. NoiseAir Limited specifically does not guarantee or warrant any estimates or projects contained in this report.

**DISCLAIMER-** This report was prepared by NoiseAir Limited. The material in it contains NoiseAir Limited best judgment in light of the information available at the time of preparation of this report. Any use which a third party makes of this report, or any reliance on, or decisions based on it are the responsibility of such third parties. NoiseAir Limited accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

## **APPENDIX B – METER READINGS**

Start Date	Start Time	Duration	$L_{Aeq,T}$	$L_{AFMax}$	$L_{A90}$
dd/mm/yyyy	hh:mm:ss	hh:mm:ss	dB	dB	dB
19/01/2023	14:00:00	00:15:00	64.2	92.8	51.1
19/01/2023	14:15:00	00:15:00	61.1	73.2	53.8
19/01/2023	14:30:00	00:15:00	61.9	81.8	54.1
19/01/2023	14:45:00	00:15:00	60.7	78.2	52.1
19/01/2023	15:00:00	00:15:00	61.5	74.2	54.2
19/01/2023	15:15:00	00:15:00	61.5	73.9	54.3
19/01/2023	15:30:00	00:15:00	61.7	74.0	54.7
19/01/2023	15:45:00	00:15:00	61.8	79.1	54.3
19/01/2023	16:00:00	00:15:00	63.1	74.7	55.6
19/01/2023	16:15:00	00:15:00	62.7	74.6	55.5
19/01/2023	16:30:00	00:15:00	63.1	73.9	56.0
19/01/2023	16:45:00	00:15:00	62.5	76.3	54.4
19/01/2023	17:00:00	00:15:00	62.7	73.8	54.2
19/01/2023	17:15:00	00:15:00	62.2	75.0	55.4
19/01/2023	17:30:00	00:15:00	62.4	72.4	54.6
19/01/2023	17:45:00	00:15:00	62.7	72.0	56.8
19/01/2023	18:00:00	00:15:00	62.3	77.7	55.1
19/01/2023	18:15:00	00:15:00	61.6	72.7	54.1
19/01/2023	18:30:00	00:15:00	61.0	74.2	52.5
19/01/2023	18:45:00	00:15:00	61.4	73.8	53.3
19/01/2023	19:00:00	00:15:00	61.9	74.7	54.2
19/01/2023	19:15:00	00:15:00	61.2	72.9	53.0
19/01/2023	19:30:00	00:15:00	60.9	75.2	52.4
19/01/2023	19:45:00	00:15:00	60.4	79.3	52.3
19/01/2023	20:00:00	00:15:00	60.1	72.9	52.3
19/01/2023	20:15:00	00:15:00	60.4	74.4	52.5
19/01/2023	20:30:00	00:15:00	59.7	76.4	51.1
19/01/2023	20:45:00	00:15:00	59.1	73.7	49.8
19/01/2023	21:00:00	00:15:00	62.5	74.6	49.0
19/01/2023	21:15:00	00:15:00	63.5	76.0	51.6
19/01/2023	21:30:00	00:15:00	62.7	74.6	49.0
19/01/2023	21:45:00	00:15:00	62.6	75.2	48.4
19/01/2023	22:00:00	00:15:00	61.5	76.1	46.8
19/01/2023	22:15:00	00:15:00	62.1	74.8	48.5
19/01/2023	22:30:00	00:15:00	63.1	75.9	47.5
19/01/2023	22:45:00	00:15:00	62.4	76.8	45.4
19/01/2023	23:00:00	00:15:00	61.4	74.9	45.5
19/01/2023	23:15:00	00:15:00	60.5	75.9	44.4
19/01/2023	23:30:00	00:15:00	59.3	74.6	44.1
19/01/2023	23:45:00	00:15:00	58.6	74.4	43.3
20/01/2023	00:00:00	00:15:00	59.4	74.8	43.8
20/01/2023	00:15:00	00:15:00	59.5	75.0	43.6
20/01/2023	00:30:00	00:15:00	59.6	75.9	41.2
20/01/2023	00:45:00	00:15:00	58.1	75.0	39.8
20/01/2023	01:00:00	00:15:00	57.3	73.6	38.4
20/01/2023	01:15:00	00:15:00	59.3	74.4	42.2
20/01/2023	01:30:00	00:15:00	59.7	74.3	42.6

Start Date	Start Time	Duration	$L_{Aeq,T}$	$L_{AFMax}$	$L_{A90}$
dd/mm/yyyy	hh:mm:ss	hh:mm:ss	dB	dB	dB
20/01/2023	01:45:00	00:15:00	58.0	79.5	40.3
20/01/2023	02:00:00	00:15:00	61.1	76.2	42.9
20/01/2023	02:15:00	00:15:00	57.9	73.7	41.6
20/01/2023	02:30:00	00:15:00	59.7	75.5	41.3
20/01/2023	02:45:00	00:15:00	59.7	74.3	41.2
20/01/2023	03:00:00	00:15:00	59.1	74.6	41.0
20/01/2023	03:15:00	00:15:00	60.9	75.6	44.3
20/01/2023	03:30:00	00:15:00	60.7	77.2	43.1
20/01/2023	03:45:00	00:15:00	60.9	75.7	45.0
20/01/2023	04:00:00	00:15:00	61.2	75.9	44.5
20/01/2023	04:15:00	00:15:00	63.5	76.8	47.7
20/01/2023	04:30:00	00:15:00	62.0	75.4	46.3
20/01/2023	04:45:00	00:15:00	61.9	75.4	43.2
20/01/2023	05:00:00	00:15:00	57.2	72.4	44.1
20/01/2023	05:15:00	00:15:00	58.9	73.7	45.8
20/01/2023	05:30:00	00:15:00	58.8	77.5	45.1
20/01/2023	05:45:00	00:15:00	59.3	74.2	48.1
20/01/2023	06:00:00	00:15:00	60.7	75.2	48.6
20/01/2023	06:15:00	00:15:00	60.7	74.2	49.7
20/01/2023	06:30:00	00:15:00	61.2	73.3	49.7
20/01/2023	06:45:00	00:15:00	60.5	72.9	50.0
20/01/2023	07:00:00	00:15:00	62.3	74.5	54.5
20/01/2023	07:15:00	00:15:00	62.7	75.4	54.2
20/01/2023	07:30:00	00:15:00	61.7	74.7	53.7
20/01/2023	07:45:00	00:15:00	62.4	73.2	56.2
20/01/2023	08:00:00	00:15:00	62.6	72.6	56.3
20/01/2023	08:15:00	00:15:00	63.7	74.3	57.7
20/01/2023	08:30:00	00:15:00	62.9	73.4	55.2
20/01/2023	08:45:00	00:15:00	63.1	74.5	56.9
20/01/2023	09:00:00	00:15:00	62.8	73.5	55.8
20/01/2023	09:15:00	00:15:00	62.2	74.9	55.0
20/01/2023	09:30:00	00:15:00	62.7	74.9	55.6
20/01/2023	09:45:00	00:15:00	62.4	74.6	54.4
20/01/2023	10:00:00	00:15:00	62.2	75.3	53.5
20/01/2023	10:15:00	00:15:00	62.9	75.1	55.7
20/01/2023	10:30:00	00:15:00	62.4	74.2	54.3
20/01/2023	10:45:00	00:15:00	62.4	72.9	54.6
20/01/2023	11:00:00	00:15:00	62.3	74.1	54.4
20/01/2023	11:15:00	00:15:00	63.0	74.2	55.6
20/01/2023	11:30:00	00:15:00	61.8	73.7	52.8
20/01/2023	11:45:00	00:15:00	62.1	74.4	51.6
20/01/2023	12:00:00	00:15:00	62.4	73.4	52.2
20/01/2023	12:15:00	00:15:00	62.6	75.0	54.7
20/01/2023	12:30:00	00:15:00	62.5	76.1	52.2

## **APPENDIX C – CALCULATED RECEPTOR NOISE LEVELS**

**Table 13: Predicted Incident Noise Levels and Internal Levels with Partially Open Windows**

Rec #	Facade	Floor	Worst Case Daytime Façade Level dB(A)	Worst Case Night-time Façade Level dB(A)	Worst Case Night-time Façade Level dB $L_{AFMax}$	Partially open Window Calculated Internal Level (dB(A))			Internal Level Achieved with Window Partially Open (Y / N)	
						Daytime dB(A)	Night-time dB(A)	Night-time dB $L_{AFMax}$	Daytime	Night-time
1	SE	GF	49.3	44.8	56.1	34.3	29.8	41.1	Y	Y
1	SE	1.FI	53.4	48.8	61.5	38.4	33.8	46.5	N	N
2	SW	GF	55.4	47.2	60.8	40.4	32.2	45.8	N	N
2	SW	1.FI	57.4	50.1	63.3	42.4	35.1	48.3	N	N
3	NW	GF	56.4	47.9	59.4	41.4	32.9	44.4	N	N
3	NW	1.FI	60.3	51.8	64.2	45.3	36.8	49.2	N	N
4	NE	GF	53.8	46.0	58.1	38.8	31.0	43.1	N	N
4	NE	1.FI	57.1	49.1	62.4	42.1	34.1	47.4	N	N
5	NW	GF	56.6	48.1	59.8	41.6	33.1	44.8	N	N
5	NW	1.FI	60.5	51.9	64.4	45.5	36.9	49.4	N	N
6	SW	GF	54.1	46.9	58.9	39.1	31.9	43.9	N	N
6	SW	1.FI	57.5	50.2	62.7	42.5	35.2	47.7	N	N
7	SE	GF	49.2	45.3	59.0	34.2	30.3	44.0	Y	Y
7	SE	1.FI	52.1	48.2	62.6	37.1	33.2	47.6	N	N
8	NE	GF	54.0	46.0	58.1	39.0	31.0	43.1	N	N
8	NE	1.FI	57.1	48.8	62.4	42.1	33.8	47.4	N	N
9	SW	GF	54.1	46.4	59.0	39.1	31.4	44.0	N	N
9	SW	1.FI	57.1	49.2	62.4	42.1	34.2	47.4	N	N
10	SE	GF	49.3	45.3	56.4	34.3	30.3	41.4	Y	Y
10	SE	1.FI	51.5	47.3	59.3	36.5	32.3	44.3	N	N
11	NE	GF	54.7	46.5	65.6	39.7	31.5	50.6	N	N

**Table 13: Predicted Incident Noise Levels and Internal Levels with Partially Open Windows**

Rec #	Facade	Floor	Worst Case Daytime Façade Level dB(A)	Worst Case Night-time Façade Level dB(A)	Worst Case Night-time Façade Level dB $L_{AFMax}$	Partially open Window Calculated Internal Level (dB(A))			Internal Level Achieved with Window Partially Open (Y / N)	
						Daytime dB(A)	Night-time dB(A)	Night-time dB $L_{AFMax}$	Daytime	Night-time
11	NE	1.FI	56.8	48.8	64.3	41.8	33.8	49.3	N	N
12	NW	GF	56.9	48.4	61.5	41.9	33.4	46.5	N	N
12	NW	1.FI	60.5	51.9	64.3	45.5	36.9	49.3	N	N
13	W	GF	53.6	49.8	62.2	38.6	34.8	47.2	N	N
13	W	1.FI	55.7	51.3	63.9	40.7	36.3	48.9	N	N
13	W	2.FI	57.0	52.9	65.9	42.0	37.9	50.9	N	N
14	N	GF	50.5	43.5	62.4	35.5	28.5	47.4	N	N
14	N	1.FI	53.9	46.1	62.2	38.9	31.1	47.2	N	N
14	N	2.FI	55.9	47.6	60.5	40.9	32.6	45.5	N	N
15	E	GF	50.6	47.3	66.1	35.6	32.3	51.1	N	N
15	E	1.FI	53.7	50.7	65.5	38.7	35.7	50.5	N	N
15	E	2.FI	54.3	51.1	64.9	39.3	36.1	49.9	N	N
16	S	GF	56.5	54.1	65.2	41.5	39.1	50.2	N	N
16	S	1.FI	59.1	56.7	69.0	44.1	41.7	54.0	N	N
16	S	2.FI	59.8	57.4	70.3	44.8	42.4	55.3	N	N
17	S	GF	49.9	47.4	55.8	34.9	32.4	40.8	Y	N
17	S	1.FI	56.9	54.5	65.3	41.9	39.5	50.3	N	N
17	S	2.FI	57.5	55.0	66.3	42.5	40.0	51.3	N	N
18	W	GF	52.5	49.1	71.6	37.5	34.1	56.6	N	N
18	W	1.FI	54.2	51.0	70.6	39.2	36.0	55.6	N	N
18	W	2.FI	55.5	52.2	69.0	40.5	37.2	54.0	N	N
19	N	GF	50.0	42.5	68.7	35.0	27.5	53.7	Y	N
19	N	1.FI	51.1	43.6	68.0	36.1	28.6	53.0	N	N

**Table 13: Predicted Incident Noise Levels and Internal Levels with Partially Open Windows**

Rec #	Facade	Floor	Worst Case Daytime Façade Level dB(A)	Worst Case Night-time Façade Level dB(A)	Worst Case Night-time Façade Level dB $L_{AFMax}$	Partially open Window Calculated Internal Level (dB(A))			Internal Level Achieved with Window Partially Open (Y / N)	
						Daytime dB(A)	Night-time dB(A)	Night-time dB $L_{AFMax}$	Daytime	Night-time
19	N	2.FI	52.6	45.0	66.8	37.6	30.0	51.8	N	N
20	E	GF	51.4	48.6	60.7	36.4	33.6	45.7	N	N
20	E	1.FI	52.9	50.2	63.2	37.9	35.2	48.2	N	N
20	E	2.FI	54.4	51.7	65.7	39.4	36.7	50.7	N	N
21 (outdoor)	N/A	GF	48.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22 (outdoor)	N/A	GF	50.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23 (outdoor)	N/A	GF	49.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24 (outdoor)	N/A	GF	49.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25 (outdoor)	N/A	GF	51.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A

## **APPENDIX D – SOUND INSULATION SCHEME CALCULATION**

## **APPENDIX D - GLOSSARY**

<b>A-weighted sound pressure, <math>p_A</math></b>	Value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network. <i>NOTE: The A-weighting network modifies the electrical response of a sound level meter with frequency in approximately the same way as the sensitivity of the human hearing system.</i>
<b>A-weighted sound pressure level, <math>L_{pA}</math></b>	Quantity of A-weighted sound pressure in decibels (dBA).
<b>Acoustic environment</b>	Sound from all sound sources as modified by the environment [BS ISO 12913-1:2013].
<b>Ambient sound</b>	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. <i>NOTE: The ambient sound comprises the residual sound and the specific sound when present.</i>
<b>Ambient sound level, <math>L_a = L_{Aeq,T}</math> (BS 4142:2014)</b>	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T <i>NOTE: The ambient sound level is a measure of the residual sound and the specific sound when present.</i>
<b>Background sound</b>	Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location.
<b>Background sound level, <math>L_{A90,T}</math> (BS 4142:2014)</b>	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
<b>Break-in</b>	Noise transmission into a structure from outside.
<b>Break-out</b>	Noise transmission from inside a structure to the outside.
<b>Cross-talk</b>	Noise transmission between one room and another room or space via a duct or other path.
<b><math>C_{tr}</math></b>	Correction term applied against the sound insulation single-number values ( $R_w$ , $D_w$ , and $D_{nT,w}$ ) to provide a weighting against low frequency performance. <i>NOTE: The reference values used within the <math>C_{tr}</math> calculation are based on urban traffic noise.</i>
<b>Equivalent continuous A-weighted sound pressure level, <math>L_{Aeq,T}</math></b>	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time.
<b>Equivalent continuous A-weighted sound pressure level, <math>L_{Aeq,T}</math> (BS 4142:2014)</b>	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$ , has the same mean-squared sound pressure as a sound that varies with time.
<b>Equivalent sound absorption area of a room, A</b>	Hypothetical area of a totally absorbing surface without diffraction effects, expressed in square metres (m <sup>2</sup> ), which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration
<b>Facade level</b>	Sound pressure level 1 m in front of the façade. <i>NOTE: Facade level measurements of <math>L_{pA}</math> are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.</i>
<b>Free-field level</b>	Sound pressure level away from reflecting surfaces. <i>NOTE: Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e., not 3.5 m from the reflecting surface in the direction of the source). Estimates of noise from aircraft overhead usually include a correction of 2 dB to allow for reflections from the ground.</i>

<b>Impact sound pressure level, <math>L_i</math></b>	Average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent.
<b>Indoor ambient noise</b>	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants. <i>NOTE: The location(s) within the room at which the ambient indoor noise is to be measured or calculated ought to be considered.</i>
<b>Measurement time interval, <math>T_m</math> (BS 4142:2014)</b>	Total time over which measurements are taken. <i>NOTE: This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.</i>
<b>Noise criteria</b>	Numerical indices used to define design goals in a given space.
<b>Noise rating, NR</b>	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves.
<b>Normalised impact sound pressure level, <math>L_n</math></b>	Impact sound pressure level normalized for a standard absorption area in the receiving room. <i>NOTE: Normalised impact sound pressure level is usually used to characterize the insulation of a floor in a laboratory against impact sound in a stated frequency band.</i>
<b>Octave band</b>	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit.
<b>Percentile level, <math>L_{AN,T}</math></b>	A-weighted sound pressure level obtained using time-weighting "F", which is exceeded for $N\%$ of a specified time interval.
<b>Reference time interval, <math>T_r</math> (BS 4142:2014)</b>	Specified interval over which the specific sound level is determined. <i>NOTE: This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.</i>
<b>Residual sound (BS 4142:2014)</b>	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
<b>Residual sound level, <math>L_r = L_{Aeq,T}</math> (BS 4142:2014)</b>	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.
<b>Rating level, <math>L_{Ar,T_r}</math></b>	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise. <i>NOTE: This is used in BS 7445 and BS 4142 for rating industrial noise, where the noise is the specific noise from the source under investigation.</i>
<b>Reverberation time, <math>T</math></b>	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped.
<b>Sound exposure level, <math>L_{AE}</math></b>	Level of a sound, of 1 s duration, that has the same sound energy as the actual noise event considered.
<b>Sound level difference, <math>D</math></b>	Difference between the sound pressure level in the source room and the sound pressure level in the receiving room.
<b>Sound pressure, <math>p</math></b>	Root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound.
<b>Sound pressure level, <math>L_p</math></b>	Quantity of sound pressure, in decibels (dB).
<b>Sound reduction index, <math>R</math></b>	Laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

<b>Specific sound level,</b> $L_s = L_{Aeq,T_r}$ (BS 4142:2014)	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, $T_r$ .
<b>Specific sound source</b> (BS 4142:2014)	Sound source being assessed.
<b>Standardised impact sound pressure level, <math>L'_{nT}</math></b>	Impact sound pressure level normalized to a reverberation time in the receiving room of 0.5 s.
<b>Standardised level difference, <math>D_{nT}</math></b>	Difference in sound level between a pair of rooms, in a stated frequency band, normalized to a reference reverberation time of 0.5 s for dwellings.
<b>Groundborne noise</b>	Audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground. <i>NOTE Common sources of ground-borne noise include railways and heavy construction work on adjacent construction sites.</i>
<b>Structure-borne noise</b>	Audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements. <i>NOTE Common sources of structure-borne noise include building services plant, manufacturing machinery and construction or demolition of the structure.</i>
<b>Third octave band</b>	Band of frequencies in which the upper limit of the band is 2% times the frequency of the lower limit.
<b>Weighted level difference, <math>D_w</math></b>	Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. <i>NOTE Weighted level difference is used to characterize the insulation between rooms in a building as they are. Values cannot normally be compared with measurements made under other conditions (see BS EN ISO 717-1).</i>
<b>Weighted normalised impact sound pressure level, <math>L'_{n,w}</math></b>	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
<b>Weighted sound reduction index, <math>R_w</math></b>	Single-number quantity which characterizes the airborne sound insulating properties of a material or
<b>Weighted standardised impact sound pressure level <math>L'_{nT,w}</math></b>	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
<b>Weighted standardised level difference, <math>D_{nT,w}</math></b>	Single-number quantity that characterizes the airborne sound insulation between rooms.

## Symbols

$D_w$	Weighted level difference (dB)
$D_{nT}$	Standardized level difference (dB)
$D_{nT,w}$	Weighted standardized level difference (dB)
$L_{Amax}$	Maximum noise level (dB)
$L_{Ar,T}$	Rating level (dB)
$L_n$	Normalised impact sound pressure level (dB)
$L'_{nT}$	Standardised impact sound pressure level (dB)
$L'_{nT,w}$	Weighted standardised impact sound pressure level (dB)
$L'_{n,w}$	Weighted normalised impact sound pressure level (dB)
$L_p$	Sound pressure level (dB)
$L_{pA}$	A-weighted sound pressure level (dB)
$L_{AN,T}$	Percentile level (dB)
$L_{AE}$	Sound exposure level (dB)
$L_{Aeq,T}$	Equivalent continuous A-weighted sound pressure level (dB)
$p$	Sound pressure (Pa)
$p_A$	A-weighted sound pressure (dB)
$p_A(t)$	Instantaneous A-weighted sound pressure (Pa)

$R$	Sound reduction index (dB)
$R_w$	Weighted sound reduction index (dB)
$T$	Time interval (also used for reverberation time) (s)
$t_0$	Reference time interval (s)

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