parkerjones acoustics

The Battleaxes

Bristol Road, Wraxall, BS48 1LQ

Noise Impact Assessment

21st February 2023
First Issue

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Revision History

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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA), has been written to assess the redevelopment of 'The Battleaxes' in Wraxall (Bristol Road, BS48 1LQ), developing the former pub building and its grounds to incorporate a café, community hub, office space, B&B accommodation, farm shop, and 9 new dwellings.

In summary, PJA believes that the noise impact on future occupants at the proposed development and the noise impact generated by it on other existing properties can be controlled to an acceptable level providing the recommendations herein are followed.

Noise Impact on the Proposed Development

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level and that this aspect of the noise assessment should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Noise levels in external amenity areas should be within the recommended range of 50 – 55 dB $L_{Aeq,16hr}$ in most private areas. The development also has a central shared lawn within this range, that all residents can use.

Regarding external noise ingress (Section 5.3), internal ambient noise level (IANL) targets vary depending upon the room type (residential, travellers' accommodation or non-residential), and external noise levels vary significantly from relatively high on the northernmost elevations of the existing building, to relatively low and able to meet IANL targets with open windows on the southernmost elevations.

In general, most dwellings will meet IANL targets with closed windows and glazing with a low to moderate level of acoustic performance. This does not mean that windows should be sealed shut as noise levels are not excessively high – but does mean that an alternative ventilation system should be used which can meet IANL targets whilst providing adequate background ventilation when the windows are closed. Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 5.1 / Figure 5.1.

Similar sound reduction indices are provided for the B&B accommodation (Table 5.2 / Figure 5.2 if deemed necessary as it appears these areas were already accommodation and hence may not be a change of use), and for non-residential areas, i.e., offices, workspace, farm shop (Table 5.3 / Figure 5.3). In short, as noise levels are relatively high on the northern elevations of the existing building overlooking Bristol Road, and as existing windows are single glazing, it may be necessary to either install secondary glazing behind the existing single glazed windows (with the benefit of retaining the external appearance given the listed building status), or replace with acoustic (i.e., thick laminated glass) double glazing, to reduce the level of external noise ingress. On the other hand, existing windows are likely to be fine without requiring upgrading on south facing elevations where they are well sheltered from the road.

Plant Noise Impact on Surrounding Properties

Noise from potential mechanical plant associated with the proposed development has been assessed in accordance with BS 4142:2014 (in Section 6.0), setting a rating level limit of 21 dB $L_{Aeq,15mins}$ at night (23:00 – 07:00) and 22 dB $L_{Aeq,1hr}$ during the day (07:00 – 23:00). This rating level limit should not be exceeded at 1m outside of nearby residential windows and is based on the level being below/at most equal to the minimum background sound level. However, it may be necessary to later revise these targets depending on the operational hours of the plant. For example, if an office air conditioning system only runs between 08:00 and 18:00, then the daytime rating level below will be too onerous given that a level of 22 dB likely occurs late in the evening when no traffic passes, given that a minimum value of 31 dB $L_{A90,5min}$ was measured between these hours during the survey.

Whilst the exact details of the plant have not been developed at this stage, it is anticipated that this target can be achieved providing the applicant follows the recommendations detailed in Section 6.3. PJA recognises that this aspect is likely to be conditioned with the requirement for a further assessment to demonstrate that the rating level targets will be achieved once the project reaches the technical design stage.

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment as part of a planning application for the proposed redevelopment of 'The Battleaxes' in Wraxall (Bristol Road, BS48 1LQ), developing the former pub building and its grounds to incorporate a café, community hub, office space, B&B accommodation, farm shop, and 9 new dwellings.

1.1 Scope of Report

This Report has been written to:

- assess the level of noise ingress from the surrounding area and thus advise on the specification of the building envelope and ventilation system to reduce internal noise levels to acceptable levels for the future occupants, and the impact of noise on external amenity areas;
- assess the risk of plant noise impacting other properties in the area, should mechanical plant be installed to service the development.

The objective is to ensure that the noise impact is being considered and controlled sufficiently. Therefore, where considered necessary, mitigation measures have been suggested to ensure that identified impacts are minimised.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in Appendix A.

1.2 Assessment Criteria

The assessment takes into account a number of guidelines, including:

- The Professional Practice Guidance on Planning and Noise (ProPG) (2017);
- BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings';
- The World Health Organisation (WHO) 'Guidelines for Community Noise' (1999) and 'Night Noise Guidelines for Europe (2009) documents; and
- BS 4142:2014+A1:2019 '*Methods for rating and assessing industrial and commercial sound*', which assesses the risk of adverse impact of noise pollution from a sound source (or sources) of a commercial or industrial nature.

The assessment is aimed at limiting the impacts to no greater than the Lowest Observed Adverse Effect Level (the level above which adverse effects on health and quality of life can be detected) – as defined in national planning policies including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in Appendix B), which outline the purpose and long-term vision of planning policy with respect to noise.

2.0 Site and Development Description

The application site is 'The Battleaxes', a former pub located on the south side of Bristol Road in Wraxall in jurisdiction of North Somerset Council, as shown in Figure 2.1 (which also shows the noise monitoring locations employed during the baseline noise survey described in Section 4.0).

As described in the *EIA Screening Opinion* document by RPS (screening opinion ref: 22/P/2078/EA1), *"The Battleaxes is a substantial detached building arranged over three storeys with single and two storey extensions. Internally the property is arranged to provide a number of interconnecting areas. At first floor level are six ensuite letting rooms. The property occupies a site of 0.42 hectares (1.04 acres) providing extensive car parking and external areas, in addition to outbuildings.*

The property is a Grade II Listed Building…

… The site consists of:

- *The former three storey Battleaxes pub and caretaker lodge.*
- *Car park and outbuildings.*
- *Garden space and large hard standing. "*

The proposals involve:

- the refurbishment of the main building to incorporate a café and farm shop on the lower ground floor, community workspace and private office/meeting space on the ground floor, and revitalising the existing B&B accommodation on the upper floor;
- constructing a small new office extension to the rear; and
- constructing 9 new houses in the car park area.

A site plan is shown in Figure 2.2 with floor plans in Figures 2.3 to 2.5.

Figure 2.1 – Aerial view of the site and surrounding area (top) – site location plan (bottom left) - street view from Bristol Road (bottom right)

Figure 2.2 – Proposed site plan

Figure 2.3 – Phase 02 Proposed Lower Ground Floor Plan

Figure 2.4 – Phase 02 Proposed Ground Floor Plan

Figure 2.5 – Phase 02 Proposed First Floor Plan

3.0 Relevant Guidelines

3.1 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region.* However, the updated guidance states that *'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'.*

The 1999 document gives the following description of community noise:

"Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs."

3.1.1 Internal Ambient Noise Levels

For steady continuous noise, the GCN recommends an indoor guideline value for bedrooms of 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} for a single sound event to prevent sleep disturbance.

3.1.2 Outdoor Amenity Noise Levels

Regarding external noise, the GCN states:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}.

3.2 BS 8233:2014

BS 8233:2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*' suggests appropriate criteria and limits for different situations. It is primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use.

This includes internal and external noise criteria for both residential and non-residential developments.

3.2.1 Internal Ambient Noise Levels

Residential Dwellings

Table 4 of BS 8233:2014 provides internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. These are summarised in Table 3.1 below.

Table 3.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

In Annex G.1 of BS 8233:2014 it suggests that "*if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB*". Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB.

Therefore, to meet internal noise targets in nearby residential dwellings, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time when measured/calculated directly outside of a residential bedroom or living room window.

B&B Accommodation

Section 7.7.5 of BS 8233 ('hotels and rooms for residential purposes') states that the "recommendations for ambient noise in hotel bedrooms is similar to those for living accommodation (see 7.7.2). Thus, the limits from Table 3.1 above can be used to assess the first floor accommodation.

Non-Residential

Appropriate internal noise criteria from BS 8233:2014 for the types of non-residential spaces in the proposed development are given in Table 3.2.

Table 3.2 – BS 8233:2014 internal ambient noise level (IANL) upper limits in non-residential spaces

Location	Design range dB $L_{Aeq,T}$
Cafeteria, canteen, kitchen	50 - 55
Retail store	50 - 55
Corridor, circulation space	45 - 55
Open plan office	45 - 50
Staff/meeting room, training room	35 - 45
Executive office	35 - 40

3.2.2 Outdoor Amenity Noise Levels

BS 8233:2014 indicates that in external areas used for amenity space, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments.

Although in many areas, i.e., next to a strategic transport network, a compromise between elevated noise levels and the convenience of living in these locations may be acceptable. In such a case, the development should be designed to 'achieve the lowest practicable levels' in these external amenity spaces but should not be prohibited.

3.3 The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, new and extended recommendations where these standards are considered to fall short. Therefore, it is considered to be the most relevant and up to date design standard for assessing the noise impact on new residential developments.

3.3.1 Internal Ambient Noise Levels

The ProPG provides internal ambient noise level targets based upon BS 8233:2014 and WHO guidelines, as shown in the table below. The targets are essentially the same as BS 8233:2014 guidelines but with the addition of an $L_{Amax,F}$ target overnight based on WHO guidelines.

The ProPG indicates that the guidance can be relaxed by up to 5 dB (as does BS 8233:2014) where development is considered necessary or desirable, despite high external noise levels.

Table 3.2 – The ProPG internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ [1]
[1] a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night			

Whilst it is desirable to achieve the recommended IANLs with windows open, an assessment can be made with closed windows and open ventilators (i.e., trickle vents) which provide *"whole dwelling ventilation"* (as defined by Building Regulations Approved Document F).

Closed windows do not mean sealed shut/un-openable windows, as occupants would favour the ability to open the windows (especially during the hotter months of the year) even if the resultant internal acoustic conditions aren't as satisfactory.

3.3.2 Outdoor Amenity Noise Levels

The ProPG also provides guidance for outdoor amenity noise levels based on WHO and BS 8233:2014 guidelines. This applies to gardens, balconies, roof terraces, and patio areas.

If outdoor amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended. Noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.

It does, however, accept that this can't be achieved in all situations, in which the development should be designed to achieve the lowest practicable noise levels in these outdoor amenity spaces. The impact can partially be offset by the residents having access to a:

- relatively quiet alternative outdoor amenity space as part of the property, group of residential properties, or a public space in the nearby area; and/or
- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e., an enclosed balcony) as part of their dwelling.

3.4 BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations (i.e., residential windows) within the context of the existing sound environment.

The method is based upon assessing the predicted noise emissions from plant/equipment against the existing background sound levels at NSRs, the latter of which is determined by a noise survey conducted at the site.

The predicted noise emissions are termed as a 'rating level', which is the 'specific sound level' from plant (the actual measurable noise level), plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

The general aim is for the 'rating level' (plant noise emissions) to not exceed the existing background sound levels outside of residential windows. BS 4142:2014 states that *"the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

4.0 Noise Survey

4.1 Methodology

PJA has attended the site and surrounding area to conduct an environmental noise survey between Friday the 18th and Tuesday the 22nd of November. The results of the survey have been used to quantify the typical residual noise levels that would be incident on the site and subsequently the proposed development on a day-to-day and night-by-night basis.

Two measurement positions were installed, the first (P1) positioned approximately 20cm outside of a north facing 1st floor window overlooking Bristol Road, the second (P2) positioned approximately 40cm outside of a west facing ground floor window to one of the outbuildings, as denoted in Figure 2.1.

The sound level meters were set to log noise levels over continuous 5-minute averaging periods with a 1-second time history rate. The monitoring equipment was left unattended with the exception of setup and collection of the equipment.

The following noise indices were recorded (amongst others):

- $L_{Aeq,T}$: The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level;
- $L_{AFmax,T}$: The maximum A-weighted noise level during the measurement period T and the best representation of short high noise levels 'events' – i.e., emergency services sirens;
- $L_{A90,T}$: The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the representative background noise level – or noise levels from continuous noise sources such as plant; and
- $L_{A10,T}$: The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level' and a good representation of traffic noise contributions.

Appendix C contains further information on the methodology of the survey; including the equipment used; photographs from site; and the weather conditions.

4.2 Results

4.2.1 Position P1

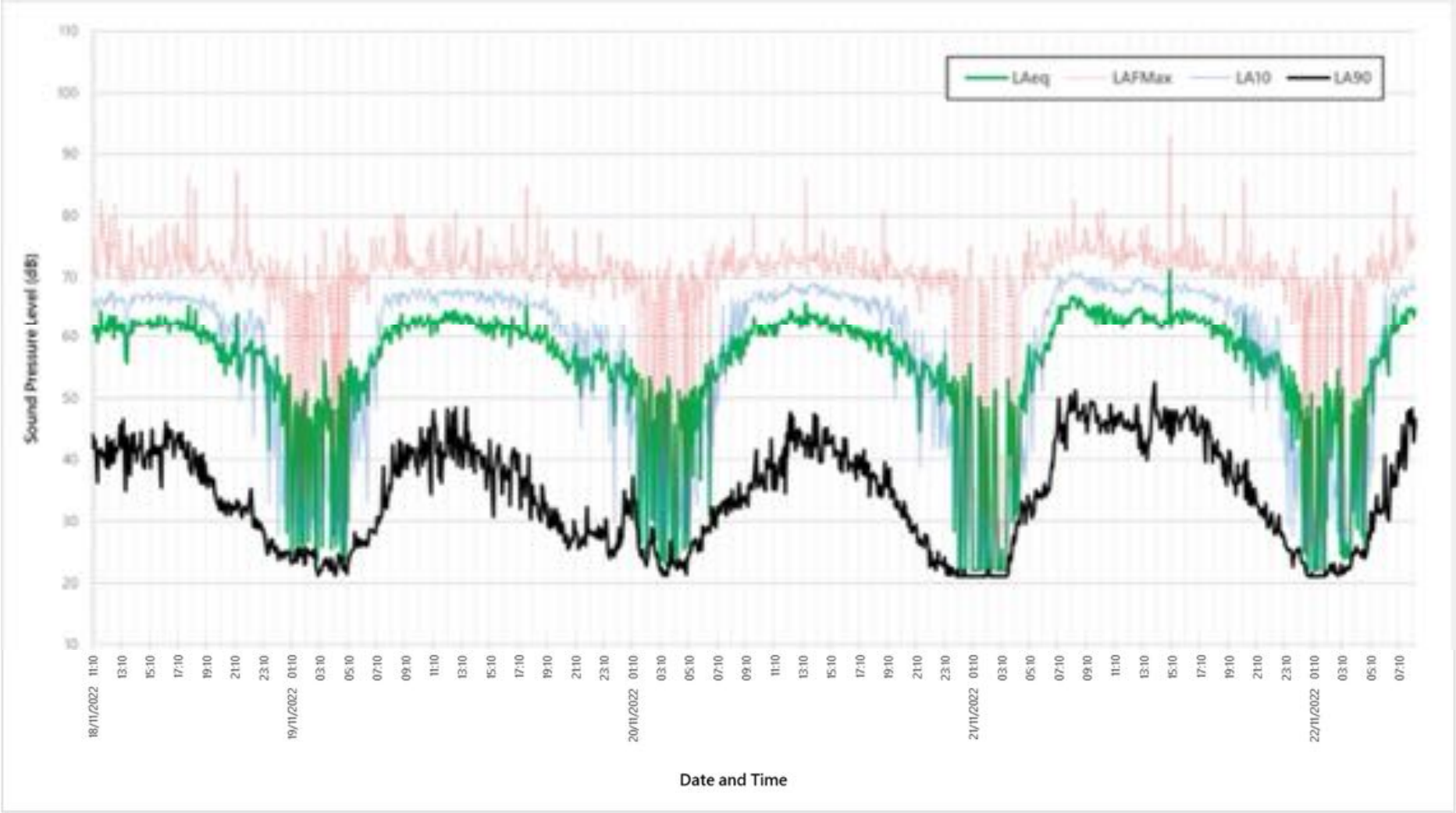
A graph of the measured noise levels at position P1 is given in Figure 4.1 overleaf, with a summary provided in Table 4.1 below.

The noise climate is dominated by intermittent road traffic along Bristol Road, particularly evident overnight when exceptionally low noise levels are seen in 5-minute measurement periods where no traffic passes (minimum 21 dB $L_{A90,5mins}$.

Table 4.1 – Summary of measured noise levels at position P1

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	10th Highest L_{AFmax} (dB)	Median L_{A90} (dB)	Median L_{A10} (dB)
Daytime (07:00 – 23:00) **T = 16-hours**				
Friday 18th November; 11:10 - 23:00	61	79	40	66
Saturday 19th November; 07:00 - 23:00	61	78	38	66
Sunday 20th November; 07:00 - 23:00	60	75	37	66
Monday 21st November; 07:00 - 23:00	63	78	45	68
Tuesday 22nd November; 07:00 - 08:25	64	74	43	68
Night-time (23:00 – 07:00) **T = 8-hours**				
Friday 18th November / Saturday 19th November; 23:00 - 07:00	52	73	25	35
Saturday 19th November / Sunday 20th November; 23:00 - 07:00	52	72	26	42
Sunday 20th November / Monday 21st November; 23:00 - 07:00	53	73	22	37
Monday 21st November / Tuesday 22nd November; 23:00 - 07:00	54	73	24	37

Figure 4.1 – Graph of measured noise levels at position P1



4.2.2 Position P2

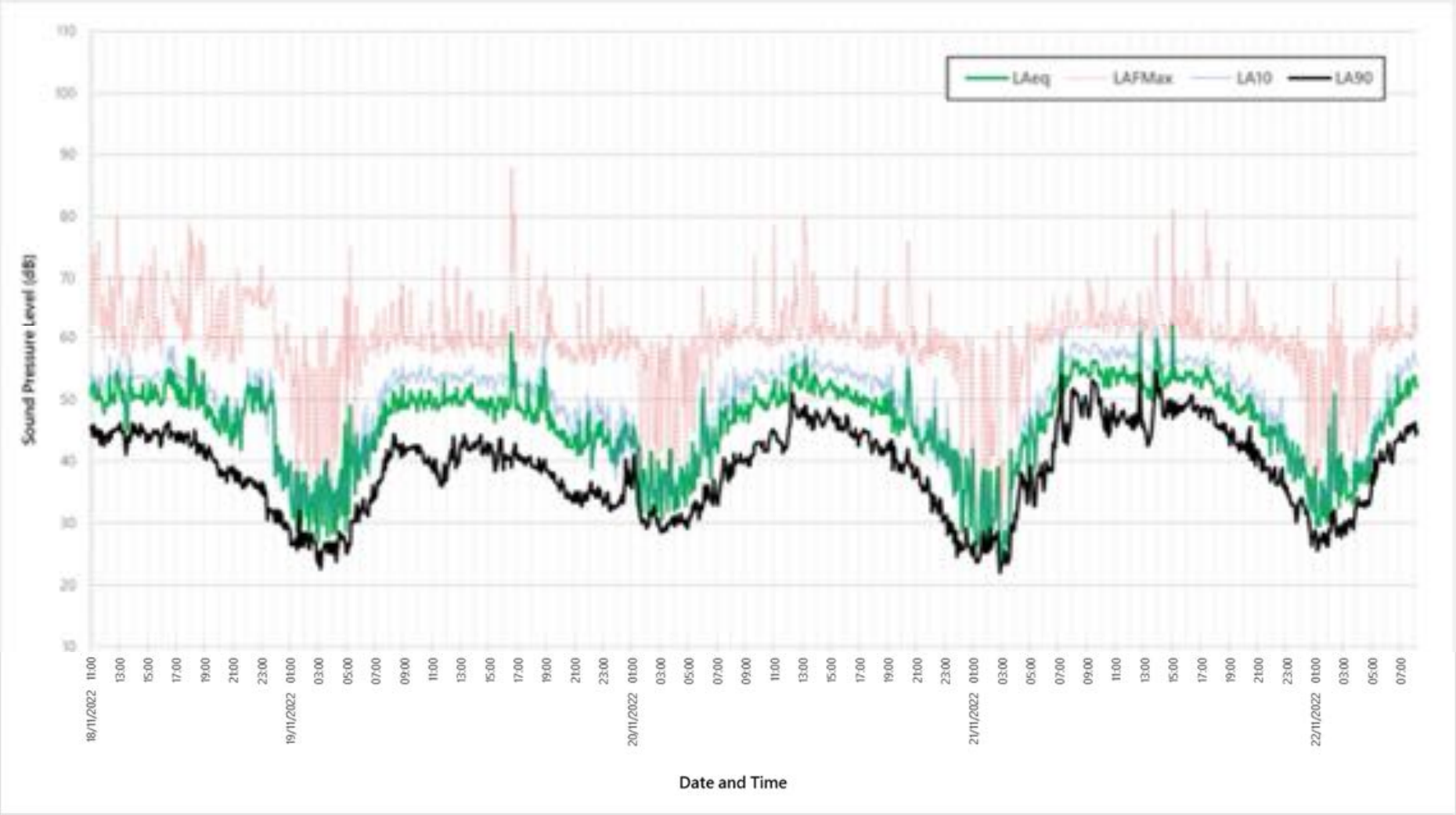
A graph of the measured noise levels at position P2 is given in Figure 4.2 overleaf, with a summary provided in Table 4.2 below.

The noise climate again is dominated by intermittent road traffic along Bristol Road.

Table 4.2 – Summary of measured noise levels at position P2

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	10th Highest L_{AFmax} (dB)	Median L_{A90} (dB)	Median L_{A10} (dB)
Daytime (07:00 – 23:00) **T = 16-hours**				
Friday 18th November; 10:45 - 23:00	51	74	43	53
Saturday 19th November; 07:00 - 23:00	49	70	40	53
Sunday 20th November; 07:00 - 23:00	50	72	43	54
Monday 21st November; 07:00 - 23:00	53	70	47	56
Tuesday 22nd November; 07:00 - 08:15	52	61	45	55
Night-time (23:00 – 07:00) **T = 8-hours**				
Friday 18th November / Saturday 19th November; 23:00 - 07:00	43	67	29	37
Saturday 19th November / Sunday 20th November; 23:00 - 07:00	42	61	32	39
Sunday 20th November / Monday 21st November; 23:00 - 07:00	43	61	29	39
Monday 21st November / Tuesday 22nd November; 23:00 - 07:00	43	62	33	39

Figure 4.2 – Graph of measured noise levels at position P2



5.0 Noise Impact on the Proposed Development

This section details the impact the existing noise environment would have on the proposed development, including the implications this has on the ventilation strategy and the construction types required within the façade to reduce external noise ingress to an acceptable level for the future occupants, as well as the enjoyment of external amenity areas.

The following summarises the main steps of action in the assessment method:

- Firstly, the existing ambient noise environment at the site is assessed with the support of an environmental noise survey;
- A 3D noise map model is constructed of the existing site and 'calibrated' to closely match the results of the noise survey.
- The model is then updated to reflect the proposed development;
- Noise levels in external amenity areas to the new residential dwellings are assessed in line with the ProPG, BS 8233:2014 and WHO targets;
- Noise ingress into the new residential dwellings and the B&B accommodation is then assessed against the IANL limits of the ProPG (and local planning policy), to determine the likely sound reduction requirements of the building envelope and determine whether background ventilation can be provided by open windows, trickle ventilators, or mechanical ventilation (to meet IANL limits); and
- A similar assessment is made with regard to noise ingress into the proposed non-residential areas within the refurbished building and the proposed small office extension.

5.1 External Noise Levels

A noise model/map for the existing site and proposed development has been constructed using the CadnaA® software package, a commonly used 3-D noise modelling software that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The intention of noise modelling/mapping for this assessment is to accurately determine the noise levels across the entire site. This is considered more accurate than simply applying the results from the monitoring positions to the whole development, as the different elevations have varying levels of exposure to noise.

The model is based upon the results of the environmental noise survey in Section 4.0, by placing a receptor point at each survey monitoring position and adjusting the model parameters to match these results as closely as possible (in terms of the highest $L_{Aeq,16hrs}$ and $L_{Aeq,8hrs}$, and the 10th highest night-time $L_{AFmax,5min}$.

Therefore, effectively the noise map for the existing site is 'calibrated'.

The proposed site has then been added to the model, which has then been run to predict the façade exposure levels at 1m outside of all windows across the proposed development for each floor in terms of the $L_{Aeq,16hr}$ for the daytime and the $L_{Aeq,8hr}$ and L_{AFmax} for the night-time periods respectively, and to predict the $L_{Aeq,16hr}$ in external amenity areas.

Screenshots from the noise model and further information on the model parameters are provided in Appendix D.

The model has first been set up to reflect the noise climate at the existing site:

- Figure D.1 – shows 3D views of the model setup of the existing site;
- Figure D.2 – shows the daytime ambient noise level $L_{Aeq,16hr}$ - at a grid height of 1.5m (and two receptor points at the precise position/height of the noise monitoring microphones detailed in Section 4.0);
- Figure D.3 – shows the night-time ambient noise level $L_{Aeq,8hr;}$
- Figure D.4 – shows the 10th highest maximum noise level L_{AFmax} at night;

The proposed development has then been added to the model:

- Figure D.5 – shows 3D views of the model setup with the proposed development in place.
- Figure D.6 – shows external daytime $L_{Aeq,16hr}$ levels within external amenity areas of the proposed dwellings (1.5m height).
- Figure D.7 - shows the predicted façade exposure levels outside the windows of the proposed buildings in terms of the daytime $L_{Aeq,16hr}$ – on the upper floor as a worst-case.
- Figure D.8 - shows the night-time ambient $L_{Aeq,8hr}$ façade exposure,
- Figure D.9 – shows the façade exposure in terms of the 10th highest maximum noise level L_{AFmax} at night.

5.2 Outdoor Amenity Noise Levels

WHO Guidelines and the ProPG imply that noise levels in outdoor amenity spaces should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$ for the spaces to be enjoyed as intended.

Figure D.6 in Appendix D plots levels (daytime $L_{Aeq,16hr}$) within each of the private external amenity areas, i.e. the rooftop terraces, and the shared lawn and ornamental garden. This shows that levels in the amenity areas can be within the recommended range of 50 – 55 dB.

The exception is the patio area of the house (the Coach House) in the eastern corner of the site, which is closest to Bristol Road. However, the ProPG suggests that the impact can partially be offset by the residents having access to a relatively quiet alternative outdoor amenity space as part of the property, group of residential properties, or a public space in the nearby area – which is the case here, with the shared lawn in the centre of the development.

5.3 External Noise Ingress

5.3.1 Dwellings

Internal Ambient Noise Limits

The criteria for internal ambient noise levels (IANLs) are based upon guidance from BS 8233:2014 and the ProPG. In summary, the proposed development should seek to control IANLs from external noise sources to no greater than:

- Daytime – 35 dB $L_{Aeq,16hr}$; and
- Night-time – 30 dB $L_{Aeq,8hr}$, and 45 dB L_{AFmax} (no more than 10 times per night).

The criteria apply to bedrooms, the most sensitive room type. The daytime target applies to living rooms (no night-time target is applied to living rooms). A 5 dB relaxation to the daytime target is applied to dining rooms/kitchens.

Building Envelope

To assess the required sound reduction performance for the building envelope, façade exposure levels have been defined as shown in Figure 5.1. Table 5.1 defines the range of external façade noise levels for each exposure level based on the results shown in Figures D.7, D.8, and D.9 in Appendix D.

Figure 5.1 – Façade exposure levels - dwellings

The weakest elements of a façade in terms of sound reduction are the windows/glazing. This is particularly true when windows are open (as an open window will typically provide around a 15 dB reduction). Alternative forms of natural background ventilation (such as trickle vents) are also a weak point but can be treated to achieve a much higher level of sound reduction than an open window – so that IANL targets can be met with natural ventilation in areas where the targets would be exceeded when opening the windows.

It is seen that IANLs are unlikely to be met with open windows on Exposures 1 and 2 – though this is not unusual by any means in an area affected by road noise. It is not uncommon for external noise levels to mean that internal targets are exceeded with open windows. It should also not be assumed that windows need to be sealed shut, as many occupants will favour the ability to open their windows at will, particularly during the hotter months of the year, and external noise levels are certainly not excessively high to prevent doing so.

What it does mean, is that an alternative form of background ventilation (i.e., trickle vents) should be provided so that IANL targets can be met whilst providing background ventilation to the dwellings on Exposures 1 and 2 with the windows closed (but openable at the occupants' discretion, rather than through necessity). This form of ventilation needs to offer a sufficient enough level of sound reduction to meet IANL targets.

Therefore, Table 5.1 provides the minimum sound reduction indices for glazing and ventilators (the weakest elements acoustically) on each elevation – to meet IANL targets with windows closed but trickle vents open to provide background ventilation. Alternatively, mechanical ventilation could be installed as an alternative to acoustically rated trickle vents.

The assessment has been based upon a simplified calculation method where only the weakest elements are considered (glazing and ventilators), as the sound reduction provided by the masonry external wall would inherently be considerably higher. The calculation method effectively treats the whole façade as being glazed – this means that a slightly higher and thus more-robust sound reduction index is determined for glazing/trickle ventilators given that a full composite noise ingress calculation in accordance with BS 12354 would include for the high level of external wall performance, and thus require a lesser rating from the glazing to achieve the same overall composite sound reduction index. Hence this approach is seen to be a worst-case one which achieves a better end result for the future occupants.

A non-exhaustive list of example glazing constructions and ventilator products such as trickle vents and air bricks have been provided in Appendix E, which are capable of achieving the required $R_w + C_{tr}$ and $D_{n,e,w} + C_{tr}$ indices.

Table 5.1 – Minimum sound reduction requirements of the building envelope to the proposed dwellings

Exposure Category	External Noise Level @ 1m outside of a window			Minimum sound reduction indices/construction examples	
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Night-time maximum [1] (23:00 – 07:00) dB L_{AFmax}	Glazing [2] See Appendix E.1	Ventilators [3] see Appendix E.2
Exposure 1	60 – 66	51 - 57	70 – 76	31 dB $R_w + C_{tr}$ Thicker than standard glass double glazing, i.e. - 4mm standard float - 10mm air cavity - 10mm standard float	34 dB $D_{n,e,w} + C_{tr}$ i.e., Duco GlasMax
Exposure 2	52 - 59	42 – 50	61 - 69	24 dB $R_w + C_{tr}$ Any glazing	27 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 SR Grando STD
Exposure 3	≤50	<40	<60	Internal noise targets met with open windows	
Criteria [4]	≤35	≤30	≤45	-	-

1. Estimated 10th highest value per night.
2. A non-exhaustive list of suitable glazing products is given in **Appendix E.1**. Standard double glazing will usually achieve a minimum sound reduction of 26 dB $R_w + C_{tr}$.
3. A non-exhaustive list of suitable ventilator products is given in **Appendix E.2**. The acoustic performance should meet these values when the vent is open. They may not be required if the development uses mechanical ventilation. Low-performance trickle vents will usually achieve a minimum sound reduction of 25 dB $D_{n,e,w} + C_{tr}$.
4. Based on the criteria for bedrooms (the most noise-sensitive room type).

5.3.2 B&B Accommodation

Internal Ambient Noise Limits

Internal noise targets for hotel accommodation are taken from BS 8233:2014 dwelling noise targets and are as follows:

- Daytime – 35 dB $L_{Aeq,16hr}$; and
- Night-time – 30 dB $L_{Aeq,8hr}$.

Building Envelope

In this case, the proposed B&B accommodation appears to be a refreshing of existing accommodation and therefore not a change of use. *If* it is deemed necessary that upgrades are made to meet internal noise targets, then the following recommendations apply.

Façade exposure levels have been defined as shown in Figure 5.2. Table 5.2 defines the range of external façade noise levels for each exposure level.

Internal noise targets on Exposure 1 can be met with glazing rated to at least 29 dB $R_w + C_{tr}$. It appears that the existing windows are single glazed. This may meet a 29 dB rating if the glass is a) at least 6mm thick and b) the wooden frames are in good condition and are airtight when closed.

If not, a double glazed or secondary glazed system (retaining the existing outer window to comply with a listed buildings constraints) would be sufficient on Exposure 1.

On Exposure 2, external noise levels are low enough to meet internal targets with the existing windows.

Figure 5.2 – Façade exposure levels – B&B accommodation

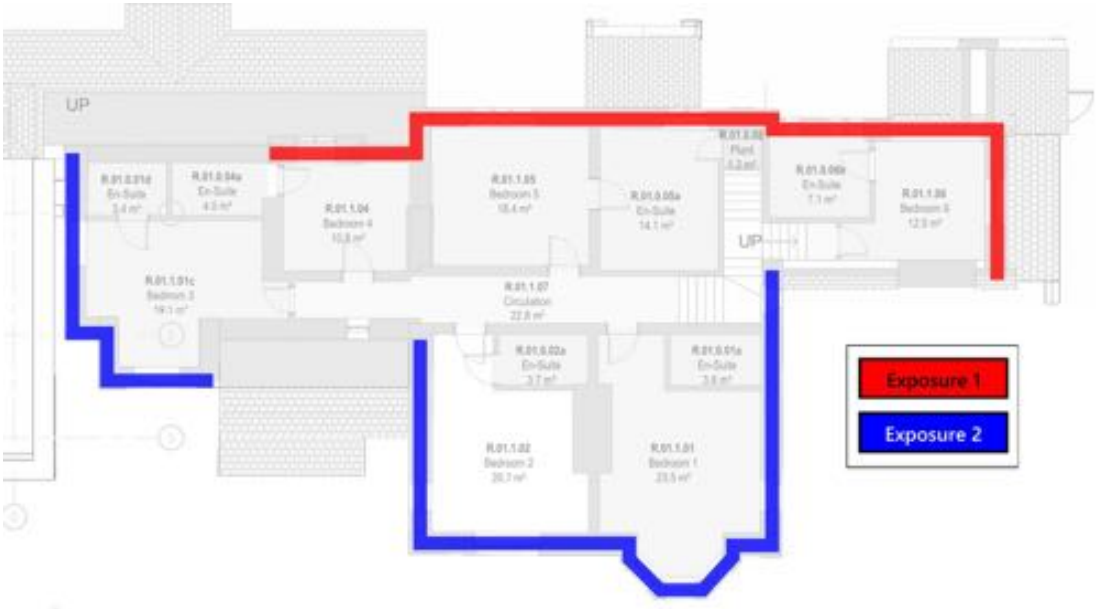


Table 5.2 – Minimum sound reduction requirements of the building envelope to the B&B accommodation

Exposure Category	External Noise Level @ 1m outside of a window		Minimum sound reduction indices / construction examples
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Glazing See Appendix E.1
Exposure 1	61 – 64	52 - 55	29 dB $R_w + C_{tr}$ Standard double glazing or secondary glazing with glass panes of different thicknesses, i.e. - 4mm standard float - 12mm air cavity - 6mm standard float
Exposure 2	45 – 58	35 - 49	23 dB $R_w + C_{tr}$ Any glazing (including existing glazing)
Criteria	≤35	≤30	-

5.3.3 Non-Residential

Internal Ambient Noise Limits

Internal noise targets for the non-residential spaces are taken from Table 3.2 in Section 3.2.1.

However, for simplicity, the lowest internal noise target (35 dB L_{Aeq} daytime) is considered appropriate to base the subsequent assessment on (particularly given that the most sensitive uses are office and meeting spaces, many of which are on the road facing elevation).

Building Envelope

Façade exposure levels have been defined as shown in Figure 5.3. Table 5.3 defines the range of external façade noise levels for each exposure level.

The results show that on the road facing elevation, to meet suitable internal noise targets, it may be necessary to either install secondary glazing behind the existing single glazed windows (to retain the external appearance), or replace with acoustic (i.e., thick laminated glass) double glazing.

Existing windows are likely to be fine on south facing elevations where they are well sheltered from the road.

Figure 5.3 – Façade exposure levels – Non residential

Table 5.3 – Minimum sound reduction requirements of the building envelope to the non-residential areas

Exposure Category	External Noise Level @ 1m outside of a window	Minimum sound reduction indices / construction examples
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Glazing See Appendix E.1
Exposure 1	69 – 71	36 dB $R_w + C_{tr}$ Acoustic double glazing or secondary glazing, i.e. - 8mm standard float glass - 20mm air cavity - 8.8mm Saint Gobain Stadip Silence
Exposure 2	64 - 66	31 dB $R_w + C_{tr}$ Thicker than standard glass double glazing or secondary glazing, i.e. - 4mm standard float - 10mm air cavity - 10mm standard float
Exposure 3	43 – 57	22 dB $R_w + C_{tr}$ Any glazing (including existing glazing)
Criteria	≤35	-

5.4 Summary

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level and that this aspect of the noise assessment should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Noise levels in external amenity areas should be within the recommended range of 50 – 55 dB $L_{Aeq,16hr}$ in most private areas. The development also has a central shared lawn within this range, that all residents can use.

Regarding external noise ingress (Section 5.3), internal ambient noise level (IANL) targets vary depending upon the room type (residential, travellers' accommodation or non-residential), and external noise levels vary significantly from relatively high on the northernmost elevations of the existing building, to relatively low and able to meet IANL targets with open windows on the southernmost elevations.

In general, most dwellings will meet IANL targets with closed windows and glazing with a low to moderate level of acoustic performance. This does not mean that windows should be sealed shut as noise levels are not excessively high – but does mean that an alternative ventilation system should be used which can meet IANL targets whilst providing adequate background ventilation when the windows are closed. Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 5.1 / Figure 5.1.

Similar sound reduction indices are provided for the B&B accommodation (Table 5.2 / Figure 5.2 if deemed necessary as it appears these areas were already accommodation and hence may not be a change of use), and for non-residential areas, i.e., offices, workspace, farm shop (Table 5.3 / Figure 5.3). In short, as noise levels are relatively high on the northern elevations of the existing building overlooking Bristol Road, and as existing windows are single glazing, it may be necessary to either install secondary glazing behind the existing single glazed windows (with the benefit of retaining the external appearance given the listed building status), or replace with acoustic (i.e., thick laminated glass) double glazing, to reduce the level of external noise ingress. On the other hand, existing windows are likely to be fine without requiring upgrading on south facing elevations where they are well sheltered from the road.

6.0 Plant Noise Emissions

The assessment of the noise impact on nearby residential noise-sensitive receptors (NSRs) concerning the operational noise produced by the proposed development should be undertaken in accordance with BS 4142:2014.

At the time of writing, no mechanical plant has been shown in the design drawings. However, it is anticipated that plant such as ASHPs could be installed for the dwellings, air conditioning systems for the offices, refrigeration plant for the plant shop, extraction fans for the café, etc.

As the mechanical plant has not been designed yet, the assessment at this stage is based upon setting a rating level $L_{Ar,Tr}$ for noise emissions from plant based upon the existing background noise level, $L_{A90,Tr}$. The rating level is the specific noise level L_s plus the addition of any 'penalties' which account for the characteristic features of the sound which may attract attention to it, such as tonality, impulsivity, intermittency, and any other sound characteristics that "are readily distinctive against the residual acoustic environment".

The operational hours of the proposed plant are currently unknown, therefore, plant limits for day and night-time have been set.

It will then be the responsibility of the developer and design team involved with the mechanical plant design to ensure that the proposed rating levels are not exceeded.

6.1 Background Sound Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a 'representative' background sound level.

For a worst-case assessment, the minimum values of the background sound level $L_{A90,5mins}$ of the survey have been set as the representative background sound level - see Table 6.1.

Table 6.1 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level $L_{A90,T}$ (dB)
All nearby residential properties	Daytime (07:00 to 23:00)	22
	Night-time (23:00 – 07:00)	21

6.2 Maximum Rating Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a 'representative' background sound level.

BS 4142:2014 states in general that "the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the

rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

Therefore, PJA proposes the rating level limits given in the table below.

However, it may be necessary to later revise these targets depending on the operational hours of the plant. For example, if an office air conditioning system only runs between 08:00 and 18:00, then the daytime rating level below will be too onerous given that a level of 22 dB likely occurs late in the evening when no traffic passes, given that a minimum value of 31 dB $L_{A90,5min}$ was measured between these hours during the survey.

Table 6.2 – Maximum rating level $L_{Ar,Tr}$ for all nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Time Period	Maximum Rating Level $L_{Ar,Tr}$ at 1m from the outside of the nearest residential window (dB)
1m outside the façade of all nearby residential properties	Daytime (07:00 to 23:00)	22
	Night-time (23:00 – 07:00)	21

6.3 Site Suitability

At this stage, the plant design has not been fully developed. If any new plant is to be installed, it is anticipated that the rating level limits can be achieved with practical and common solutions.

MVHR systems and kitchen extraction systems are likely to require an in-duct silencer (noise attenuator) which is around 600 - 1200mm in length on the atmospheric side. This is not an unusual requirement as such measures are included in the large majority of ventilation systems.

Noise from small extract fans, i.e., toilet extract fans, is likely to be relatively quiet without requiring mitigation.

Small domestic ASHP units (which are less than 1.2m tall) from Mitsubishi, Panasonic, and Daikin typically have a breakout sound pressure level of around 50 – 60 dB @ 1m in front of the fan outlet. Larger units (around 1.6 – 2m tall) can be much louder at around 75 dB @ 1m above the unit (as the fan outlet is usually at the top on larger units). Hence from a noise perspective, it is better to have several small units rather than a single large unit. Similar levels are expected from air conditioning plant. It may be necessary to install acoustic enclosures around these units depending on their proximity to residential dwellings.

These are not considered to be unusual or onerous requirements. PJA recognise that this aspect is likely to be conditioned with the requirement for a further assessment to demonstrate that the noise limits will be achieved once the project reaches the technical design stage.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
Airborne sound	Airborne sound is sound that is transmitted through the air. Airborne sound can be transmitted through elements, by causing the element to vibrate (imperceptible to the eye), in turn transmitting vibrations into the air on the other side. Most noise in a typical acoustic assessment is 'airborne' sound and is generated by sources such as speech, music and transport.
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2x10-5 Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e., 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
C_{tr}	A weighting curve applied to level differences to account for low-frequency noise, typically associated with traffic noise. This is often applied as an addition to $D_{nT,w}$ and R_w ratings used to describe levels of sound insulation.
D_w / $D_{nT,w}$	The D_w weighted level difference used to characterize the sound insulation between rooms in a building as they are. Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. A $D_{nT,w}$ is a D_w which is then 'normalised' to account for the reverberation time of the room (the 'nT'), recognising that the level difference is dependent on how reverberant the receiver room is and that every room will have a slightly different reverberation time, hence the $D_{nT,w}$ *is* adjusted to reference conditions.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, when considering a separating wall, as well as transmitting directly through the wall, sound can also travel around the wall by the floor, ceiling, corridor wall, and external wall.
Frequency	Sound is generally assessed over the frequency range of 63 Hz to 4000 Hz (4 kHz), although humans can potentially hear between 20 Hz and 20 kHz. Frequency is often divided into ('first') octave bands for analysis, with the range above considered within 7-octave bands with centre frequencies at 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz and 4 kHz. 'Third' octave bands split this further into smaller frequency bands.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A).
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{A10,T}$	The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level' and a good representation of traffic noise contributions.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to the ability of a material to stop sound travelling through it.
Structure-borne sound	Transmission of sound energy as vibrations inside the structure of a building. Can be used an alternative term to impact sound, however, structure-borne will usually refer to noise transmitted into a structure from mechanical sources, rather than human sources.

A.2 – Subjective Changes in Sound Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by … preventing new and existing development from contributing to, being put at unacceptable risk from … noise pollution"*.

B.2 - Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is 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."*. It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- 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.

Under the first aim of the NPSE ("avoid significant adverse impacts on health and quality of life"), an impact in line with SOAEL should be avoided. Under the second aim ("mitigate and minimise adverse impacts on health and quality of life"), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions form the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e., changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level [1]			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g., turning up the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent

[1] This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.

Appendix C – Noise Survey Details

C.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meter was calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meter has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of as BS EN 60942:2003 Class 1 device.

Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
SVAN 949 Class 1 Sound Level Meter	9720	Nov-21	Nov-23
SV22 Class 1 Microphone	4012386	Nov-21	Nov-23
SVAN 949 Class 1 Sound Level Meter	9719	Nov-21	Nov-23
SV22 Class 1 Microphone	4011862	Nov-21	Nov-23
Cirrus CRL511E Class 1 Acoustic Calibrator	035235	Nov-21	Nov-23

C.2 – Meteorological Conditions

During the survey, weather conditions were mostly dry and mild with wind speeds generally under 7 ms^{-1}. The microphone was fitted with a weather protection kit/windshield. The length of the survey meant that sufficient data could be captured under calm wind conditions suitable for the measurement of environmental noise in accordance with BS 7445 '*Description and Measurement of Environmental Noise*'. The weather data below has been sourced from https://www.timeanddate.com/weather/@2641913/historic?month=11&year=2022.

Figure C.1 – Meteorological conditions during the survey

C.3 – Photographs

Figure C.2 – Photographs of position P1

Figure C.3 – Photographs of position P2

Appendix D – Noise Mapping

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package which implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The noise model accounts for the topography of the land based on data available from the Ordnance Survey. All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap, or drawn in manually where the OSM did not contain sufficient data. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Lastly, the scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting daytime (16-hour) and night-time (8-hour) L_{Aeq} and 10th highest (per night) L_{AFmax} noise levels across the site.

The noise map model has assumed:

- downwind propagation, i.e., a wind direction that assists the propagation of sound from source to receptor, as a worst-case;
- a ground absorption factor of 0 in all areas as a worst-case;
- a maximum reflection factor of two where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- façade receptor points representing the worst-case floor – placed at 0.05m from the façade (and not accounting for the sound reflection off that façade);
- receptor points in the plots of the existing site based on the position and height of the survey positions;
- a noise contour/map height of 1.5m;
- atmospheric sound absorption based upon a temperate of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996.

The images on the following pages contain the results of the mapping.

D.1 – Existing Site

Figure D.1 – Views of the model setup – existing site

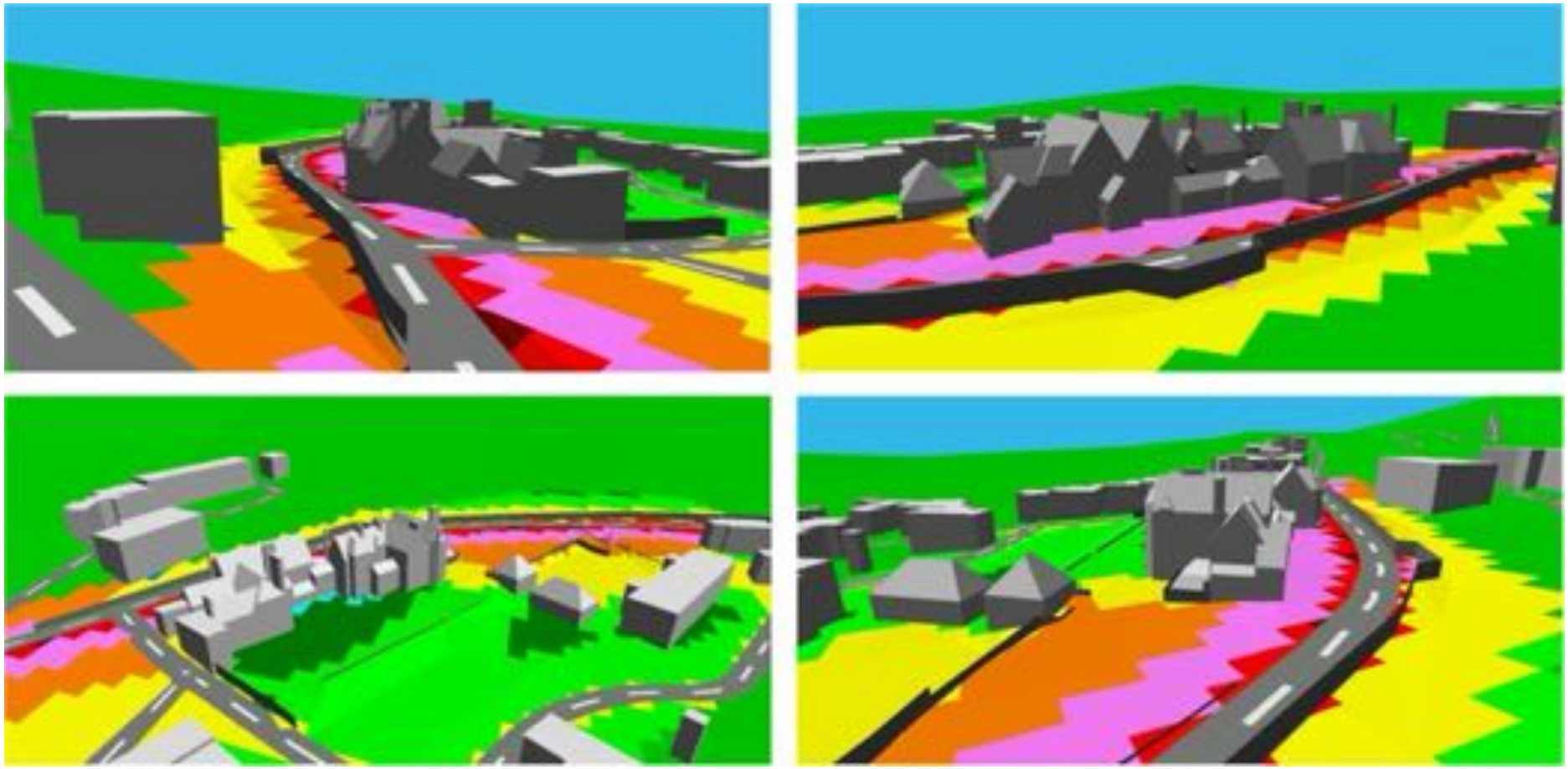


Figure D.2 – Existing site - Predicted dB $L_{Aeq,16hr}$ external ambient noise levels – Daytime (07:00 – 23:00)

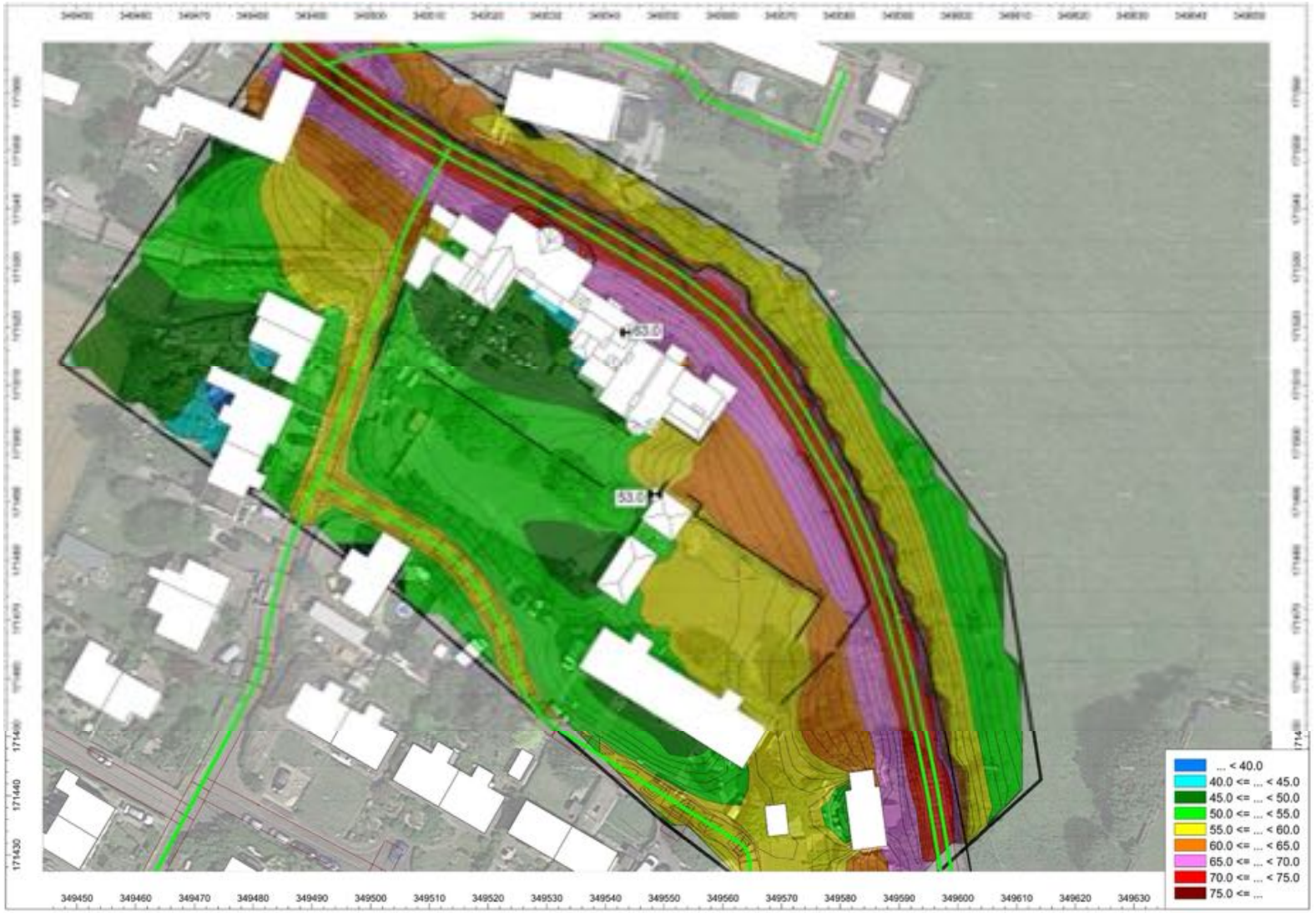


Figure D.3 – Existing site - Predicted dB $L_{Aeq,8hr}$ external ambient noise levels – Night-time (23:00 – 07:00)

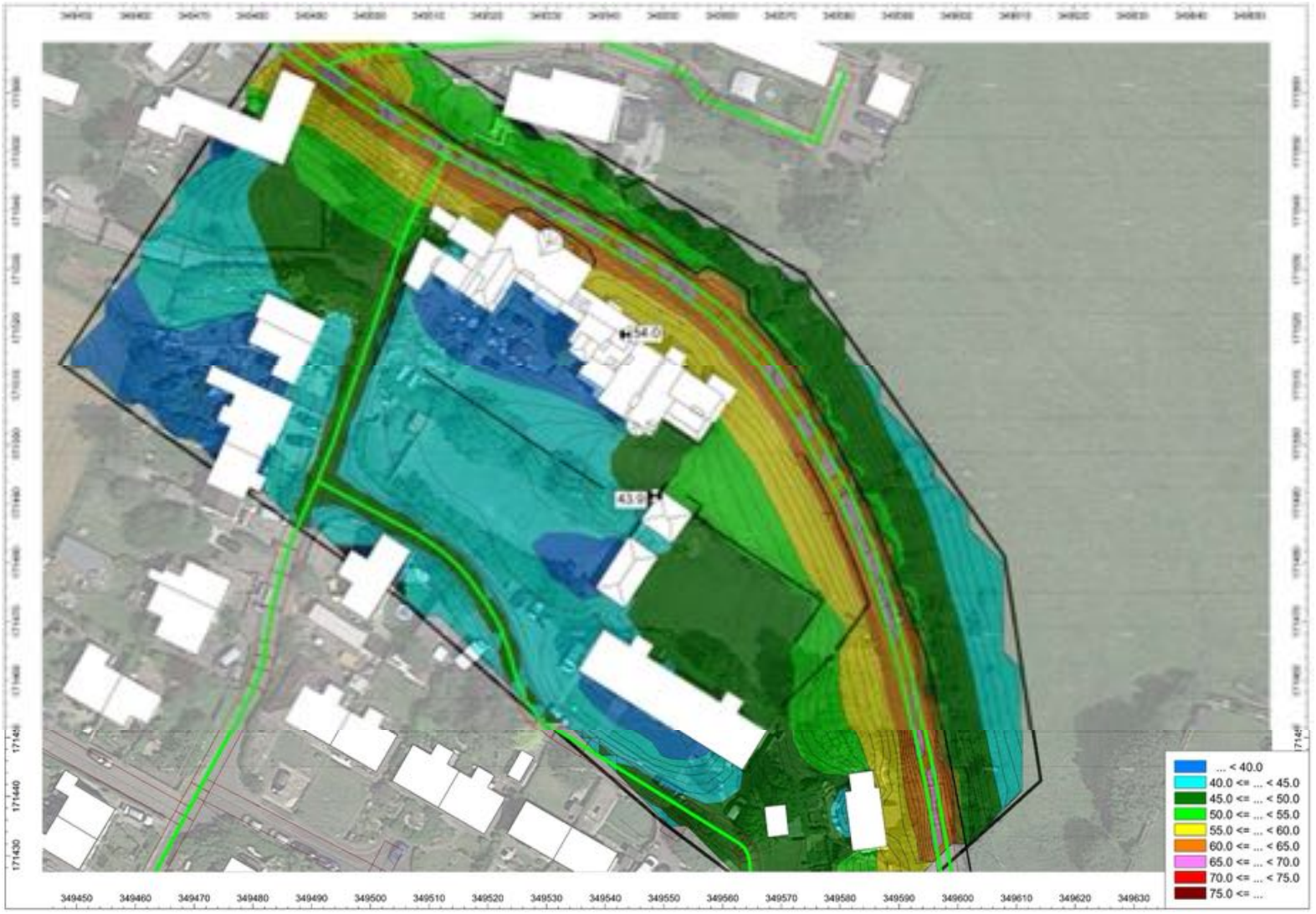


Figure D.4 – Existing site – Predicted 10th highest per night dB L_{AFmax} maximum noise levels – Night-time (23:00 – 07:00)

D.2 – Proposed Development

Figure D.5 – Views of the model setup – proposed development

Figure D.6 – Proposed development - Predicted $L_{Aeq,16hr}$ in outdoor amenity areas – Daytime (07:00 – 23:00)

Figure D.7 – Proposed development - Predicted façade dB $L_{Aeq,16hr}$ exposure levels – Daytime (07:00 – 23:00)

Figure D.8 – Proposed development - Predicted façade dB $L_{Aeq,8hr}$ exposure levels – Night-time (23:00 – 07:00)

Figure D.9 – Proposed development - Predicted façade 10th highest dB L_{AFmax} exposure levels – Night-time (23:00 – 07:00)

Appendix E – Example Façade Constructions

E.1 - Glazing

Table E.1 – Example secondary glazing constructions (retaining existing glazing) and associated sound reduction indices

Glazing Type	Configuration (Glass/Void/Glass mm)	$R_w + C_{tr}$ (dB)
Double (secondary)	4 (50) 6	**34**
	4 (100) 6	**37**
	6 (100) 6	**37**
	10 (100) 6	**39**
	4 (150) 6	**40**
	4 (100) 6.8 laminated/toughened[1]	**40**
	4 (100) 8.8 laminated/toughened[1]	**42**
	6 (100) 6.8 laminated/toughened[1]	**43**
	4 (100) 12.8 laminated/toughened[1]	**44**
	6 (100) 8.8 laminated/toughened[1]	**45**
	6 (100) 12.8 laminated/toughened[1]	**47**
1 – i.e., Pilkington Optiphon or Saint Gobain Stadip Silence		

Table E.2 – Example new double/triple glazing constructions and associated sound reduction indices

Single / Double / Triple	Configuration	Manufacturer	$R_w + C_{tr}$ (dB)
Double	4 (12) 6	Saint Gobain	**29**
Double	5 (12) 4	Saint Gobain	**29**
Double	4 (16) 8	Saint Gobain	**30**
Double	4 (12) 6.8P	Pilkington	**30**
Double	4 (10) 10	Saint Gobain	**31**
Double	6 (25) 4	Saint Gobain	**31**
Double	8 (18) 6	Saint Gobain	**32**
Double	8.8L (12) 8.8P	Pilkington	**32**
Double	4 (6) 10	Saint Gobain	**33**
Triple	4 (12) 4 (12) 8.4S	Saint Gobain	**33**
Double	4 (16) 8.8P	Pilkington	**33**
Double	10 (15) 6	Saint Gobain	**34**
Double	8 (6) 8.8S	Saint Gobain	**34**
Double	6 (16) 8.8P	Pilkington	**34**
Double	10 (6) 8.8S	Saint Gobain	**35**
Double	6 (24) 10	Saint Gobain	**35**
Double	6 (12) 9.5A	Saint Gobain	**35**
Triple	8 (12) 4 (12) 8.8P	Pilkington	**35**
Double	8 (12) 8.8A	Saint Gobain	**36**
Double	10 (12) 8.8A	Saint Gobain	**37**
Double	8.4A (16) 10.4A	Saint Gobain	**38**
Double	8.8P (16) 12.8P	Pilkington	**39**
Double	10 (16) 12.4A	Saint Gobain	**40**
Double	12.8A (15) 12.8A	Saint Gobain	**41**
Double	9.1P (20) 13.1P	Pilkington	**42**
Double	9.1P (20) 17.1P	Pilkington	**43**
Double	16.8A (15) 16.8A	Saint Gobain	**44**
Double	9.1P (20Arg) 17.1P	Pilkington	**44**
NOTATION A = Stadip Silence S = Stadip P = Optiphon L = Optilam Arg = Argon Cavity			
Further data at https://techhub.uk.saint-gobain-building-glass.com/acousticcalculator			

E.2 - Ventilators

For each additional ventilator, the required $D_{n,e,w}$ + C_{tr} should be increased by 10log(n), where 'n' is the number of ventilators. The $D_{n,e,w}$ + C_{tr} must be assessed in the open position.

Table E.3 – Example ventilator products and associated sound reduction indices

Product	$D_{n,e,w}$ + C_{tr} (dB)
Duco DucoTop 60 SR (over window frame) – Corto STD	**25**
Duco DucoTop 60 SR (over window frame) – Corto AK	**26**
Duco DucoTop 60 SR (over window frame) – Grando STD	**27**
Duco DucoTop 60 SR (over window frame) – Corto AK+	**28**
Duco DucoTop 60 SR (over window frame) – Alto AK	**30**
Duco DucoTop 60 SR (over window frame) – Basso AK+	**30**
Titon Invent	**30**
Duco DucoTop 60 SR (over window frame) – Grando AK	**31**
Titon Hit & Miss HM5050	**31**
Duco DucoTop 60 SR (over window frame) – Medio AK+	**32**
Duco DucoStrip Slimline	**32**
Duco GlasMax – Air slot 20mm	**32**
Rytons R2700 Window trickle ventilator (412mm wide)	**33**
Titon SF 3300 EA Vent	**33**
Greenwood Slotvent 3000S	**33**
Duco GlasMax – Air slot 10mm	**34**
Greenwood 2000D	**35**
Duco DucoTop 60 SR (over window frame) – Largo AK+	**35**
Duco DucoMax Corto 15	**36**
Duco DucoTop 60 SR (over window frame) – Grando AK+	**37**
Duco DucoMax Medio 25	**37**
Duco DucoMax Alto 25	**38**
Titon SF Xtra Sound Attenuator	**39**
Willan Fresh 100dB	**40**
Greenwood Airvac Acoustic Air Brick AAB-4000	**40**
Duco DucoMax Corto 10	**41**
Duco DucoMax Medio 15	**42**
Greenwood EHA574	**42**
Duco DucoMax Alto 15	**43**
Duco DucoMax Alto 10	**45**

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