Environmental Noise Survey, Noise Break-in Assessment & Sound Insulation Scheme

Client:	Brownacre Properties Ltd.
Client Address:	30 Sky Peals Road, Essex, IG8 9NF
Site Address:	61 Bedford Street & 116 The Parade, Royal Leamington Spa, CV32 4AQ
Date:	05/05/2022

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An environmental noise survey and noise impact assessment have been undertaken to assess the suitability of the site at 61 Bedford Street & 116 The Parade, Royal Leamington Spa, CV32 4AQ for residential development. The measured ambient sound levels have allowed BS8233:2014 and BS414:2014 noise assessments to be carried out.

A sound insulation scheme has been provided in Section 6.0, including glazing and an alternative ventilation strategy. These recommendations should be sufficient to achieve appropriate internal sound levels for the Proposed Development according to the BS8233:2014 criteria.

An overview of all recommendations can be found in the table below:

Recommendations and Mitigation Overview
- All glazing requires the sound reduction specified in Table 8.0. - Appropriate glazing specifications can be found in Table 9.0. - Reliance on open windows to achieve the BS8233:2014 internal noise criteria is discussed in Section 6.0. - Appropriate acoustically treated trickle ventilation can be found in Table 12.0. - It is recommended that the separating floor between the ground floor commercial property and proposed residential development provides 53.0 dB $D_{nT,w}$ + C_{tr} of sound reduction. A Proposed floor construction that is predicted to achieve this can be found in Section 7.0.

The findings of this report will require written approval from the Local Authority prior to work commencing.

1. Introduction

Overview

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the Proposed Development') at 61 Bedford Street & 116 The Parade, Royal Leamington Spa, CV32 4AQ ('the Site').

The applicant is preparing a planning application ('the Application') to be submitted to Warwick Borough Council.

An initial version of the noise impact assessment was submitted to the local authority for review. The local environmental protection team has raised some concerns with regards to the noise levels incident on site. Specifically in relation to the future residents having quiet façade areas in which the usage of open windows could be facilitated.

The following technical noise assessment has been prepared to support the planning application to Warwick Borough Council and address the concerns of the local environmental protection team where possible. This report details the ambient sound climate at the proposed development site and provides a sound insulation scheme to protect the amenity of the occupants of the proposed residential dwellings.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

Scope & Objectives

The scope of the noise assessment can be summarised as follows:

- Ambient sound monitoring survey to evaluate the prevailing ambient and maximum sound levels incident on the proposed development;
- A detailed assessment of the suitability of the Site, in accordance with relevant standards in respect of sound from the surrounding noise sources; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Policy Framework (2021), Noise Policy Statement for England (2010) and British Standard BS8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'. Further information on the legislation can be found in Appendix B.

2. Environmental Noise Survey

Measurement Methodology

In order to characterise the sound profile of the area at the proposed development, a long-term environmental sound survey was carried out from 04/12/20 to 07/12/20. For the long-term monitoring two sound level meters were installed within the building, one on the 3rd floor, with the microphone protruding from a window on the eastern façade fronting the B4087 Road (The Parade), and one protruding from a 1st floor window on the western façade fronting Bedford Street. Both microphones were placed 1m from the façades of the building and consequently, façade corrections have been applied to the results.

Short-term measurements were also taken to measure noise from the rooftop plant associated with the adjacent Wetherspoons. In each case, the microphone was positioned 1m from the source, 1.5m from the floor of the roof and at least 3m from any other reflective surface.

The monitoring positions were chosen in order to collect representative sound levels at the proposed development during the day and night. The long-term monitoring locations are shown in Figure 1.0 below.

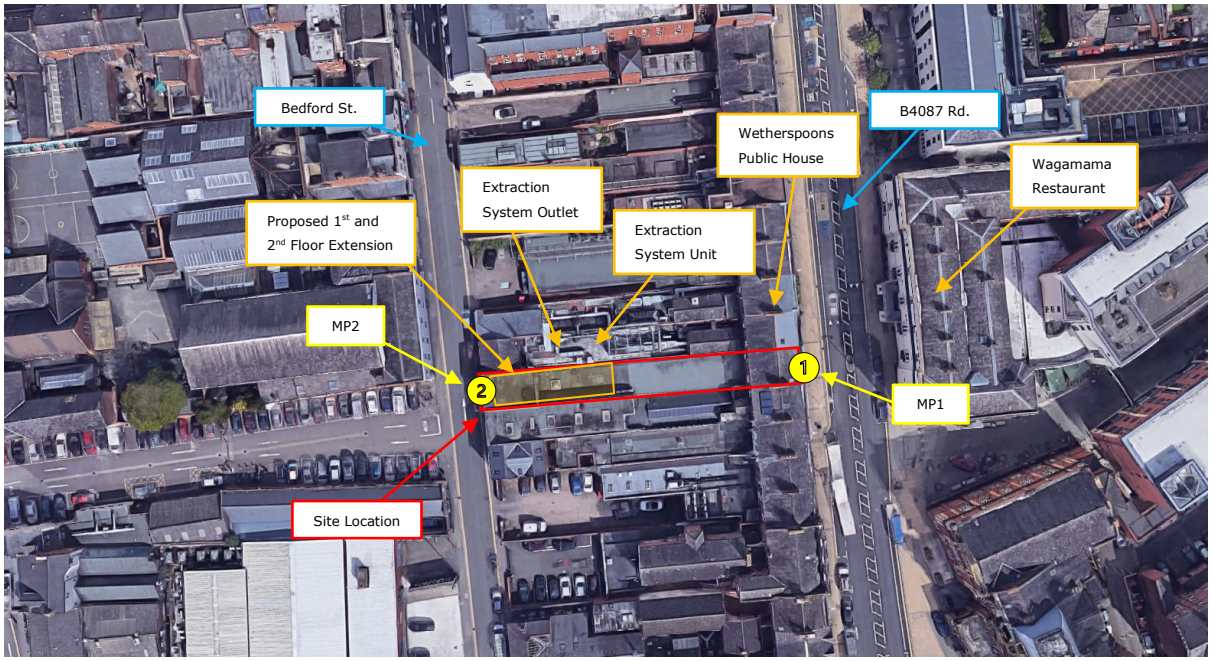


Figure 1.0 – Indicative Site Layout

Context & Subjective Impression

The area surrounding the site is primarily mixed in nature with both commercial properties and residential dwellings. Adjacent to the Proposed Development is a Wetherspoons pub which operates from 07:00 to 00:00 – Sunday to Thursday, and 07:00 to 01:00 – Friday and Saturday, however, due to COVID-19 restrictions it was not operational during the environmental noise survey. The acoustic environment of the area is deemed to be moderate in level and the noise profile is dominated by road traffic utilising the B4087 (The Parade) and Bedford Street. During the site visit, it was noted that the noise emissions from the adjacent rooftop plant units associated with the

Wetherspoons were the dominant noise sources incident on the inward-facing façades. However, it is assumed that this plant only operates in the day time when the Associated commercial unit is serving food.

In the surrounding area, there are already existing residential development including flats in the neighbouring property 118 Parade and 49 – 51 Parade which are both subject to similar, however, not identical noise sources. Given the recent planning history of the area, it is assumed that this site is suitable for development provided good acoustic design is implemented.

Environmental Noise Survey Results

Long-Term Results Summary

The following table shows a summary of the sound survey results; L_{Aeq}, L_{Amax}, L_{A90} and the L_{A10} measured during the day time and night time periods that will be used in the noise break-in assessment. A full summary of all results can be found in Appendix D.

Measurement Position MP1				
Measurement Period ('t')	**$L_{Aeq,t}$**	**$L_{Amax,t}$**	**$L_{A90,t}$**	**$L_{A10,t}$**
Highest $L_{Aeq,1hr}$ (Day)	64.0	95.0	59.0	68.0
Highest $L_{Aeq,1hr}$ (Night)	63.0	87.0	48.0	63.0
Measurement Position MP2				
Measurement Period ('t')	**$L_{Aeq,t}$**	**$L_{Amax,t}$**	**$L_{A90,t}$**	**$L_{A10,t}$**
Highest $L_{Aeq,1hr}$ (Day)	64.0	96.0	52.0	68.0
Highest $L_{Aeq,1hr}$ (Night)	54.0	83.0	44.0	53.0

Table 1.0 – Summary of Measured Long-Term Sound Levels During Day & Night

In the following section, the maximum noise level events are assessed. ProPG states:

"…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 $L_{Amax,F}$ more than 10 times a night."

The following table shows a summary of the maximum sound level results.

Measurement Position MP1			
Measurement Period ('t')	**$L_{AFMax,15min,}$**	***SMR $L_{AFMax,15min}$**	**10th Highest $L_{AFMax,15min}$**
Night 1	84.0	71.0	**73.0**
Night 2	87.0	69.0	69.0
Night 3	86.0	56.0	72.0
Measurement Position MP2			
Measurement Period ('t')	**$L_{AFMax,15min}$**	***SMR $L_{AFMax,15min}$**	**10th Highest $L_{AFMax,15min}$**

Night 1	83.0	73.0	**74.0**
Night 2	81.0	72.0	73.0

Table 2.0 – Maximum Sound Level Summary Results

**Statistically Most Repeated*

Short-Term Results Summary

The following table presents the sound survey results for the spot measurements that will be used to further augment the ambient noise maps.

Short-Term Measurements	
Measurement Period ('t')	**$L_{Aeq,t}$ (dB)**
Extraction System Outlet at 1m	79.0
Extraction System Unit at 1m	65.0

Table 3.0 – Summary of Measured Short-Term Sound Levels During Day

Context – COVID-19

The current situation due to the COVID-19 pandemic has forced the Government to take extraordinary measures, as is well known by everyone. The consequence of those measures is a potential decrease in traffic flow levels, leading to a quieter sound profile of the assessed area. Regarding the above, the Institute of Acoustics (IOA) has raised that, *"…We have, therefore, recommended below some changes in working practices in the production of such reports. In so doing, it is still important to minimize uncertainties in surveying and to select appropriate baselines conditions, in a clear and transparent way. Furthermore, by good communication between those preparing the reports and those that will be reviewing them, the planning process (and other relevant processes) will be able to continue as smoothly as possible, …"*

<u>Competence:</u>

> *"Appropriate sound level surveying should always be designed to obtain data, which is representative of normal conditions, whilst taking account of variations in sound levels due to, for example. Fluctuations in transportation traffic flows and industrial output. Acoustics professionals are skilled in understanding the effects of such variations an, therefore, check that results are representative and conclusions technically robust so that clients and decision-makers can come to well-informed judgements."*

<u>Methodology:</u>

> *"For some transport scheme, there may be a heavier reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to source flow/activity data. There are now many sources of transport data available and these should be used, where possible, as an alternative to, or to augment direct site measurements to describe baseline conditions.*

Where sound from existing facilities is needed to uniform noise levels, or where it is the existing sound that is being assessed, enquiries will be needed to understand whether the facility is running as normal…

The acoustics professional will need to consider whether alternative sources of information in respect of sound levels can be reasonably used. Where appropriate, a case should be made regarding why any alternative methods are suitable for a robust assessment."

Taking this into consideration, site-specific noise monitoring was conducted to establish a baseline. To ensure a robust assessment of the noise breaking into the site, this baseline will be compared with calculated traffic noise levels based on vehicle pass by data of the roads in the area to assess the potential difference in noise levels.

CRTN Ambient Sound Level Prediction

Due to the COVID-19 outbreak, the UK Government has placed Leamington Royal Spa ('site location') into the tier 3 category. Consequently, further analysis of the measured noise data on-site is required to assess whether the measured noise levels are representative. This will allow a robust assessment of the noise levels incident on the façade of the development and will ensure that façade elements such as glazing are robustly specified ensuring the internal noise criteria of BS8233:2014 can be achieved.

An assessment of the proposed site and its surroundings indicates that the primary noise sources in the area are of Bedford Street and the B4087 (The Parade). Consequently, it can be assumed that comparing the predicted noise level from the road, based on Department of transport vehicle pass by data, will provide a good indication as to whether the noise levels measured at the site are representative of the typical scenario outside of the COVID-19 lockdown.

To calculate noise emissions caused by traffic flow, formulas from the 'Calculation of Road Traffic Noise: 1988' (CRTN) document have been used. The CRTN:1988 document is used to specify predicted noise from traffic considering the following variables:

- Number of vehicles,
- Types of vehicles (heavy or light),
- Speed of vehicles.

The following vehicle pass by data has been obtained from the Department of Transports website on traffic flow, https://roadtraffic.dft.gov.uk/manualcountpoints/0804489, which is taken from Prospect Road approximately 1.6km south of the Proposed Development. Data count points for the B4087 near the Proposed Development are not currently available, however, it is thought that Prospect Road is similar in nature in terms of its size and the fact it is a bus route with multiple bus stops along it.

The same is true to Bedford street, there are no data count points along the road. Therefore, the following vehicle pass by data, https://roadtraffic.dft.gov.uk/manualcountpoints/804493, is taken from Wood Street situated approximately 350m from the Proposed Development. It is thought to be similar in nature to Bedford Street and thus is deemed appropriate.

Description	Wood Street	Prospect Road
Total Vehicles Per Day	602	14104
Heavy Vehicles & Busses Per Day	6	65
Speed	48kph (30mph)	
Road Surface	Impervious Bituminous Surface	
Calculated Noise Level at MP ($L_{Aeq,16hr}$)	62.0 dB	67.0 dB
Measured Noise Levels at MP ($L_{Aeq,16hr}$)	61.0 dB	61.0 dB

Table 4.0 – CRTN Calculation – Bedford Street & B4087 (The Parade)

As can be seen in the table above, the predicted noise level arising from Prospect Road during typical conditions outside of lockdown is 67.0 dB. This is 6.0 dB above the $L_{Aeq,16hour}$ noise level measured at MP1. The predicted noise level arising from Wood Street during typical conditions outside of lockdown is 62.0 dB. This is 1.0 dB above the $L_{Aeq,16hour}$ noise level measured at MP2.

These are both indications that the lockdown may have influenced traffic levels. Table 1.0 shows that the highest 1-hour measurements on the first floor of the Proposed Development at MP1 and MP2 are 67.0 and 64.0 dB respectively, which fall in line with the predicted noise levels outside of COVID-19 tier 3 restrictions.

It is assumed that provided the noise break-in assessment is based on the highest 1-hour measurements instead of the average 16-hour day time and 8-hour night time measurements, the amenity of future residents can be protected.

3. Internal Noise Design Criteria

This section highlights the premise of using BS8233:2014 and BS4142:2014 in tandem. This approach does not create a hybrid methodology but is the correct way of applying both standards with reference to each other.

BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, 'WHO Guidelines on Community Noise, 1999'. The Guidelines on Community Noise (1999) document defines community noise to include noise from "industries" and "construction". The desirable criteria levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
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 $L_{Aeq,8hour}$

Table 5.0 – BS8233:2014 Internal Noise Level Criteria

It should be noted that the WHO Guidelines should be considered as aspirational. Furthermore, BS8233:2014 states that where development is considered necessary or desirable, despite external noise levels that are above WHO guidelines, the target levels may be relaxed by up to 5 dB.

It is stated that the desirable internal and external noise criteria outlined in Table 4.0 of BS8233, are based on anonymous steady state sources and where there are normal diurnal fluctuations in external noise. Where the external noise climate comprises of dominant non-anonymous sources or does not follow normal diurnal fluctuations an alternative assessment period may be appropriate.

It is stated in BS8233 that:

> *"This subclause applies to external noise as it affects the internal acoustic environment from sources without specific character, previously termed "anonymous noise". Occupants are usually more tolerant of noise without a specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4.0. For dwellings, the main consideration are:*
>
> *a.) For bedrooms, the acoustic effect on sleep; and*
> *b.) For other rooms, the acoustic on resting, listening and communicating.*
>
> *NOTE: Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate."*

It is clear from this statement that noise that is not considered to be "anonymous" in nature may require more stringent noise criteria than is typically recommended for anonymous steady-state

noise sources. This could include applying penalties to account for specific acoustic characteristics that may be deemed to cause increased annoyance or a shortening of the assessment period.

Paragraph 6.5.2 of BS8233 states the following for residential developments in areas affected by industrial noise:

> *"Where industrial noise affects residential or mixed residential areas, the methods for rating the noise in BS4142 should be applied. BS4142 describes methods for determining, at the outside of a building:*
>
> *a.) Noise levels from factories, industrial premises or fixed installations, or sources of an industrial nature in commercial premises; and*
> *b.) Background noise level."*

The paragraph above states that the methods for rating the noise in BS4142 should be applied (specifying a rating level (L_{Ar})).

As with the internal noise levels, it is recommended that the character of the industrial noise source affecting external areas is accounted for by applying the rating corrections provided within BS4142.

The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, and that 55 dB $L_{Aeq,T}$ would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels. These design measures should also be weighed against other factors of sustainable development.

BS4142:2014 'Methods for rating and assessing industrial and commercial sound'

BS4142:2014 provides commentary on situations where new noise sensitive premises are introduced to a site and where the new development incorporates specific noise control measures. Section 8.5 of the standard states:

> *"Where a new noise-sensitive receptor is introduced and there is existing industrial and/or commercial sound, it ought to be recognised that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of the required noise mitigation."*

From this it can be inferred that standards other than BS4142 can also be considered in the context of a scheme, where a new noise sensitive development is proposed next to an existing noise source.

Section 11 of the Standard advises that "*When making assessments and arriving at decisions… it is essential to place the sound in context"* and further clarifies this by stating:

> "*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following:*

1.) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2.) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

NOTE 3: Consideration ought to be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available.

3.) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as;

i) façade insulation treatment

ii) ventilation and/or cooling that will reduce the need to have windows open so as to avoid rapid or purge ventilation; and

iii) acoustic screening"

Where the impact affects internal noise levels it is necessary to develop a mitigation scheme in the form of façade insulation and alternative ventilation. Section 11 of BS4142:2014 implies that all control measures should be taken into consideration, and that sound levels within a dwelling after allowance for these measures may be assessed on the basis of other design criteria appropriate to residential property. As such, it is thought that the provided the façade sound reduction is specified considering the BS4142 rating noise level, the amenity of future residents can be fully protected.

BS4142:2014 Rating Penalties of Surrounding Commercial Activity

The following section relates specifically to the noise emissions that are produced by the adjacent external fixed plant and the extraction systems to the rear of the proposed development that are associated with the surrounding businesses. This section defines the BS4142:2014 rating penalties used to conduct the BS8233:2014 noise break-in assessment and generate the subsequent sound insulation scheme.

To assess these noise emissions, a BS4142:2014 rating noise level must be defined. This should include the calculation of a specific sound level, however, due to the complex acoustic environment, which includes multiple commercial noise sources, a specific sound level for individual sources cannot be calculated. Therefore, as per paragraph 6.5.2 of BS8233:2014 it is deemed appropriate to apply a rating penalty to account for audible characteristics of the cumulative commercial noise emissions which may be deemed to cause increased annoyance, such as intermittency or impulsivity.

During the site visits, it was noted that multiple external fixed plant units are located in the centre of the proposed development. The noise emissions produced by these units were found to be readily distinctive in the environment. Although each unit was operating intermittently, the operating periods overlapped causing a near-continuous nature in the cumulative noise emissions.

In accordance with BS4142:2014, a +3.0 dB penalty will be applied to account for the commercial noise emissions being readily distinctive against the residual noise climate, and a +2.0 dB penalty will be applied to account for the subtle tonal elements of the fixed plant noise emissions. The façade sound reduction for those façades deemed to be affected by the external fixed plant noise emissions shall be specified considering the BS4142:2014 rating penalties.

4. Noise Modelling

External Fixed Plant Noise

To account for the external rooftop fixed plant associated with the adjacent public house, point source emitters with the calculated sound power levels shown in the table below shall be inputted into the noise model. The client has indicated that the external fixed plant associated with Wetherspoons only operates during periods where food is served and thus it is assumed this plant ceases operation at 23:00 hours.

External Fixed Plant		
Measurement Period ('t')	**$L_{Aeq,t}$ (dB)**	**Calculated L_w (dBA)**
Extraction System Outlet at 1m	79.0	87.0
Extraction System Unit at 1m	65.0	73.0

Table 6.0 – Sound Power Levels of External Fixed Plant

Public House External Patron Noise

Due to the COVID-19 situation, the Wetherspoons public house adjacent to the development site was not operating. In order to predict the noise emissions from the pub, the noise of two people talking in loud voices at the entrances/exits to the pub will be added to the measured noise levels. This is shown in the table below. The following table shows the noise level for one very loud voice and the resultant sound power level.

Description	Value (dBA)
Sound Pressure Level of Very Loud Voice at 1m	75.0
Calculated Sound Power Level of Very Loud Voice	83.0

Table 7.0 – External Patron Noise Levels

Noise Modelling

Based on the measured noise levels a sound map has been generated using SoundPlan 8.2, which undertakes its calculation in accordance with the guidance given in IS09613 – 1:1993 and ISO9613 – 2:1996. The following assumptions have been made within the calculation software:

- To accurately model the land surrounding the development the topographical data has been taken from Google Maps, it is assumed this has an accuracy within the last 3 years.
- The ground between the source and receiver is modelled as primarily acoustically 'soft' surfaces.
- The sound map is shown at a height of 3.5m which is the approximate first-floor height of the Proposed Development, however, the worst-case noise levels incident upon the façades shall be used.
- The Proposed Development has been modelled according to drawing No. '602A & 503A'. All other buildings have been modelled according to data from Google Earth Pro. The orientation

of more sensitive bedrooms has been fully considered and thus all bedrooms are located along the internal facades where nosie levels are lowest.

- As per drawing No. 602, a 1.8m noise barrier has been implemented along the rooftop perimeter with the adjacent plant units.
- The highest $L_{Aeq,t}$ values measured at MP1 and MP2 shown in Table 1.0 have been used to calibrate the noise map.
- The 10th highest $L_{Amax,15min}$ value from MP1 and MP2 shown in Table 2.0 has been used to calibrate the L_{Amax} noise map.
- 2 No. point source emitters with a sound power level of 83.0 dBA have been used to represent patrons outside the front and rear entrances/exits of the public house.
- Point source emitters with the sound power levels stated in Table 6.0 have been used to represent the external fixed plant on the roof of the adjacent public house.

The noise maps showing the day time and night time L_{Aeq} sound levels incident on the Proposed Development can be seen in Figures 2.0 and 3.0 below.

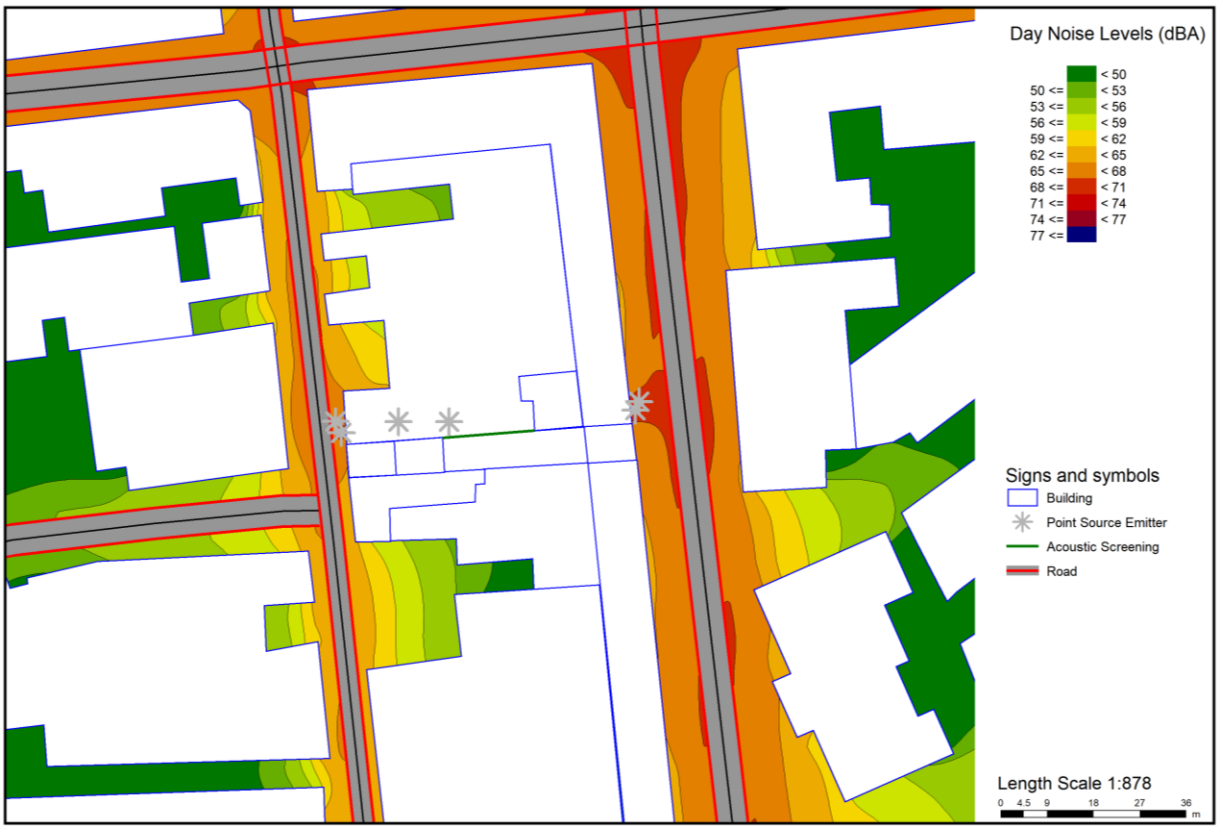


Figure 2.0 – Ambient Noise Level Map – $L_{Aeq,1hr}$ Day Time – 3.5m Grid Map Height

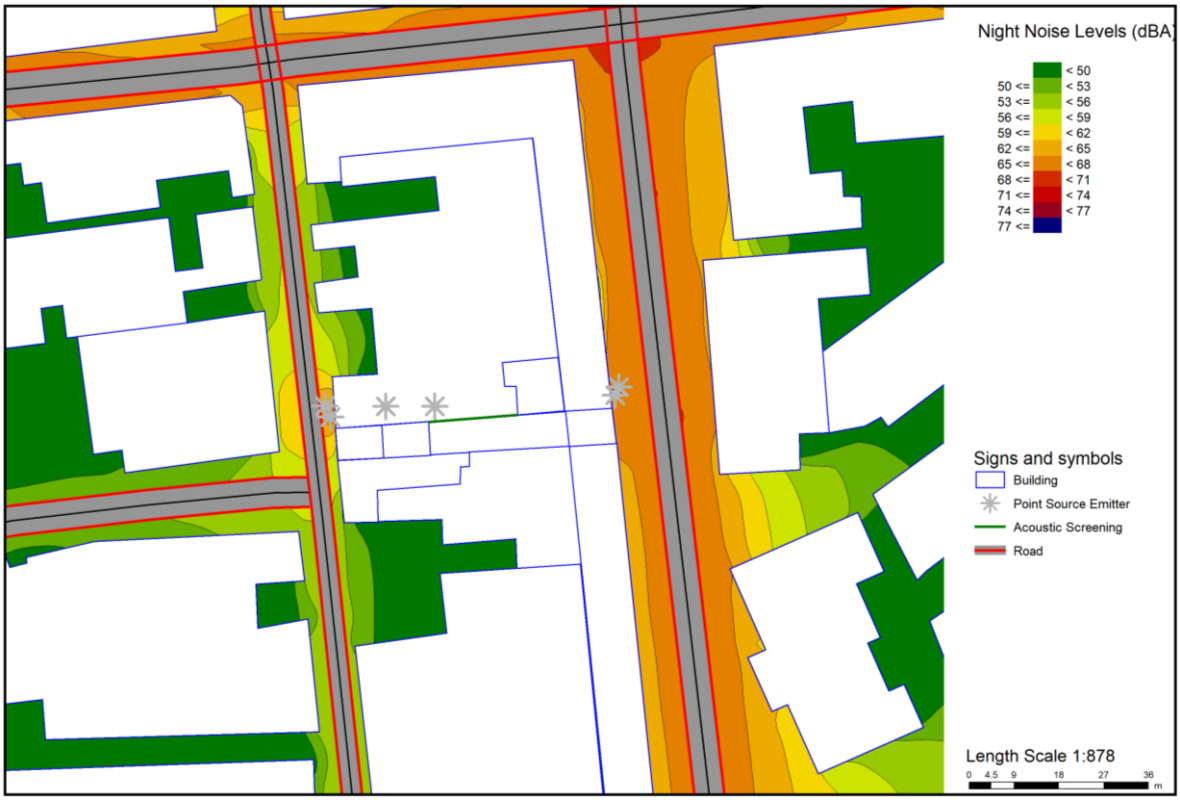


Figure 3.0 – Ambient Noise Level Map – $L_{Aeq,1hr}$ Night Time – 3.5m Grid Map Height

The noise map showing the maximum noise emissions at each façade of the Proposed Development is shown below.

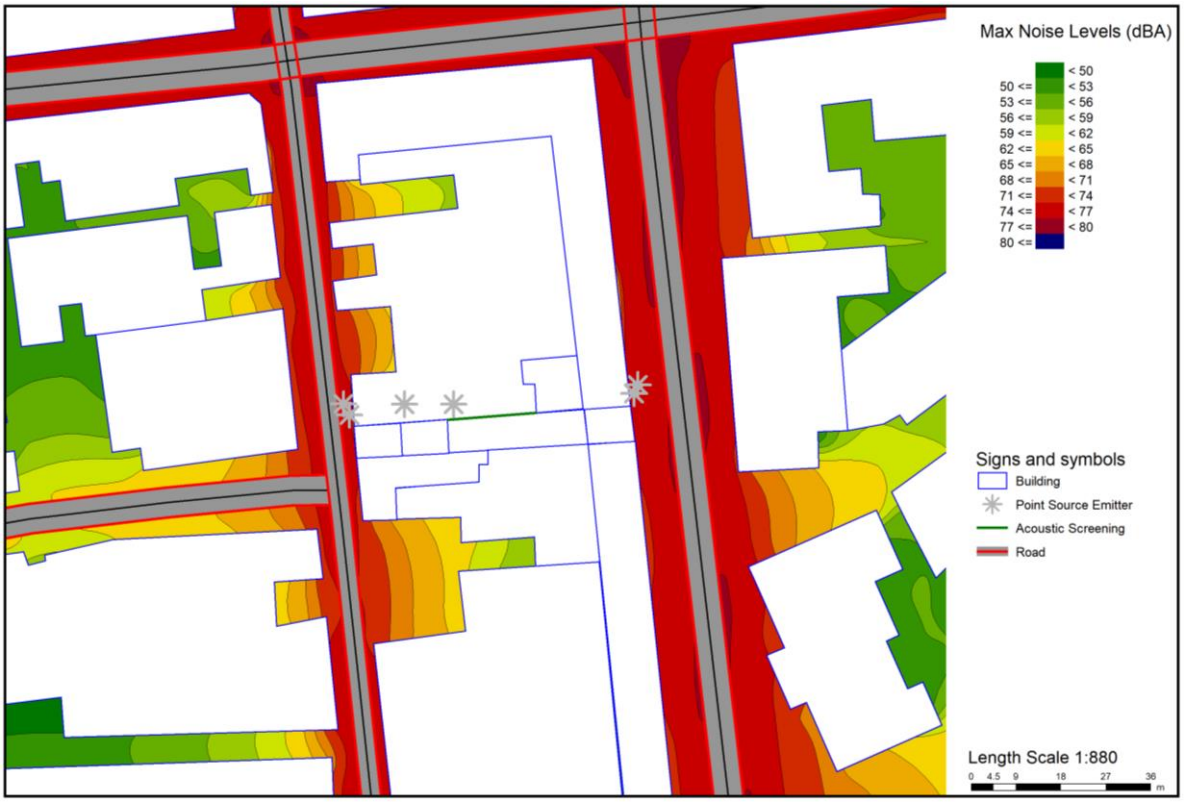


Figure 4.0 – Maximum Noise Level Map - $L_{Amax,15min}$ Night Time – 3.5m Grid Map Height

5. Noise Break-in Assessment

The following section analyses the ambient sound levels incident on the development compared with the internal noise level criteria presented within BS8233:2014.

Façade Colour Allocation Map

As the noise levels vary significantly across the development, the façades have been grouped together as shown in the figure below.

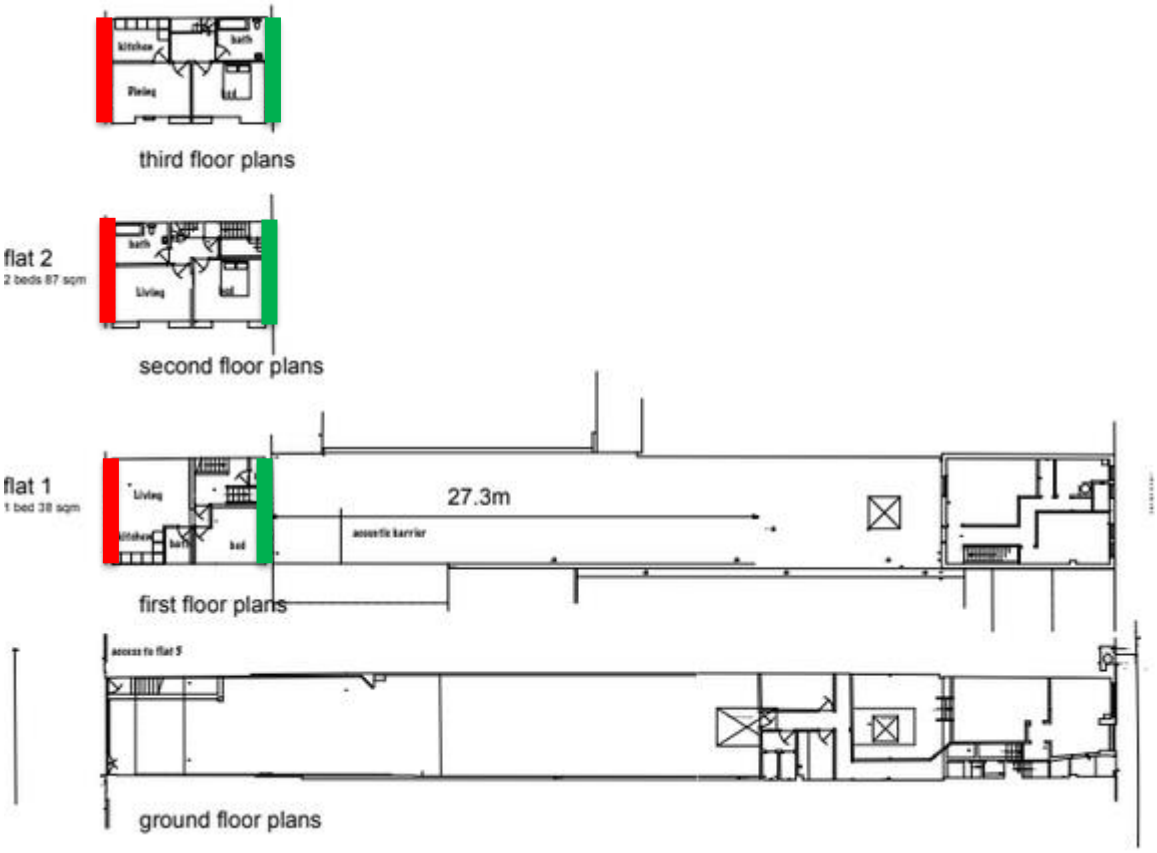


Figure 5.0 – Façade Layout

Noise Break-in Assessment

To achieve the recommended internal noise levels, the façade sound reduction has been specified taking the following into consideration:

- The $L_{AFmax,15min}$ during the night exceeded fewer than ten times predicted using the SoundPlan model.
- The highest $L_{Aeq,t}$ values predicted within the SoundPlan Model.
- The BS4142:2014 rating penalties stated in Section 3.0.

The following table outlines the minimum sound reduction required of the building envelope in order to achieve appropriate internal noise levels.

Façade	Floor	Location	Time Period	Façade Noise Level	BS8233:2014 Criteria	Min. SRI Required (dB)
Red Façades	F1 to F3	Bedroom / Living Room	Day time	65.0 – 67.0	35.0 dB $L_{Aeq,16hour}$	32.0 $R_w + C_{tr}$
		Bedroom	Night time	64.0 – 66.0	30.0 dB $L_{Aeq,8hour}$	36.0 $R_w + C_{tr}$
		Bedroom	Night time	73.0 – 74.0	45.0 dB $L_{Amax,8hour}$	29.0 R_w
Amber Façades	GF to F1	Bedroom / Living Room	Day time	66.0 – 67.0	35.0 dB $L_{Aeq,16hour}$	32.0 $R_w + C_{tr}$
		Bedroom	Night time	63.0 – 65.0	30.0 dB $L_{Aeq,8hour}$	35.0 $R_w + C_{tr}$
		Bedroom	Night time	74.0 – 75.0	45.0 dB $L_{Amax,8hour}$	30.0 R_w
Amber Façades	F2 & Skylights	Bedroom / Living Room	Day time	63.0 – 64.0	35.0 dB $L_{Aeq,16hour}$	29.0 $R_w + C_{tr}$
		Bedroom	Night time	58.0 – 60.0	30.0 dB $L_{Aeq,8hour}$	30.0 $R_w + C_{tr}$
		Bedroom	Night time	72.0 – 73.0	45.0 dB $L_{Amax,8hour}$	28.0 R_w
Yellow Façades	F2 & Skylights	Bedroom / Living Room	Day time	65.0 – 67.0*	35.0 dB $L_{Aeq,16hour}$	32.0 $R_w + C_{tr}$
		Bedroom	Night time	45.0 – 48.0	30.0 dB $L_{Aeq,8hour}$	18.0 $R_w + C_{tr}$
		Bedroom	Night time	62.0 – 64.0	45.0 dB $L_{Amax,8hour}$	19.0 R_w
Blue Façades	F1	Bedroom / Living Room	Day time	56.0*	35.0 dB $L_{Aeq,16hour}$	21.0 $R_w + C_{tr}$
		Bedroom	Night time	42.0	30.0 dB $L_{Aeq,8hour}$	12.0 $R_w + C_{tr}$
		Bedroom	Night time	55.0	45.0 dB $L_{Amax,8hour}$	10.0 R_w
Green Façades	F1 to F2	Bedroom / Living Room	Day time	52.0 – 54.0*	35.0 dB $L_{Aeq,16hour}$	19.0 $R_w + C_{tr}$
		Bedroom	Night time	40.0 – 42.0	30.0 dB $L_{Aeq,8hour}$	12.0 $R_w + C_{tr}$
		Bedroom	Night time	52.0 – 54.0	45.0 dB $L_{Amax,8hour}$	9.0 R_w
Green Façades	F3	Bedroom / Living Room	Day time	57.0*	35.0 dB $L_{Aeq,16hour}$	22.0 $R_w + C_{tr}$
		Bedroom	Night time	44.0	30.0 dB $L_{Aeq,8hour}$	14.0 $R_w + C_{tr}$
		Bedroom	Night time	57.0	45.0 dB $L_{Amax,8hour}$	12.0 R_w

*Table 8.0 – Internal Noise Level Analysis *BS4142:2014 Rating Noise Level*

6. Sound Insulation Scheme

The following section outlines the required sound insulation scheme that should be installed at the proposed development to protect the amenity of the future residents. The sound insulation scheme should be installed prior to occupation and be retained thereafter.

Building Envelope

The noise levels within the proposed dwellings will be dictated by the configuration, materials, and elements of the façade. The non-glazed elements of the facade will contribute significantly to the reduction of ambient noise levels. The façade construction for lightweight or heavyweight constructions will provide ample levels of sound insulation, for the purposes of this report it is assumed the façade provides a minimum sound reduction of 50.0 dB R_w. The following section provides a sound insulation scheme based on the weakest elements of the façade, including the glazing, ventilation and roof construction.

a) Roof Specification

If the development has rooms within the roof space the roof system will require additional sound insulation to achieve appropriate internal noise levels. Where the roof, is being utilized as a voided loft space with thermal insulation the following detailing is not required. Where rooms are within the roof, the ceilings should consist of standard roofing slates, 100mm 45kg/m^3 fitted tightly between the 200mm roof joists and 1no. 15mm SoundBloc plasterboard fixed to British Gypsum RB1 resilient bars to achieve a minimum sound reduction of 50.0 dB R_w. Any other configuration of roof that would achieve at least 50.0 dB R_w will be suitable for the development.

b) Glazing Specification

Windows can be considered the weakest point of a façade in terms of noise reduction from external noise. The glazed elements installed in all the living rooms and bedrooms require the minimum sound reduction as shown in Section 3.0.

The glazing units shown in the following table provide a suitable sound reduction, any other window capable of providing this attenuation will be suitable. The performance is specified for the whole window unit, including frame and other design features. The glazing specifications have been taken from the Pilkington Optiphon Range.

Façade Colour	Location	Glazing Configuration	Attenuation (dB)
Red – F1 to F3 Amber GF to F1	Living Rooms	*Double Glazing* 6mm Glass – 16mm Argon Cavity – 6.8mm Optiphon Glass	34.0 R_W + C_{tr} 40.0 R_W
	Bedrooms	*Double Glazing* 10mm Glass – 16mm Argon Cavity – 8.8mm Optiphon Glass	38.0 R_W + C_{tr} 44.0 R_W
Amber – F2 & Skylights	Living Rooms / Bedrooms	*Double Glazing* 6mm Glass – 16mm Argon Cavity – 6.8mm Optiphon Glass	34.0 R_W + C_{tr} 40.0 R_W
Yellow – F2 & Skylights	Living Rooms/ Bedrooms	*Double Glazing* 6mm Glass – 16mm Argon Cavity – 6.8mm Optiphon Glass	34.0 R_W + C_{tr} 40.0 R_W
All Green & Blue	Living Rooms / Bedrooms	*Double Glazing* 4mm Glass – 16mm Air Cavity – 4mm Glass	25.0 R_W + C_{tr} 29.0 R_W

Table 9.0 – Glazing Specification

The glazing suppliers are required to demonstrate the acoustic performance of their proposed system either by providing an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

c) Ventilation Specification

Open Window Assessment

This section outlines the façades where the BS8233:2014 internal noise level criteria can be achieved with open windows. It is assumed that a partially open window provides up to 15.0 dB of sound attenuation. The following table outlines the façade noise levels that should not be exceeded in order to achieve the appropriate internal noise levels, considering the 5.0 dB relaxation as stated in BS8233:2014.

Location	Time Period	Max. Façade Noise Level (dB)
Bedroom / Living Room	Day time	55.0 $L_{Aeq,t}$
Bedroom	Night time	50.0 $L_{Aeq,t}$
Bedroom	Night time	65.0 $L_{Amax,t}$

Table 10.0 – BS8233:2014 Open Window Criteria

The following table outlines the areas of the Proposed Development that are able to achieve the BS8233:2014 internal noise levels considering partially open windows.

Façade	Floor	Location	Time Period	Façade Noise Level	Max. Façade Noise Level	Achieve Criteria
Red Façades	F1 to F3	Bedroom / Living Room	Day time	65.0 – 67.0	55.0 $L_{Aeq,t}$	No
		Bedroom	Night time	64.0 – 66.0	50.0 $L_{Aeq,t}$	No
		Bedroom	Night time	73.0 – 74.0	65.0 $L_{Amax,t}$	No
Amber Façades	GF to F1	Bedroom / Living Room	Day time	66.0 – 67.0	55.0 $L_{Aeq,t}$	No
		Bedroom	Night time	63.0 – 65.0	50.0 $L_{Aeq,t}$	No
		Bedroom	Night time	74.0 – 75.0	65.0 $L_{Amax,t}$	No
Amber Façades	F2 & Skylights	Bedroom / Living Room	Day time	63.0 – 64.0	55.0 $L_{Aeq,t}$	No
		Bedroom	Night time	58.0 – 60.0	50.0 $L_{Aeq,t}$	No
		Bedroom	Night time	72.0 – 73.0	65.0 $L_{Amax,t}$	No
Yellow Façades	F2 & Skylights	Bedroom / Living Room	Day time	65.0 – 67.0*	55.0 $L_{Aeq,t}$	No
		Bedroom	Night time	45.0 – 48.0	50.0 $L_{Aeq,t}$	Yes

		Bedroom	Night time	62.0 – 64.0	65.0 $L_{Amax,t}$	Yes
Blue Façades	F1	Bedroom / Living Room	Day time	56.0*	55.0 $L_{Aeq,t}$	No**
		Bedroom	Night time	42.0	50.0 $L_{Aeq,t}$	Yes
		Bedroom	Night time	55.0	65.0 $L_{Amax,t}$	Yes
Green Façades	F1 to F2	Bedroom / Living Room	Day time	52.0 – 54.0*	55.0 $L_{Aeq,t}$	Yes
		Bedroom	Night time	40.0 – 42.0	50.0 $L_{Aeq,t}$	Yes
		Bedroom	Night time	52.0 – 54.0	65.0 $L_{Amax,t}$	Yes
Green Façades	F3	Bedroom / Living Room	Day time	57.0*	55.0 $L_{Aeq,t}$	No**
		Bedroom	Night time	44.0	50.0 $L_{Aeq,t}$	Yes
		Bedroom	Night time	57.0	65.0 $L_{Amax,t}$	Yes

Table 11.0 – Open Window Analysis

**BS4142:2014 Rating Noise Levels*

*** Marginal Exceedance*

As can be seen in the assessment above, the majority of façades are not capable of relying on open windows to achieve the BS823:2014 internal noise criteria considering the 5.0 dBA relaxation. Only the first and second floors of the green façades and the first floor of the blue façades are capable of relying on open windows to achieve the relaxed BS8233:2014 internal noise levels criteria. It should be noted however that only marginal exceedance have been identified on the Blue Façade 1st floor and Green façade 3rd Floor. As such, it is recommended that secondary ventilation is also employed and in areas where criteria can be achieved the internal layout should be orientated so that as much as practicable non-sentative rooms are allocated on the facades which higher noise levels.

Ventilation Specification

It is stated in BS8233:2014 that;

"If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

and

"The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice. Alternatively, acoustic ventilation units are available for insertion in external walls. These can provide

sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

An alternative trickle/background ventilation system, should be installed within habitable rooms to fully protect the amenity of future residents. As stated in BS8233:2014 section 5.4.4, having complete enclosure of the noise source or receiver is the most effective barrier of sound. An alternative trickle/background ventilation strategy allows for maximum sound insulation from the noise source whilst still maintaining a sufficient level of ventilation. It is recommended that the alternative trickle ventilation should provide the same resistance to sound as the glazed elements. The following table provides ventilation systems options that meets the above recommendations. As well as the proposed trickle ventilation system a through wall option has also been outlined as a secondary option.

Façade	Location	Model	Attenuation
Red – F1 to F3 Amber – GF to F1	Bedrooms	Titon Trickle SF Xtra V75 + C50	40.0 dB Open / 50 dB Closed
All Other Façades & Areas	Living Rooms / Bedrooms	Titon Trickle XS13 – 4400EA (Vent and Canopy)	33.0 dB Open / 40.0 dB Closed

Through Wall Ventilation (not purge)	
Model	**Attenuation ($D_{n,e,w}$ + C_{tr})**
Titon Sonair F+ Mechanical Input Ventilator with G3 filter and DV100F duct [1]	56.0 dB

Table 12.0 – Ventilation Specification

[1]The self-generated noise from the Titon Sonair F+ when measured at the maximum ventilation capacity of 60m³/h emits 23.5dB $L_{PA:10m2}$ which is below the required internal noise criteria from BS8233:2014.

The ventilation specified within the table above are capable of providing background ventilation. If the above ventilation systems are not deemed suitable for the development then a further ventilation system may need to be employed. Should any installed ventilation system be installed that has self-generated noise these should be selected to ensure the internal noise criteria outlined in BS8233:2014 can be achieved. The following table outlines recommended noise levels from ventilation systems in dwellings.

Ventilation Condition	Possible System	Desirable Internal Ambient Noise Levels from Mechanical Services, L_{Aeq} (dB)		
		Bedrooms	Living Rooms	Bathrooms / Kitchens
Whole dwelling ventilation	Continuous MEV at low ventilation rates Continuous MVHR at minimum ventilation rates	≤ 26 - 30	≤ 30	-
Extract ventilation	Intermittent Extract Fans Continuous MEV at high ventilation rates	≤ 26 - 30	≤ 35	≤ 45

Table 13.0 – Recommended Internal Noise Levels from Mechanical Ventilation

The ventilation suppliers are required to demonstrate the acoustic performance of their proposed system either by providing an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

7. Noise Breakthrough Assessment

As the development has commercial units on the ground floor and residential units on the 1st floor, the noise level breaking through the floor partition must be assessed. It is recommended that the partition should score a minimum of 10.0 dB above the regulations stated at Part E of Building regulations to ensure the amenity of future residents is fully protected. This means the partition must score a minimum of 53.0 dB $D_{nT,w}$ + C_{tr} when tested for airborne sound attenuation.

During the site visit, it was found that the existing floor build-up is comprised of 200-300mm timber joists and lath and plaster. The current build-up (200mm has been modelled as a worst-case scenario) has been modelled with INSUL 9.0 software and it is predicted to score approximately 25.0 dB $D_{nT,w}$ + C_{tr}.

In order to achieve the necessary attenuation, one of the following upgrades is recommended:

Option A:

- 18mm Cement Particle Board
- 18mm Floorboards
- 200mm Timber Joists
- Existing Lath and Plaster
- Min. 50mm Air Cavity
- New Independent Timber Ceiling (*check joist depth to room span with structural engineer) with 100mm RW45 Rockwool Insulation (min. density of 45 kg/m^3).
- 2 No. 15mm SoundBloc Plasterboards

Option B:

- 18mm Floorboards
- 200mm Timber Joists with 100mm RW45 Rockwool Insulation (min. density of 45 kg/m^3)
- Gyproc Acoustic Hangers (attached to joists)
- 100mm MF Ceiling with 100mm RW45 Rockwool Insulation (min. density of 45 kg/m^3)
- 2 No. 15mm SoundBloc Plasterboards

Appendix A – Acoustic Terminology

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided. The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source. A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the

time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound. To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS4142:2014 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125ms.

Appendix B – Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

B.1 – National Planning Policy Framework (2021)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2021. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 174e, it states:

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;

Paragraph 185 states:

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:

a) *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
b) *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 185 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

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;*
- *Where possible, contribute to the improvement of health and quality of life.*

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

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. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS8233:201 'Guidance on sound insulation and noise reduction for buildings'

The British Standard BS 8233: 2014, Guidance on Sound insulation and noise reduction for buildings provides additional guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, WHO Guidelines on Community Noise, 1999. The criteria desirable levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
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 $L_{Aeq,8hour}$

Table 14.0 – BS8233:2014 Internal Noise Level Criteria

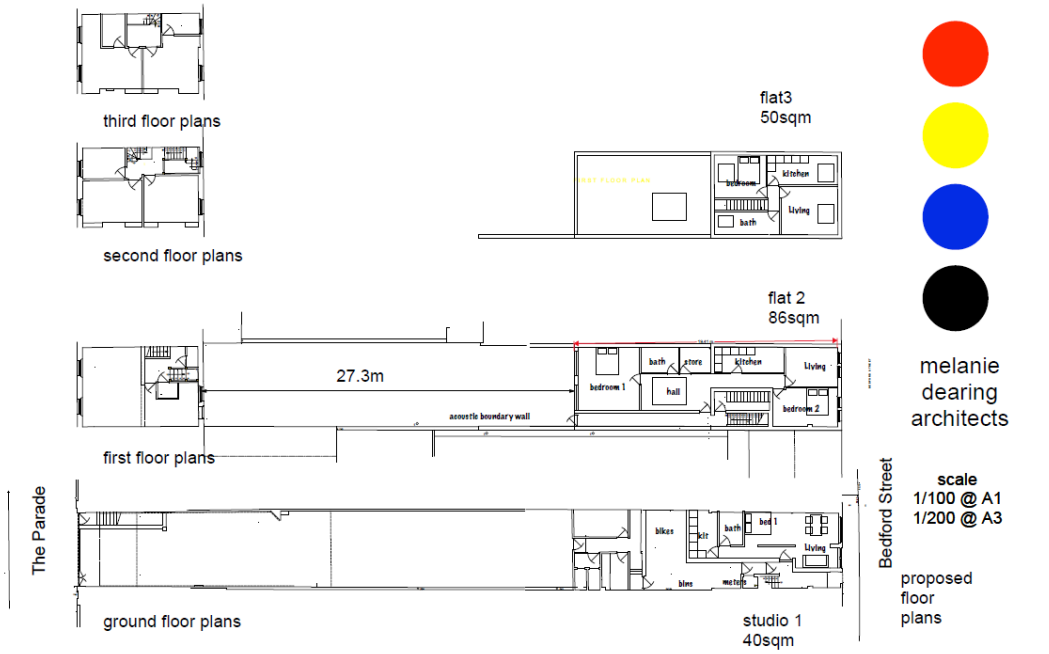
It is noted, however that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

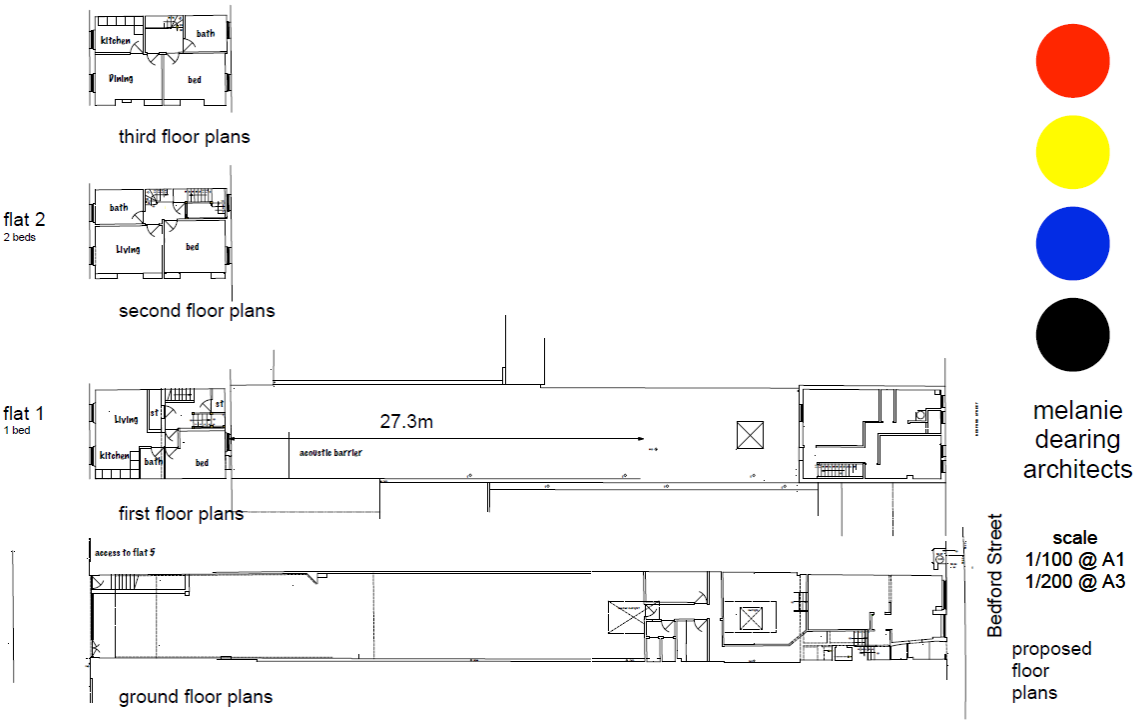
The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, and that 55 dB $L_{Aeq,T}$ would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the LOAEL as defined in the NPSE above.

Appendix C – Site Plans





PRIOR APPROVAL 2 new flats above a shop
116 The Parade St Leamiongton Spa

503A

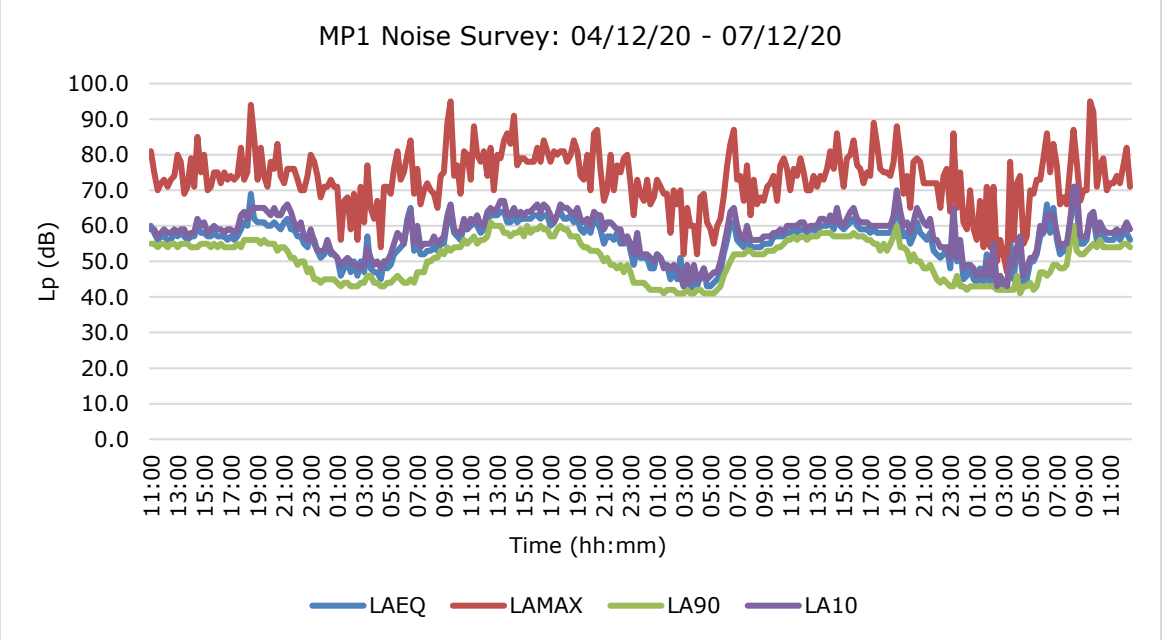
Appendix D – Environmental Survey

D.1 – Tabulated Summary Noise Data

Measurement Position MP1								
Measurement Period ('t')	**Octave Band $L_{eq,t}$**						**$L_{Aeq,t}$**	**$L_{AMax,t}$**
	125	**250**	**500**	**1k**	**2k**	**4k**		
Day 1 - 04/12/20: 11:00 – 23:00	60.0	55.0	53.0	55.0	54.0	50.0	59.0	94.0
Night 1 – 04/12/20: 23:00 – 07:00	58.0	53.0	50.0	50.0	48.0	45.0	55.0	84.0
Day 2 – 05/12/20: 07:00 – 23:00	64.0	58.0	57.0	56.0	54.0	47.0	61.0	95.0
Night 2 – 05/12/20: 23:00 – 07:00	56.0	48.0	47.0	47.0	46.0	41.0	52.0	87.0
Day 3 – 06/12/20: 07:00 – 23:00	62.0	56.0	55.0	54.0	52.0	46.0	59.0	89.0
Night 3 – 06/12/20: 23:00 – 07:00	61.0	55.0	53.0	51.0	49.0	45.0	56.0	86.0
Day 4 – 07/12/20: 07:00 – 13:00	62.0	56.0	56.0	55.0	53.0	47.0	59.0	95.0

Measurement Position MP2								
Measurement Period ('t')	**Octave Band $L_{eq,t}$**						**$L_{Aeq,t}$**	**$L_{AMax,t}$**
	125	**250**	**500**	**1k**	**2k**	**4k**		
Day 1 - 04/12/20: 12:00 – 23:00	59.0	56.0	54.0	57.0	56.0	51.0	61.0	95.0
Night 1 – 04/12/20: 23:00 – 07:00	52.0	49.0	45.0	48.0	46.0	41.0	52.0	83.0
Day 2 – 05/12/20: 07:00 – 23:00	61.0	58.0	55.0	55.0	54.0	45.0	60.0	96.0
Night 2 – 05/12/20: 23:00 – 07:00	52.0	48.0	45.0	47.0	45.0	35.0	51.0	81.0
Day 3 – 06/12/20: 07:00 – 08:40	55.0	56.0	54.0	51.0	50.0	47.0	57.0	87.0

Graphical Time History



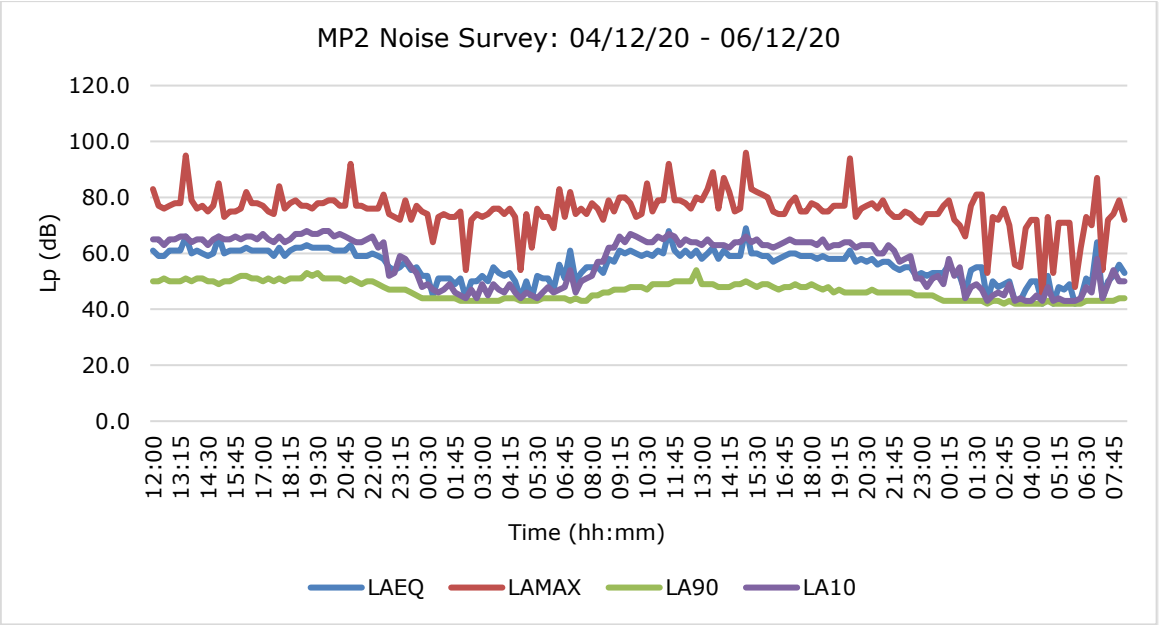


Table 15.0 – Sound Survey Summary Results

D.2 – Surveying Equipment

Piece of Equipment	Serial No	Calibration Deviation
CESVA SC420 Class 1 Sound Level Meter	T246458	≤0.5
CESVA CB006 Class 1 Calibrator	901927	
CESVA SC420 Class 1 Sound Level Meter	T250681	≤0.5
CESVA CB006 Class 1 Calibrator	902442	

Table 16.0 – Measurement Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.5 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localized records of weather conditions were taken. However, during the set up and collection of the monitoring equipment the weather conditions have been documented in the following table. All measurements have been compared with met office weather data of the area, specifically the closest weather station, the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Sherbourne (7km)				
Time Period	**Air Temp (^{0}C)**	**Rainfall mm/h**	**Prevailing Wind Direction**	**Wind Speed (m/s)**
04/12/20: 00:00 – 23:59	2.6 – 6.1	0.0 – 3.6	WSW	0.0 – 4.1
05/12/20: 00:00 – 23:59	2.8 – 6.2	0.0 – 3.0	E	0.0 – 3.2
06/12/20: 00:00 – 23:59	-0.5 – 4.1	0.0 – 1.8	ESE	0.0 – 1.0
07/12/20: 00:00 – 23:59	-1.6 – 1.5	0.0 – 1.2	ESE	0.0 – 1.4

Table 17.0 – Weather Summary