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# Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU

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**Noise Impact Assessment Report**  
Report 31382.NIA.01

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Report 31382.NIA.01		
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	Revision of Sections 6.2 and 7.0 to outline the proposed development's overheating mitigation strategy.	
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31382.TH1-2	Environmental Noise Time Histories
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## SUMMARY

KP Acoustics Ltd has been commissioned to assess the suitability of the site at Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU for a residential development in accordance with the provisions of the National Planning Policy Framework (NPPF) and the Noise Policy Statement for England (NPSE).

An environmental noise survey has been undertaken on site in order to establish the current ambient noise levels, as shown in Table 3.1.

Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed elements in order to meet the requirements of BS8233:2014, taking into consideration the non-glazed external building fabric elements. The results of these calculations and the sound reduction performance requirements for the glazed elements are shown in Table 5.2.

Further advice can be provided with regards to the overheating strategy to assess the noise implications once thermal modelling calculations have been undertaken.

Noise levels within external amenity areas would be expected to meet the recommended levels provided within BS8233:2014.

No further mitigation measures should be required in order to protect the proposed habitable spaces from external noise intrusion.

## 1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Caldecotte Group, 15 London House, Swinfens Yard, Stony Stratford, MK11 1SY to assess the suitability of the site at Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU for a residential development in accordance with the provisions of the National Planning Policy Framework (NPPF) and the Noise Policy Statement for England (NPSE).

This report presents the results of the environmental survey undertaken in order to measure prevailing background noise levels and outlines any necessary mitigation measures.

## 2.0 SITE SURVEYS

### 2.1 Site Description

The site is bounded by residential properties and associated gardens to the north and south, Sipson Road (A408) to the west and Grassland and M4 to the east. Entrance to the site is located at Sipson Road. It should be noted that the proposed development is located approximately 1,24 Km from the Northern Runway (09L/27R) of Heathrow Airport and therefore at the time of the survey, the background noise climate was dominated by road traffic noise from Sipson Road and M4 motorway but also aircraft noise.

### 2.2 Environmental Noise Survey Procedure

A noise survey was undertaken on the proposed site as shown in Figure 2.1. The location was chosen in order to collect data representative of the worst-case levels expected on the site due to all nearby sources.

Continuous automated monitoring was undertaken for the duration of the survey between 11:00 on 05/12/2025 and 10:04 on 09/12/2025.

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*'.

### 2.3 Measurement Positions

Measurement positions are as described within Table 2.1 and shown within Figure 2.1.

Icon	Descriptor	Location Description
1	Noise Measurement Position 1	The microphone was installed on a microphone stand on the first floor of the north façade, as shown in Figure 2.1. The microphone was located within 3.5 metres of the nearest surface and therefore includes local reflections.
2	Noise Measurement Position 2	The microphone was installed on a microphone stand at the rear land, as shown in Figure 2.1. The microphone was positioned within free-field conditions at least 3.5 metres from the nearest surface.

**Table 2.1 Measurement positions and descriptions**



**Figure 2.1 Site location and measurement positions (Image Source: Yoop Architects)**

**2.4 Equipment**

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.2.

Measurement instrumentation		Serial no.	Calibration Date	Cert no.
Noise Kit 28	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21140-E0	11/09/2025	TCRT25/1689
	Free-field microphone NTI Acoustics MC230A	A23592		
	Preamp NTI Acoustics MA220	10981		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise Kit 29	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21175-E0	22/07/2024	TCRT24/1568
	Free-field microphone NTI Acoustics MC230A	A23073		
	Preamp NTI Acoustics MA220	11033		
	NTI Audio External Weatherproof Shroud	-	-	-
B&K Type 4231 Class 1 Calibrator		2147411	10/09/2025	UCRT25/2295

**Table 2.2 Measurement instrumentation**

### 3.0 RESULTS

The  $L_{Aeq,5min}$ ,  $L_{Amax,5min}$  acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as a time history in Figures 31382.TH1-2.

The measured noise levels, as shown in Table 3.1, are considered representative of the noise exposure levels expected to be experienced all facades of the proposed development.

Time Period	Noise Measurement Position 1 (Measured Noise level – dBA)	Noise Measurement Position 2 (Derived Noise level – dBA)
Daytime $L_{Aeq,16hour}$	62	59
Night-time $L_{Aeq,8hour}$	58	54

**Table 3.1 Site average noise levels for daytime and night time**

Noise Measurement Position 1 was located at a distance less than 3.5 metres from the nearest reflective surface and therefore a 3dB correction has been applied, as per ISO1996 Part 2, to obtain the free-field measurements shown in Table 3.1.

Further to the *Development Control for Noise-Generating and Noise-Sensitive Development* (London Borough of Hillingdon, April 2016), and based on the measured on-site noise levels,

the initial site risk assessment indicates that the site falls within a Medium Noise Risk Category. In the absence of mitigation, the associated noise exposure is likely to result in adverse effects on health and quality of life. Accordingly, appropriate mitigation measures will be required to ensure that the proposed habitable spaces are adequately protected from external noise intrusion.

#### **4.0 NOISE ASSESSMENT GUIDANCE**

##### **4.1 National Planning Policy Framework 2024 & Noise Policy Statement for England 2010**

The National Planning Policy Framework (NPPF) has superseded and replaces Planning Policy Guidance Note 24 (PPG24), which previously covered issues relating to noise and planning in England. Paragraph 187 of NPPF 2024 states that planning policies and decisions should contribute to the natural and local environment by:

*“preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.”*

In addition, Paragraph 198 of the NPPF states that *‘Planning policies and decisions should also 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’:*

- 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
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

The Noise Policy Statement for England (NPSE) was developed by DEFRA and published in March 2010 with the aim to ‘Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development.’

Noise Policy Statement England (NPSE) noise policy aims are as follows:

*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life*

The Noise Policy Statement England (NPSE) outlines observed effect levels relating to the above, as follows:

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

As stated in The Noise Policy Statement England (NPSE), it is not currently possible to have a single objective based measure that defines SOAEL that is applicable to all sources of noise in all situations. Specific noise levels are not stated within the guidance for this reason, and allow flexibility in the policy until further guidance is available.

#### **4.2 Planning Practice Guidance – Noise (PPG-N)**

Planning Practice Guidance – Noise (PPG) was introduced by the Ministry of Housing, Communities & Local Government in March 2014 and revised in July 2019. It is an online digital resource that “advises on how planning can manage potential noise impacts in new development”. It gives guidance on establishing whether noise will likely cause a concern, factors of influence on noise impact and methods by which planning can address adverse effects of noise sources.

A noise exposure hierarchy table is provided within the guidance that follows the same observed effect descriptors given within the NPSE guidance, i.e. NOEL, NOAEL and LOAEL and SOAEL.

For a NOAEL descriptor: “A noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life”

#### **4.3 ProPG: Planning and Noise**

As outlined above, the National Planning Policy Framework encourages improved standards of design, although it provides no specific noise levels which should be achieved on site for varying standards of acoustic acceptability, or a prescriptive method for the assessment of noise.

ProPG: Planning and Noise was published in May 2017 in order to encourage better acoustic design for new residential schemes in order to protect future residents from the harmful effects of noise. This guidance can be seen as the missing link between the current NPPF and its predecessor, PPG24 (Planning Policy Guidance 24: Planning and Noise), which provided a prescriptive method for assessing sites for residential development, but without the nuance of ‘good acoustic design’ as outlined in ProPG.

ProPG allows the assessor to take a holistic approach to consider the site’s suitability, taking into consideration numerous design factors which previously may not have been considered alongside the noise level measured on site, for example the orientation of the building in relation to the main source of noise incident upon it.

It should be noted this document is not an official government code of practice, and neither replaces nor provides an authoritative interpretation of the law or government policy, and therefore should be seen as a good practice document only.

**4.4 BS 8233:2014**

BS 8233:2014 ‘Sound insulation and noise reduction for buildings’ describes recommended internal noise levels for residential spaces. These levels are shown in Table 4.1.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Rooms	35 dB(A)	-
Dining	Dining Room/area	40 dB(A)	-
Sleeping (daytime resting)	Bedrooms	35 dB(A)	30 dB(A)

**Table 4.1 BS8233 recommended internal background noise levels**

It should be noted that the recommended internal noise levels outlined above are not applicable under “purge ventilation” conditions as defined by Approved Document F of the Building Regulations, as this should only occur occasionally (e.g. to remove odour from painting or burnt food). However, the levels above should be achieved whilst providing sufficient background ventilation, either via passive or mechanical methods.

The external building fabric would need to be carefully designed to achieve these recommended internal levels.

**4.5 WHO Guidelines for Community Noise (1999) & Night Noise Guidelines for Europe (2009)**

WHO Guidelines for Community Noise (1999) recommend that internal noise levels for individual events should not exceed 45dB  $L_{Amax}$  more than 10-15 times per night.

WHO Night Noise Guidelines for Europe (2009) presents guidelines for noise levels outside dwellings and discusses the relationship between these and the criteria for internal noise presented in Guidelines for Community Noise. The document states that the two should be considered complimentary and that the 1999 guidelines should be considered valid to achieve the 2009 guidelines.

**4.6 Approved Document O (ed. 2021)**

Approved Document O (ADO) supports Part O of Schedule 1 to the Building Regulations 2010. ADO introduces requirements for residential premises in order to prevent overheating from occurring. There are two specific requirements from ADO:

Requirement O1 (1):

To limit unwanted solar gains in summer and to provide adequate means to remove heat from the indoor environment.

Requirement O1 (2):

- (a) Account must be taken of the safety of the occupant, and their reasonable enjoyment of the residence.
- (b) Mechanical cooling may only be used where sufficient heat cannot be removed from the indoor environment without it.

The statutory guidance to support Requirement O1(2)(a) contains requirements relating to noise at night.

**4.6.1 Application**

The guidance within ADO applies to new residential buildings only and are defined within the following table:

Title	Purpose for which the building is intended to be used.
Residential (dwellings)	Dwellings, which includes both dwellinghouses and flats.
Residential (institutions)	Home, school or other similar establishment, where people sleep on the premises. The building may be living accommodation for the care or maintenance of any of the following. <ul style="list-style-type: none"> <li>A. Older and disabled people, due to illness or other physical or mental condition.</li> <li>B. People under the age of 5 years.</li> </ul>
Residential (other)	Residential college, hall of residence and other student accommodation, and living accommodation for children ages 5 years or older.

**Table 4.2 Residential buildings within the scope of ADO (ref. Table 0.1 of Approved Document O)**

Paragraphs 3.2 and 3.3 of ADO specifically refer to noise within bedrooms at night. Whilst any habitable room could be used as a bedroom, it is proposed that the scope is confined to those rooms specifically designated as bedrooms.

**4.6.2 Internal Noise Level Targets**

ADO sets internal noise level targets within Paragraph 3.3 of the document:

*“Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.*

- a. *40dB  $L_{Aeq,T}$ , averaged over 8 hours (between 11pm and 7am)*
- b. *55dB  $L_{AFmax}$ , more than 10 times a night (between 11pm and 7am).”*

Where an openable window for the removal of excess heat is predicted to result in the above internal noise levels to be exceeded, then the overheating mitigation strategy must adopt one of the alternative means listed within Paragraph 2.10 of ADO (presented within Section 4.7.3

of this report). This constraint applies regardless of which method is used to demonstrate compliance with Requirement O1 (1).

**4.6.3 Methods to Remove Excess Heat**

Paragraph 2.10 of ADO lists the means for removing excess heat from dwellings according to the following:

- Openable windows
- Ventilation louvres in external walls
- A mechanical ventilation system
- A mechanical cooling system

Where mitigation of impacts related to overheating is required, this must be led by an overheating specialist.

**5.0 EXTERNAL BUILDING FABRIC SPECIFICATION**

Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed and non-glazed elements in order to achieve the recommended internal noise levels shown in Table 4.1, taking into account average and maximum noise levels monitored during the environmental noise survey.

$L_{Amax}$  spectrum values of night-time peaks have also been considered and incorporated into the glazing calculation in order to cater for the interior limit of 45 dB  $L_{Amax}$  for individual events, as recommended in WHO Guidelines.

Please note that the glazed and non-glazed element calculations would need to be finalised once all design proposals are finalised.

**5.1 Non-Glazed Elements**

At this project stage, the exact construction of the non-glazed external building fabric is unknown, however, it is understood that it would be based upon the construction proposed in Table 5.1 and would be expected to provide the minimum figures shown in the following table when tested in accordance with the BS EN ISO 10140 series of standards.

Element	Sound Reduction Index , dB, at Octave Band Centre Frequency, Hz					
	125	250	500	1k	2k	4k
Brickwork Cavity Wall	41	43	48	50	55	55

**Table 5.1 Assumed sound reduction performance for non-glazed elements**

## 5.2 Glazed Elements

Minimum octave band sound reduction index (SRI) values required for all glazed elements to be installed are shown in Table 5.2. The performance is specified for the whole window unit, including the frame, seals, etc. as appropriate. Sole glass performance data would not demonstrate compliance with this specification.

Glazing performance calculations have been based both on average measured night-time noise levels as well as verified against the  $L_{Amax}$  spectrum of individual events in order to comply with a maximum internal noise level of 45dB(A) in bedrooms as recommended by World Health Organisation Guidelines. The combined most robust results of these calculations are shown in Table 5.2.

Elevation	Sound Reduction Index , dB, at Octave Band Centre Frequency, Hz						$R_w(C;C_{tr})$ , dB
	125	250	500	1k	2k	4k	
All Elevations	27	26	33	39	39	47	36 (-1;-3)

**Table 5.2 Required glazing performance**

The nominated glazing supplier should verify that their proposed window system meets the attenuation figures shown at each centre frequency band as shown in Table 5.2.

Example glazing types that would be expected achieve the above spectral values are shown in Table 5.3.

Elevation	Example Glazing Type
All Elevations	6/12/10

**Table 5.3 Example glazing types**

All major building elements should be tested in accordance with the BS EN ISO 10140 series of standards.

Independent testing at a UKAS accredited laboratory will be required in order to confirm the performance of the chosen system for an ‘actual’ configuration.

## 6.0 VENTILATION AND OVERHEATING RELIEF

### 6.1 Ventilation Strategy

Approved Document F 2021 describes the following system types for background and extract ventilation:

Ventilation System Type	Whole Dwelling Ventilation	Extract Ventilation
Natural Ventilation	Trickle ventilators	Intermittent extract fans
Continuous Mechanical Extract Ventilation (MEV)	Continuous mechanical extract (low rate) and trickle vents for supply	Continuous mechanical extract (high rate) with trickle vents providing inlet air
Mechanical Ventilation with Heat Recovery (MVHR)	Continuous mechanical supply and extract (low rate)	Continuous mechanical supply and extract (high rate)

**Table 6.1 Ventilation system types as described in ADF 2021**

Based on the results of the noise survey, the suitability of each system type and the required trickle ventilator performance (where appropriate) is shown in Table 6.2 below.

Elevation	ADF Ventilation System Type Suitable?			Minimum Trickle Ventilator Performance (dB $D_{n,e,w}$ )
	Natural Vent	MEV	MVHR	
All Elevations	Yes	Yes	Yes	40

**Table 6.2 Suitability and required performance of ventilation systems**

For our assessment of trickle ventilator performance, we have assumed 2no. vents are proposed in the assessed rooms. As trickle vents introduce a weak point in the building façade, increasing the number of trickle vents will reduce the composite performance of the facade. If trickle vents are proposed, the total number of trickle vents for each sensitive space should be confirmed so that calculations can be accurately revised.

Where mechanical ventilation is proposed, systems should be designed so that the combined internal noise levels from external sources and from the mechanical ventilation meet the BS 8233: 2014 criteria shown in Table 4.1.

In all cases, purge ventilation would be provided by openable windows. As outlined in Section 4.4, the internal noise level requirement would not be applicable during purge conditions as this would only occur occasionally.

**6.2 Openable Windows for Overheating Relief**

Approved Document O (ADO) only applies to Bedrooms during night. The advice within this section would therefore only apply to Bedrooms during night-time hours (23:00-07:00) to ensure that the internal noise level targets of 40dB(A)  $L_{eq,T}$  and 55dB(A)  $L_{max}$  are not exceeded.

Table 6.4 presents the open area of the window as a % of the floor area which would need to be achieved to ensure that sufficient attenuation is provided from outside to inside.

Elevation	Sound Reduction Required to Achieve ADO Target Internal $L_{Aeq}$ Noise Levels	Sound Reduction Required to Achieve ADO Target Internal $L_{Amax}$ Noise Levels	Maximum Open Area of the Window as a Percentage of the Floor Area to Achieve ADO Target Internal Noise Levels
East	14 dB	17 dB	1 %
West	18 dB	21 dB	0 %

**Table 6.4 Window open areas**

*Note: Acoustic open area is the measurable, cross-sectional, geometric area of an opening. For a partially open window, this is considered to be the lesser of either the size of the hole in the window frame that is left by the opening light, or the combined cross-sectional area around the opening light through which air must pass to move from outside to inside. The area around a hinged opening light includes the triangular areas on the sides adjacent to the hinge, and the rectangular area on the side opposite the hinge. This should not be used for comparing the air-flow performance of elements because this will also be dependent on factors such as depth (length of air-path), surface roughness and tortuosity.*

Further discussions with the client indicate that the Energy Statement proposes the use of Mechanical Ventilation with Heat Recovery (MVHR) units incorporating a cooling module as the primary overheating mitigation strategy, thereby avoiding the need to rely on opening windows for thermal comfort. Therefore, it can be confirmed that the requirements of Approved Document O (ADO) are not expected to be exceeded.

**7.0 CONCLUSION**

An environmental noise survey has been undertaken at Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU allowing the assessment of daytime and night-time levels likely to be experienced by the proposed development.

Measured noise levels allowed a robust glazing specification to be proposed which would provide internal noise levels for all residential environments of the development commensurate to the design range of BS8233:2014.

The maximum openable area for the bedroom windows within the development has been presented based on the requirements of Approved Document O, and the MVHR strategy ensures both compliance with Approved Document O.

Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU - Position 1  
Environmental Time History  
05/12/2025 to 09/12/2025

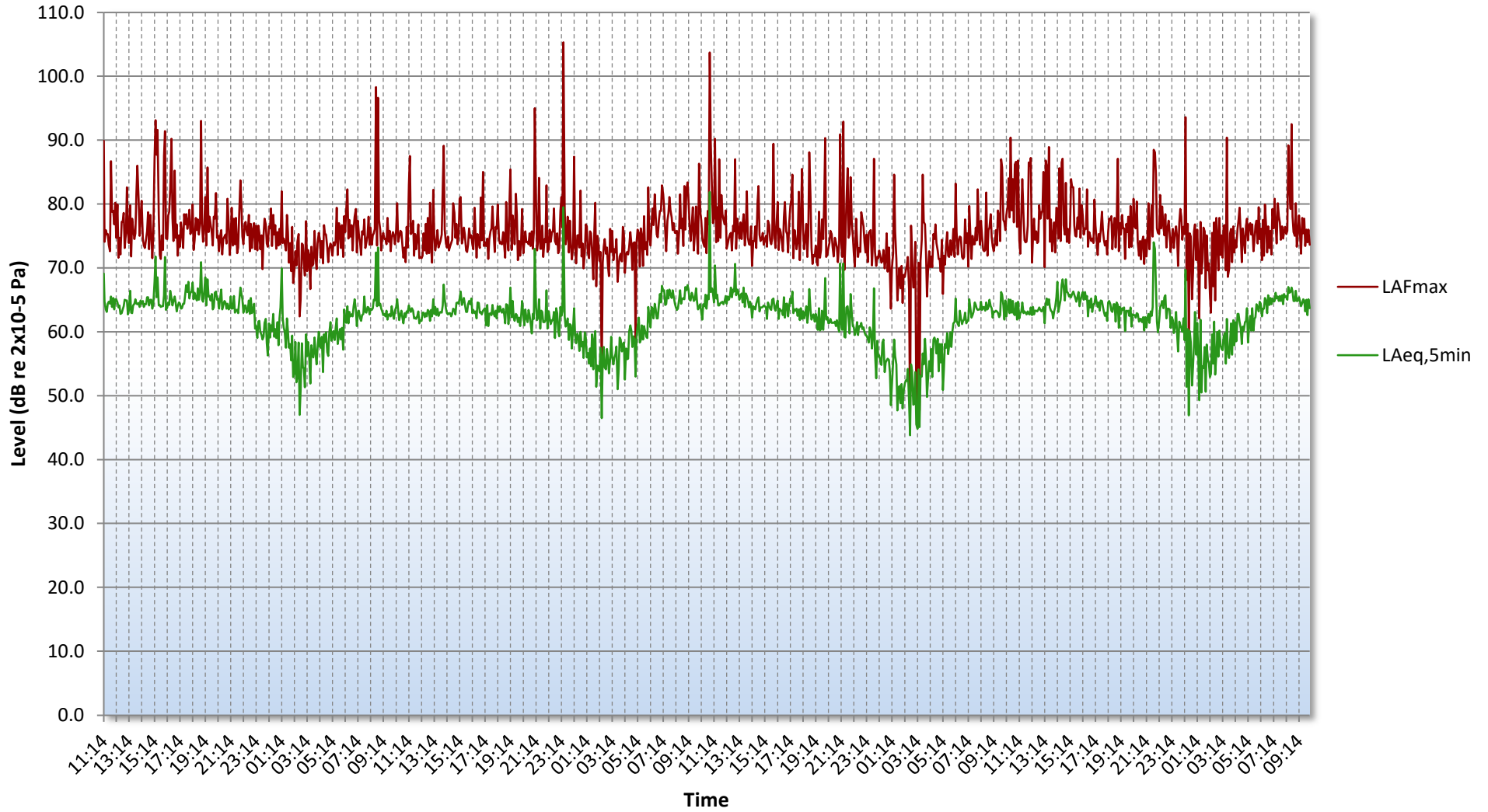


Figure 31382.TH1

Land rear of Zayani Restaurant, 395 Sipson Road, Uxbridge, UB7 9HU - Position 2  
Environmental Time History  
05/12/2025 to 09/12/2025

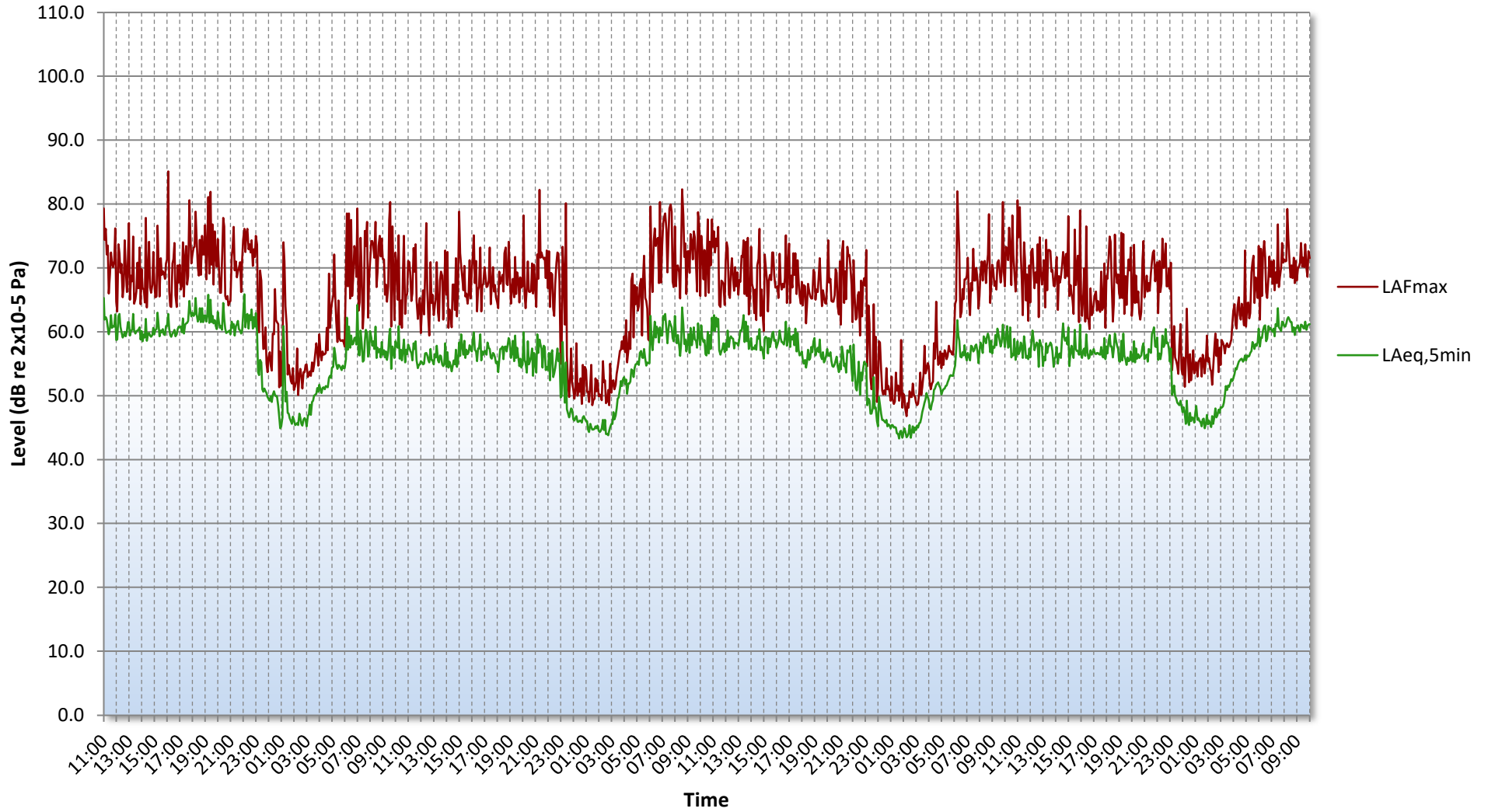


Figure 31382.TH2

## GENERAL ACOUSTIC TERMINOLOGY

### Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of  $10^{13}$  units, that only a logarithmic scale is the sensible solution for displaying such a range.

### Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

### $L_{eq}$

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level  $L_{eq}$ . The  $L_{eq}$  is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

### $L_{10}$

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

### $L_{90}$

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

### $L_{max}$

This is the maximum sound pressure level that has been measured over a period.

### Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

## APPLIED ACOUSTIC TERMINOLOGY

### Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

### Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

### Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

### Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

### Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

### Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.