parkerjones acoustics

Land West of Axis House

Bath Road, Heathrow

Noise Impact Assessment

12th July 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 proposals for residential development on the land adjacent to Axis House, Bath Road, Heathrow, in terms of the noise impact that the residual environment would have on future occupants of 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.

As per Section 4.5, internal ambient noise level (IANL) targets can be met with closed windows and high acoustic performance glazing and trickle ventilators. Trickle ventilators/air bricks (or mechanical ventilation) can be used to provide background ventilation as an alternative to open windows.

Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 4.4 of Section 4.5.3.

As per Section 4.6, noise levels on the first floor rear terrace will be in line with the recommended range of 50 – 55 dB $L_{Aeq,16hr}$ (as recommended by WHO guidelines, BS 8233:2014, the ProPG and the Hillingdon SPD for noise). This means that this area will be suitable for the provision of external amenity – if desired.

Therefore, noise should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Assessment for residential development on the land adjacent to Axis House, Bath Road, Heathrow.

1.1 Scope of Report

This report has been written to assess the site in terms of the noise impact that the residual environment would have on the future occupants of the proposed 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

This report takes into consideration 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. 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).

More specifically, the assessment has been undertaken with reference to:

- The *Development Control for Generating and Noise Sensitive Development*' supplementary planning document, London Borough of Hillingdon;
- The Professional Practice Guidance on Planning and Noise (ProPG) (2017), which provides guidelines regarding suitable internal ambient noise levels for residential properties;
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, which "provides guidance on the control of noise in and around buildings" and recommends appropriate criteria and internal noise limits for different situations, including residential developments;
- The World Health Organisation (WHO) '*Guidelines for Community Noise*' (1999) and '*Night Noise Guidelines for Europe* (2009) documents, which suggest suitable internal noise levels in dwellings, and external noise levels in external amenity areas which would constitute a "*moderate*" or "*serious*" annoyance; and

2.0 Site and Development Description

The proposed residential development is to be situated on land west of Axis House, Bath Road, Heathrow.

The application site is currently occupied by car parking servicing Axis House, an adjacent office block to the east. The site is bordered by Bath Road to the south, which carries a significant volume of vehicles. Heathrow Airport is located further to the south. Day and night time environmental noise levels are seen to be dictated by traffic on Bath Road, and air traffic at Heathrow Airport. Other local roads contribute to ambient noise levels but to a much lesser extent.

Proposals are for a new residential building, forming 60 dwellings.

On overview of the proposed development site, and the locations of environmental noise monitoring are indicated in Figure 2.1. The proposed site plan and elevations of the proposed development are shown in Figures 2.2 and 2.3.

Figure 2.1 – Aerial views of the site and surrounding area, and existing site plan

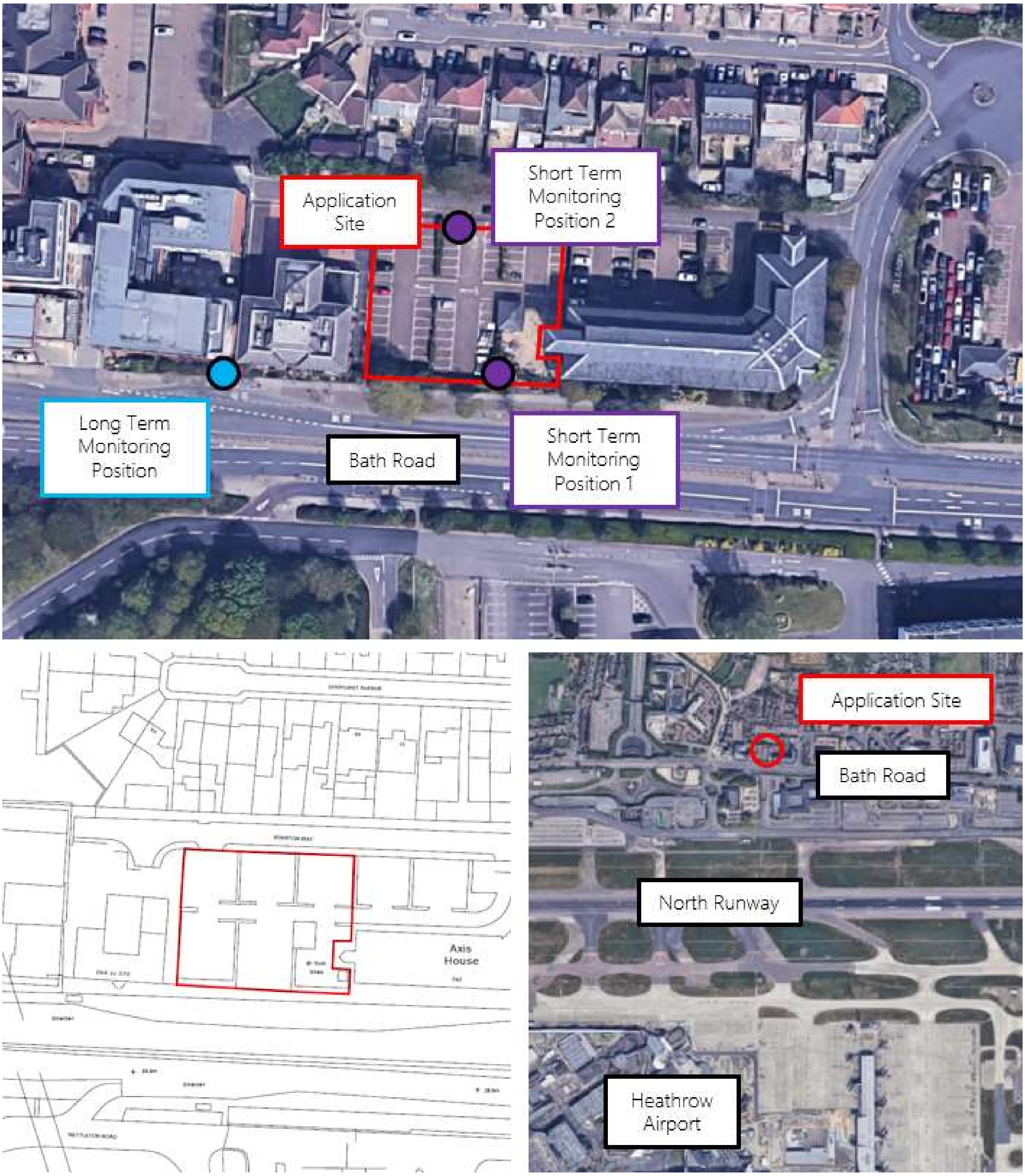


Figure 2.2 – Proposed site plan

Figure 2.3 – Proposed Elevations

Proposed Rear Elevation

Proposed Front Elevation

Proposed Side Elevation

Proposed Side Elevation

3.0 Relevant Guidelines

3.1 Hillingdon SPD

The *Development Control for Generating and Noise Sensitive Development'* supplementary planning document (SPD) adopted by Hillingdon Borough Council, serves to address noise issues affecting the Borough and assist in providing a consistent approach to development where noise is an issue. The SPD supplements the Borough's Local Plan by providing interpretation of national planning and noise policy in a local context, along with advice on technical requirements that the Borough regards as relevant to meeting those policy requirements.

The SPD states that noise can have a significant effect on the environment, and on the health and quality of life enjoyed by individuals and communities. Consequently, noise needs to be considered when new developments may create noise and when new developments would be sensitive to the existing noise conditions – as is the case for the proposed development.

The SPD goes on to state that noise can interfere with residential and community amenity and the utility of noise sensitive land uses, with effects including sleep disturbance and annoyance, which impact on health and quality of life. The mitigation strategy provided in this report is seen to effectively mitigate the adverse effects of noise on the proposed development, in line with the requirements of Hillingdon Borough Council. These requirements are summarised in the following sub-sections.

3.1.1 Stage 1: Initial Site Noise Risk Assessment

The first step required by the Hillingdon SPD is to conduct an initial site noise risk assessment. Note that the Hillingdon SPD approach is seen to be influenced by the ProPG document (2017) as outlined in Appendix B.4. The noise criteria are however slightly different. Table 3.1 below provides an overview of the initial site noise risk criteria from the Hillingdon supplementary planning document.

Table 3.1 – Hillingdon SPD initial site noise risk assessment guidelines

Noise Significance Risk	Noise Significance (Without Mitigation)	Indicative Noise Levels	Pre-Planning Application Advice
Negligible	No Adverse Noise Effect	$L_{Aeq,16Hr}$ <50 dB $L_{Aeq,8Hr}$ <40 dB	Low noise levels indicate that the development site is likely to be acceptable from a noise perspective.
Low	Increasing Risk of Adverse Effect	$L_{Aeq,16Hr}$ 50 - 63 dB $L_{Aeq,8Hr}$ 40 - 55 dB	Noise levels in this region mean that the development site is likely to be acceptable from a noise perspective, provided that good acoustic design is followed and demonstrated in an Acoustic Design Statement which confirms how the adverse impacts of noise will be mitigated and minimised in the completed development.
Medium		$L_{Aeq,16Hr}$ 63 - 69 dB $L_{Aeq,8Hr}$ 55 - 60 dB	As noise levels increase, the site is less likely to be suitable for development from a noise perspective and planning consent is more likely to be refused unless a good acoustic design process is demonstrated in a detailed Acoustic Design Statement which confirms how adverse noise impacts will be mitigated and minimised, and which clearly demonstrates that any significant adverse noise impacts will be avoided in the completed development.
High		$L_{Aeq,16Hr}$ >69 dB $L_{Aeq,8Hr}$ >60 dB	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. The risk of refusal may be reduced by following a good acoustic design process. Applicants are strongly advised to seek expert advice and discuss the proposals in advance with the Local Authority.

3.1.2 Stages 2, 3, 4 and 5

Following the initial site risk assessment, Stage 2 requires that noise sensitive rooms are designed to achieve compliance with the internal noise criteria of BS 8233: 2014 (See Section 3.2). Consideration should also be made to individual noise events (L_{Amax}). This is seen to be especially important for mitigation of road and air traffic noise. The design of ventilation elements is also of high importance. Stage 3 of the assessment should account for noise in external amenity areas, in line with the recommendations of the WHO (See Section 3.3). Stage 4 requires consideration of other relevant factors such as wider planning objectives. Stage 5 requires the development of an acoustic design and mitigation strategy, as provided by this report.

3.2 BS 8233:2014

3.2.1 Internal Ambient Noise Levels

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.

Table 4 of BS 8233:2014 provides 'desirable' internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. BS 8233:2014 also notes that *"where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."* These targets are summarised in Table 3.2 below.

Table 3.2 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)		Night-time (23:00 – 07:00)	
		Desirable conditions	Reasonable conditions	Desirable conditions	Reasonable conditions
Resting	Living Room	35 dB $L_{Aeq,16hr}$	40 dB $L_{Aeq,16hr}$	-	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	45 dB $L_{Aeq,16hr}$	-	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	40 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$	35 dB $L_{Aeq,8hr}$

Annex G.1 of BS 8233:2014 suggests that *"if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"*.

Whilst it is desirable to achieve the recommended IANLs with windows open, this is not stipulated as a mandatory requirement within the guidance of BS 8233:2014 which states *"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. If applicable, any room should have adequate ventilation (e.g., trickle ventilators should be open) during assessment."*

Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB, as per below:

- Desirable internal conditions – Façade noise levels <50 dB $L_{Aeq,16hr}$
- Reasonable internal conditions – Façade noise levels <55 dB $L_{Aeq,16hr}$

3.2.2 External Amenity Ambient 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.

The advice in BS8233:2014 states that the resulting noise levels outside are never a reason for refusal as long as levels are designed to be as low as practicable.

3.3 WHO Guidelines

The WHO document *Guidelines for Community Noise 1999* ('GCN') sets out guidance as to noise levels at which there will be an unacceptable impact on the occupants of residential developments.

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. The document also states, 'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dBA LAmax more than 10-15 times per night, (Vallet & Varnet 1991).'

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 $L_{Aeq.}$

4.0 Assessment

4.1 Methodology

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 has been evaluated, based on environmental noise monitoring undertaken previously. Noise levels on site are seen to be consistent and as such the environmental noise survey undertaken by KP Acoustics, ref – *21928.NIA.01 Noise Impact Assessment Report* (26/01/2021) is seen to be appropriate in making this assessment. The results of the environmental noise monitoring are provided in Section 4.2.
- Based on the results of the environmental noise survey undertaken by KP Acoustics, 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 updated to include the proposed development and therefore accurately predict external noise levels outside of all facades and in external amenity areas;
- Noise levels in external amenity areas are assessed in line with the Hillingdon SPD requirements including WHO targets;
- Noise ingress into living spaces is then assessed against the IANL limits of the Hillingdon SPD (i.e BS 8233 and maximum events), to determine the 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).

4.2 Environmental Noise Survey

PJA are aware that an extensive noise survey has already been conducted in relation to a previous application at this site. The results obtained by KP Acoustics, ref – *21928.NIA.01 Noise Impact Assessment Report* (26/01/2021) are seen to be appropriate in assessing the current development proposals.

The assessment is based on a noise survey conducted in January 2021, over several days at 1 fixed long term position and 2 short term positions. The locations of the noise monitoring positions are indicated in Figure 2.1. Appendix C provides a graph of the measurement results at the long term monitoring position.

Table 4.1 provides the assessment noise levels, which have formed the basis of the noise modelling assessment. The survey results should remain valid and are relevant given that there has not been significant development in the area which is likely to have increased noise levels, and road traffic / air traffic is unlikely to have changed substantially. It appears that the survey:

- used Class 1 sound measuring equipment which was within calibration;
- was conducted by a consultant sufficiently qualified and competent in environmental noise monitoring;
- was conducted in appropriate weather conditions (dry with low wind speeds);
- was conducted at representative measurement positions;
- generally followed the guidelines of British Standard 7445: 2003: Description and measurement of environmental noise;

Table 4.1 – External noise levels measured during the *KP Acoustics* survey

Period	Long Term Monitoring Position	Short Term Monitoring Position 1	Short Term Monitoring Position 2
Daytime $L_{Aeq,16hr}$	75	75	61
Night time $L_{Aeq,8hr}$	71	--	--

4.3 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, in each garden, and at each façade and each floor of the building(s) associated with the proposed development. 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 4.2, by placing a receptor point at the 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 $L_{Aeq,8hrs}$.

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 the residential 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 $L_{Aeq,16hr}$ – for the existing site, at a height of 1.5m and grid spacing of 1m.
- Figure D.3 – shows the night-time ambient noise level $L_{Aeq,8hr}$ – for the existing site, at a height of 1.5m and grid spacing of 1m.

The proposed development has then been added to the model:

- Figure D.4 – shows 3D views of the model setup with the proposed development in place.
- Figure D.5 – shows external daytime $L_{Aeq,16hr}$ levels within outdoor amenity areas (1.5m height).
- Figure D.6 - shows the predicted façade exposure levels in terms of the daytime $L_{Aeq,16hr.}$
- Figure D.7 - shows the predicted night-time ambient $L_{Aeq,8hr}$ façade exposure.

4.4 Stage 1 - Initial Site Noise Risk Assessment

As described in Section 3.1.1, the Hillingdon SPD recommends that an initial assessment of the risk of adverse noise impact is made without accounting for the impact of any new or additional mitigation measures that may subsequently be included in development proposals. An overview of the noise risk criteria is provided in Table 3.1.

Based on the daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ levels in Figures D.2 and D.3, it is seen that the potential risk of adverse effect without noise mitigation when comparing the levels to those in Table 3.1 are as follows. The noise exposure areas are defined in Figure 4.1.

- Daytime - High on Exposure 1, Medium on Exposure 2.
- Night-time – High on Exposure 1, Medium on Exposure 2.

4.5 Stage 2 – Internal Design Noise Levels

4.5.1 Internal Ambient Noise Limits

The criteria for internal ambient noise levels (IANLs) has been based on the criteria of the Hillingdon SPD, with reference to BS 8233: 2014 and ProPG. In summary, IANL contributions inside the bedrooms and living rooms of the residential dwellings should be no greater than those in the table below.

Table 4.2 – 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 - no more than 10 times a night			

The criteria are considered to be in line with the Lowest Observed Adverse Effect Level (LOAEL) referenced in national planning policy (Appendix B).

4.5.2 'Good' Acoustic Design

A 'good' acoustic design process should first explore other methods of mitigating noise which doesn't wholly rely on using the building envelope. Table 4.3 analyses the feasibility of the suggested mitigation measures for this site.

Table 4.3 – Analysis of noise mitigation measures as part of a 'good' acoustic design process

Mitigation Method	Analysis
Maximising the spatial separation of noise source(s) and receptor(s).	Given the proximity of the site to Bath Road and Heathrow Airport, it is not seen to be possible to create more distance than has been achieved by the proposed design.
Investigating the necessity and feasibility of reducing existing noise levels and relocating existing sources.	Reducing road / air traffic or relocating these noise sources is not possible.
Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.	There are no existing structures between the proposed dwellings and the railway.
Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.	This is not seen to be a feasible strategy to reduce façade noise levels from road traffic, as daylighting cannot be restricted for dwellings on lower levels of the building. Additionally, a barrier will not be effective at reducing noise levels from air traffic.
Using the layout of the scheme to reduce noise propagation across the site.	The site is formed by a single building and therefore there is no propagation to other areas of the site. The building itself will however screen noise from the railway line, leading to 2 levels of noise exposure.
Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.	Difficult given that there are no non-sensitive spaces on the upper floors.
Using the building envelope to mitigate noise to acceptable levels.	See the following section.

4.5.3 Building Envelope

To assess the required sound reduction performance for the building envelope, façade exposure levels have been defined as shown in Figure 4.1. These are based upon the worst case floor-by-floor façade noise levels.

Figure 4.1 – Façade exposure levels

Table 4.4 defines the external façade noise levels for each exposure level in Figure 4.1.

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 in most areas of the development – though this is not unusual by any means in an area affected by road traffic 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.

The ProPG states "*where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g., trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded*".

Given the expected exceedance of IANL targets with open windows, an alternative form of background ventilation (i.e., trickle vents or mechanical ventilation) must be provided so that IANL targets can be met whilst providing background ventilation to the dwellings 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. Alternative forms of natural background ventilation (such as trickle vents) can be treated to achieve a much higher level of sound reduction than an open window. Closed windows (and external walls and roofs) can be treated to achieve the necessary level of sound reduction through the specification of the glazing/construction.

Table 4.4 provides the minimum sound reduction indices for glazing [1] and ventilators (the weakest elements acoustically) – to meet IANL targets with windows closed but alternative ventilators open/ventilation systems operating to provide background ventilation. Alternatively, mechanical ventilation could be installed as an alternative to acoustically rated trickle vents – particularly if overheating is identified as an issue.

1 - which also apply to external walls and roofs – albeit these will almost always achieve a much higher level of reduction than glazing

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 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.

The required sound reduction indices are most influenced by the internal night-time ambient noise level target. For example, on Exposure 1, the reduction required to meet the night time ambient noise limit is 41 dB. This will provide an internal level of 45 dB L_{Amax} for noise events of <87 dB. When examining the noise survey data obtained by KP Acoustics, it is seen that an external level of 87 dB L_{Amax} is not experienced more than 10 times per night. This means that the specification provided will provide adequate protection against daytime ambient noise levels, night time ambient noise levels, and night time maximum noise levels.

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.

PJA recommend that glazing which has two panes of glass that are the same thickness are avoided where possible unless the manufacturer has test data that proves its performance can meet the required $R_w + C_{tr}$ – as these can resonate together and are usually worse performing than two panes of different thicknesses, even if the second pane is slightly thinner than the first. This is especially true with triple glazing.

It should also be noted that other glazed façade elements must as a minimum achieve the sound reduction indices given for glazing. This includes glazed doors and spandrel panels where applicable.

Table 4.4 – Minimum sound reduction requirements of the building envelope

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 [2] See Appendix E.1	Ventilators [3] see Appendix E.2
Exposure 1	75	71	41 dB $R_w + C_{tr}$ i.e., Saint Gobain 12.8A (15) 12.8A Acoustic Double Glazed System	44 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoMax Alto 10 Acoustic Trickle Vent
Exposure 2	64	60	30 dB $R_w + C_{tr}$ i.e., Saint Gobain 4 (16) 8 Double Glazed System	33 dB $D_{n,e,w} + C_{tr}$ i.e., Titon SF 3300 EA Trickle Vent
Criteria [4]	≤35	≤30		

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).

4.6 Stage 3 – Design Noise Levels for External Amenity Spaces

The ProPG indicates that "*the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.*". This is reflected in the requirement of the Hillingdon SPD for noise.

Figure D.5 in Appendix D plots the external amenity noise levels (daytime $L_{Aeq,16hr}$) for the rear first floor terrace area, which is assumed to be proposed for outdoor amenity. This shows that it is possible for levels to be within or below this range. No additional noise mitigation is seen to be required.

4.7 Stage 4 – Assessment of Other Relevant Issues

Stage 4 of the Hillingdon SPD is an assessment of other relevant issues. These factors include the likely occupants of the development, and unintended adverse consequences and wider planning objectives.

Table 4.5 – Assessment of other relevant issues

Issues	Comments
4(i) compliance with relevant national and local policy	The proposed scheme will achieve full compliance with the requirements of the Hillingdon SPD for noise.
4(ii) magnitude and extent of compliance with SPD	
4(iii) likely occupants of the development	Given the size of the flats, it is expected that occupants will likely either be living alone, with 1 other person, or young families. The noise-sensitivity of this group is likely to be less than for example, the elderly.
4(iv) acoustic design v unintended adverse consequences	Alternative ventilation will be provided to allow internal noise limits to be met without relying on opening the windows. Facades will not be 'sealed'.
4(v) acoustic design v wider planning objectives	The area contains other residential dwellings. Therefore, residential development is considered to be in character with the area. It is understood that the provision of housing is desirable to the local authority, given that full compliance with the SPD for noise has been achieved.

4.8 Summary

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level.

As per Section 4.5, internal ambient noise level (IANL) targets can be met with closed windows and high acoustic performance glazing and trickle ventilators. Trickle ventilators/air bricks (or mechanical ventilation) can be used to provide background ventilation as an alternative to open windows.

Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 4.4 of Section 4.5.3.

As per Section 4.6, noise levels on the first floor rear terrace will be in line with the recommended range of 50 – 55 dB $L_{Aeq,16hr}$ (as recommended by WHO guidelines, BS 8233:2014, the ProPG and the Hillingdon SPD for noise). This means that this area will be suitable for the provision of external amenity – if desired.

Therefore, noise should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
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.
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) as defined above.
$L_{A90,T}$	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'.
$L_{AFmax,T}$	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.

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 – National Planning Policy

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.			

B.4 – The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, is a design guide for new residential development that are exposed predominantly to airborne noise from transport sources. It was produced *"to provide practitioners with guidance on the management of noise within the planning system in England"*, though it is not an official code of practice or official interpretation of the law or government policy.

However, the ProPG extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, as well as national planning policy, providing 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.

The ProPG *"advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging…*

…The two sequential stages of the overall approach are:

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

The approach is underpinned by the preparation and delivery of an "Acoustic Design Statement" (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk."

B.4.1 - Stage 1: Initial Site Noise Risk Assessment

The ProPG recommends that an initial site noise risk assessment should be undertaken based on indicative external noise levels on the existing site, without accounting for the impact of any new or additional mitigation measures that may subsequently be included in development proposals. Figure 1 of the ProPG relates the increasing risk of adverse effect against indicative daytime noise levels ($L_{Aeq,16hr}$) and night-time noise levels ($L_{Aeq,8hr}$) without noise mitigation. This is recreated in the table below.

Table B.2 – The ProPG initial site noise risk assessment guidelines

Indicative external daytime noise levels $L_{Aeq,16hr}$	Indicative external night-time noise levels $L_{Aeq,8hr}$	Potential risk of adverse effect without noise mitigation
≤ 50 dB	≤ 40 dB	Negligible / No adverse effect [1]
> 50 dB and ≤ 60 dB	> 40 dB and ≤ 50 dB	Low
> 60 dB and ≤ 70 dB	> 50 dB and ≤ 60 dB	Medium
> 70 dB	> 60 dB	High
NOTES: The noise level limits are an interpretation of Figure 1 in the ProPG, which is presented as a diagram rather than a table and does not explicitly state the limits at which each risk category exists. [1] An indication that there may be more than 10 noise events at night with $L_{Amax,F}$ > 60 dB means the site should not be regarded as a negligible risk.		

B.4.2 – Stage 2: Good Acoustic Design Process

The ProPG talks about a *"good acoustic design process"*, that will be suitable in the majority of situations likely to be encountered in practice, with the aim of a more consistent approach from designers through the use of the document. In short, "good acoustic design" means that the acoustic design should:

- be considered early in the development control process;
- take an integrated approach to achieve 'optimal' acoustic conditions both internally and externally, which does not just focus on compliance with noise exposure standards, but aims to avoid compromises for other sustainable design objectives that may adversely affect living conditions and quality of life;
- avoid "unreasonable" and prevent "unacceptable" acoustic conditions, without overdesigning or 'gold plating' the new development; and
- consider the viability of alternative solutions rather than solely rely on the building envelope to provide sufficient sound insulation, which may adversely affect living conditions.

B.4.3 – Stage 2: Noise Management Measures

The ProPG recommends that the design of sealed shut/un-openable windows should be avoided where possible, as occupants would favour the ability to open the windows even if the resultant internal acoustic conditions are unsatisfactory.

Therefore, every effort should be made in the first instance to mitigate noise through alternative solutions before simply using the building envelope to mitigate noise. Supplementary Document 2 of the ProPG therefore advises that the following hierarchy of noise management measures (in descending order of preference) should be followed:

- Maximising the spatial separation of noise source(s) and receptor(s).
- Investigating the necessity and feasibility of reducing existing noise levels and relocating existing sources.
- Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.
- Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
- Using the layout of the scheme to reduce noise propagation across the site.
- Using the orientation of buildings to reduce the noise exposure of noise sensitive rooms.
- (and finally) Using the building envelope to mitigate noise to acceptable levels.

Any reliance on the use of the building envelope alone to mitigate noise levels should be justified. In many cases there is "justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources".

B.4.4 – Stage 2: Internal Ambient Noise Levels

Whole Dwelling Ventilation

The ProPG provides internal ambient noise level targets based upon Table 4 of BS 8233:2014, with a few additions in guidance. These are summarised in the table below.

The ProPG suggests that the development layout should be designed such that internal noise level targets can be achieved with open windows in as many areas as possible, on the basis that residents will value the ability to open windows at will. It is generally stated within guideline documents (including the ProPG) that an open window will typically provide up to a 15 dB(A) reduction in noise from outside to inside.

However, 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).

Table B.3 – The ProPG internal ambient noise level guidelines

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			

The following summarises the ProPG guidance which relates to the table above.

- Internal L_{Aeq} targets:
  - assume normal daytime fluctuations in external noise;
  - are based on average annual data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events such as bonfire night or New Year's Eve; and
  - can be relaxed by up to 5 dB where development is considered necessary or desirable, despite high external noise levels. However, most people will regard exceeding the targets by more than 5 dB on a regular basis as 'unreasonable' and exceeding by more than 10 dB as 'unacceptable'.
- Internal $L_{Amax,F}$ targets:
  - are set on the basis that regular individual noise events (such as aircraft and passing trains) can cause sleep disturbance; and
  - are not an absolute limit but a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night. However, where it is not practical to achieve this guideline, the judgement of acceptability will depend on the noise level, source, number, distribution, predictability and regularity of noise events.

Purge Ventilation

The guidelines above are generally not applicable under *"purge ventilation"* conditions (as defined by ADF), as this should only occur occasionally.

Mechanical Services

The ProPG indicates that *"where mechanical services are used as part of the ventilation or thermal comfort strategy for the scheme, the impact of noise generated by these systems on occupants should also be assessed."* It does not, however, give an explicit set of noise level targets for any form of mechanical ventilation (continuous, extract or purge).

B.4.5 – Stage 3: Outdoor Amenity

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 external 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.

The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.

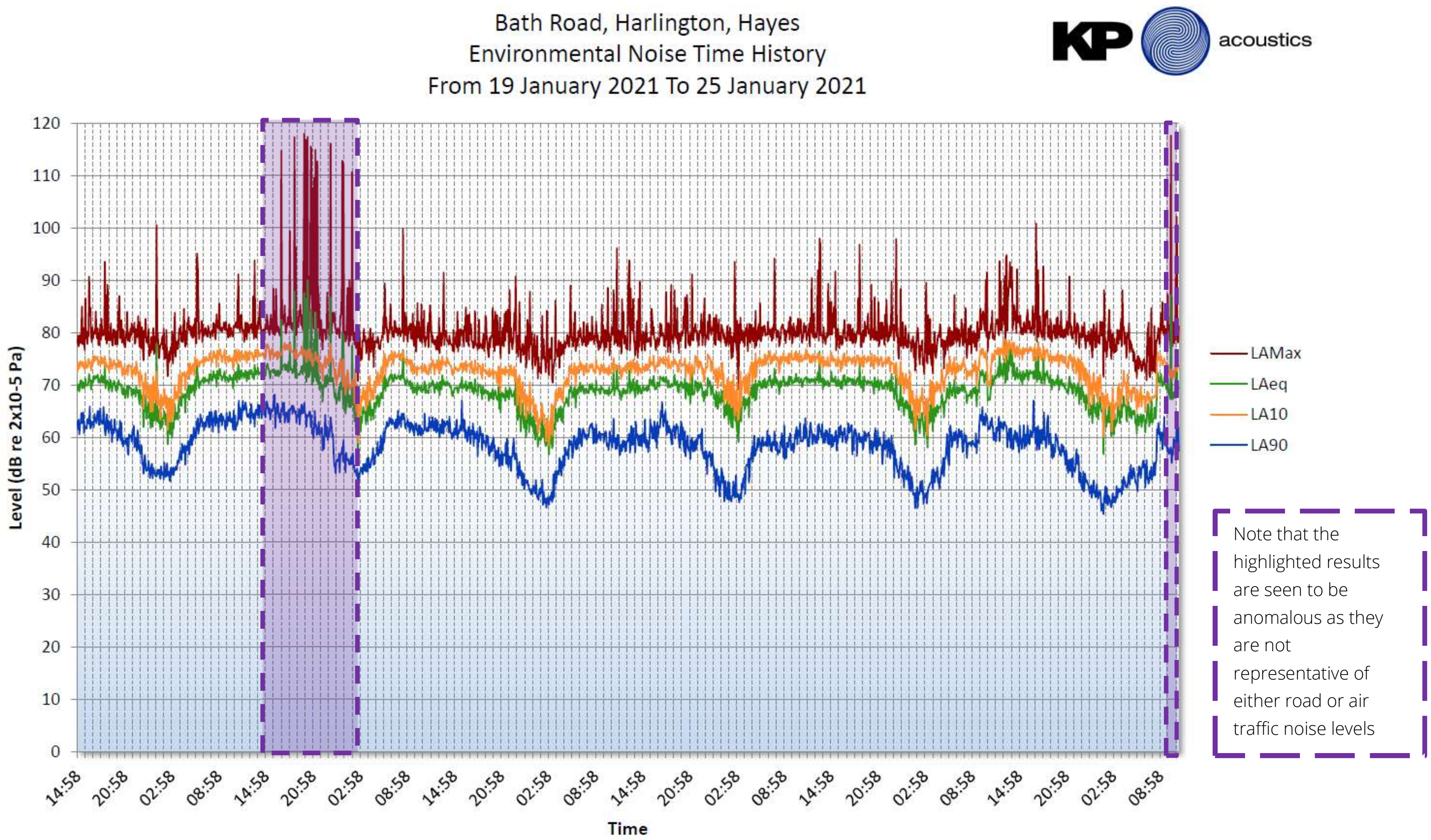
These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces. Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.

Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- *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; and/or*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.*

LPAs will be best placed to provide guidance on the meaning of "relatively quiet" in any given location as this concept will inherently vary from one place to another. In addition, it may not be necessary for the whole of an external amenity area to be relatively quiet, nor for it to be relatively quiet all of the time. It is proposed that it may be helpful to define "relatively quiet" for the purposes of Element 3 as any situation where the typical average hourly daytime LA90 is more than 10 dB below the typical average hourly daytime LAeq noise levels in the immediate locality. However, other definitions of "relatively quiet", including the use of other noise metrics or a locally set absolute noise level, may also be suitable depending on local circumstances."

Appendix C – Noise Survey Results – Long Term Monitoring Position



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 10^{th} highest $L_{AFmax,5min}$ 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 on roads, buildings, and tarmacked areas;
  - 0.5 in 'mixed land' – i.e., gardens and residential streets with a mixture of road, gardens, grass, pavements, patios.
  - 1 on grassland.
- 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 heights of 1.5m when assessing noise in external amenity spaces/grid height of 1.5m for the noise contour plots;
- receptor points in the plots of the existing site based on the position and height of the survey positions;
- 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

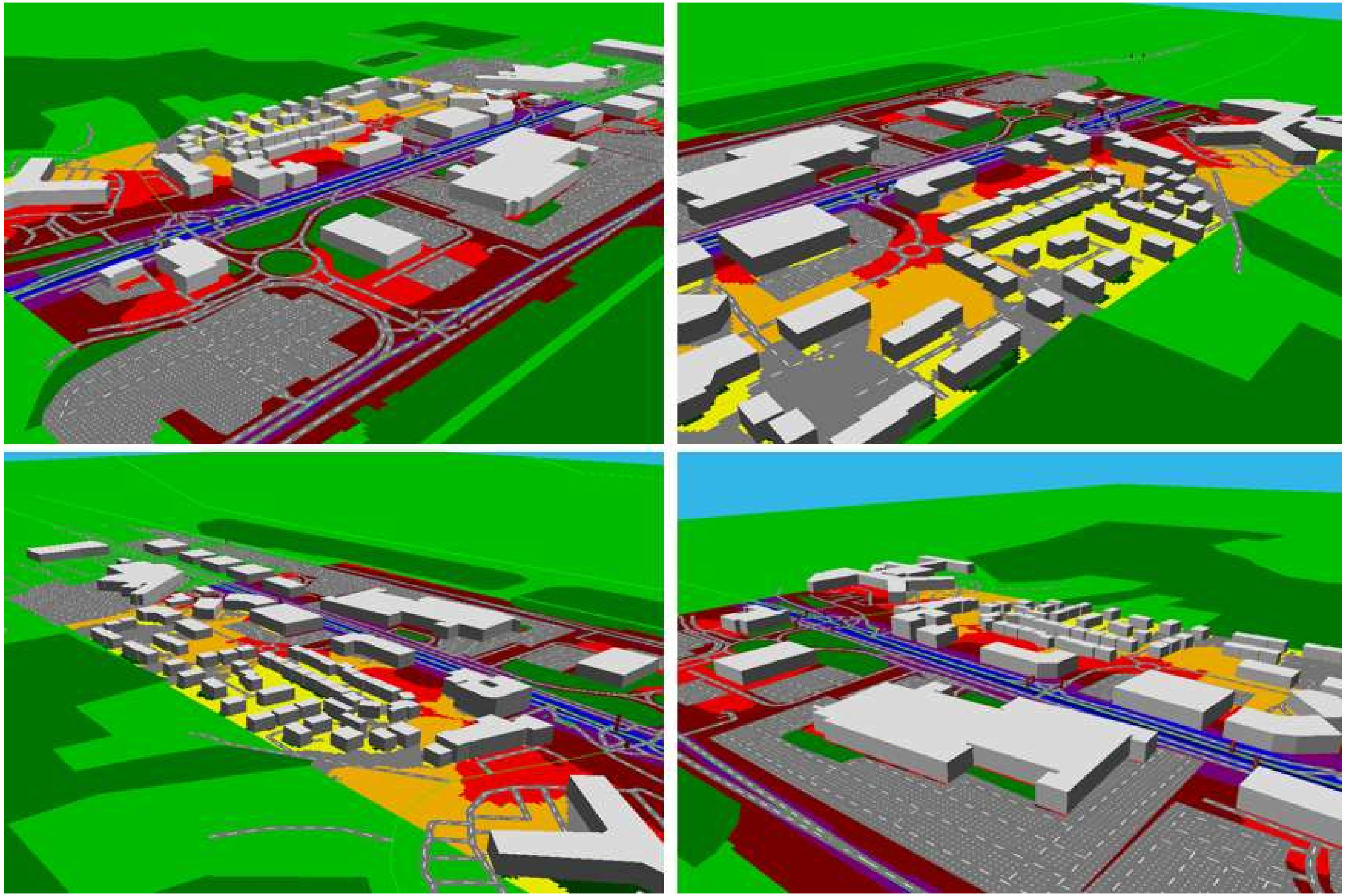


Figure D.2 – Existing site - Predicted dB $L_{Aeq,16hr}$ external ambient noise levels – Daytime (07:00 – 23:00) – grid height 1.5m – grid resolution 1m

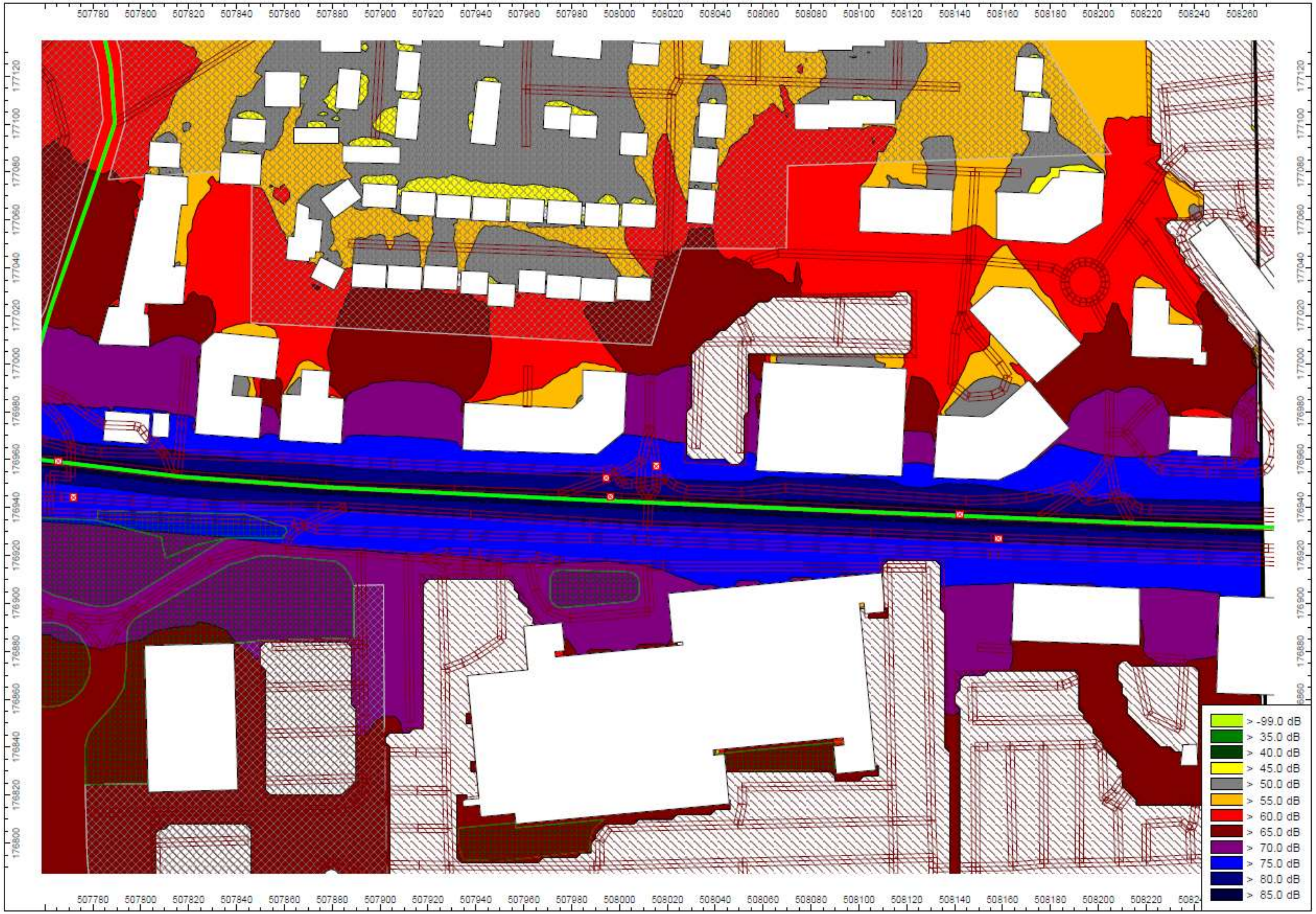
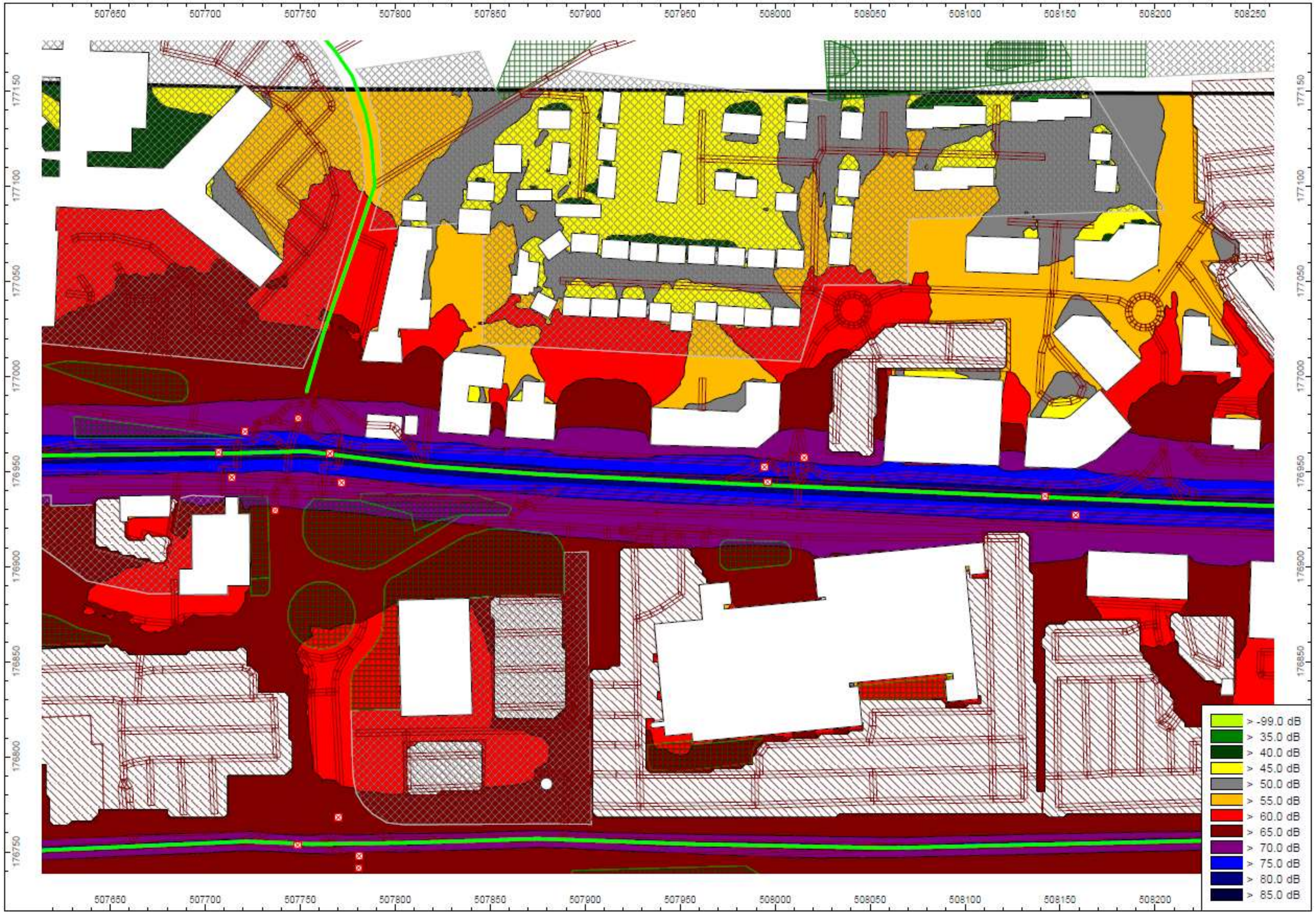


Figure D.3 – Existing site - Predicted dB $L_{Aeq,8hr}$ external ambient noise levels – Night-time (23:00 – 07:00) – grid height 1.5m – grid resolution 1m



D.2 – Proposed Development

Figure D.4 – Views of the model setup – proposed development

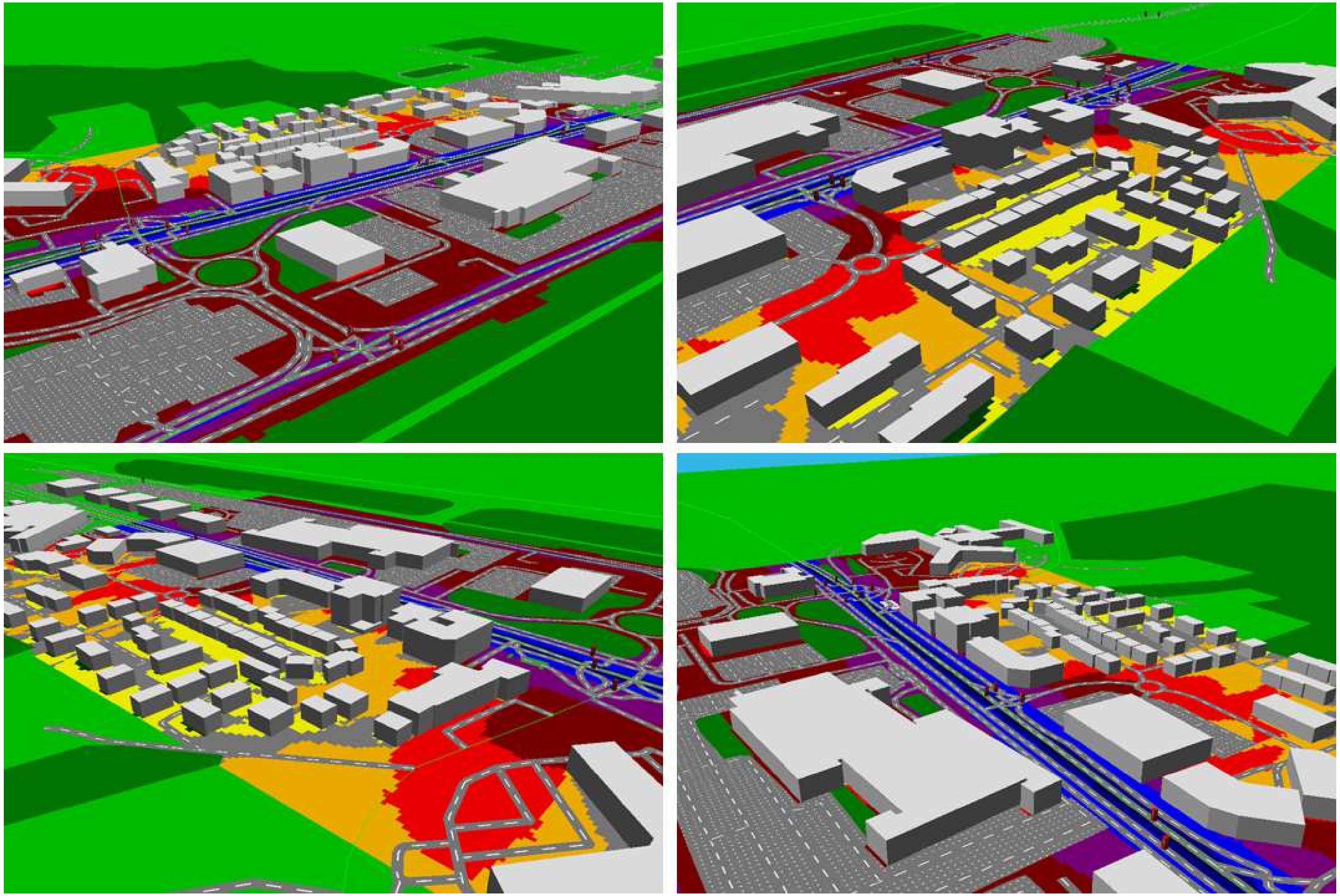


Figure D.5 – Proposed development - Predicted $L_{Aeq,16hr}$ in outdoor amenity areas – Daytime (07:00 – 23:00)

Figure D.6 – Proposed development - Predicted façade dB $L_{Aeq,16hr}$ exposure levels – Daytime (07:00 – 23:00)

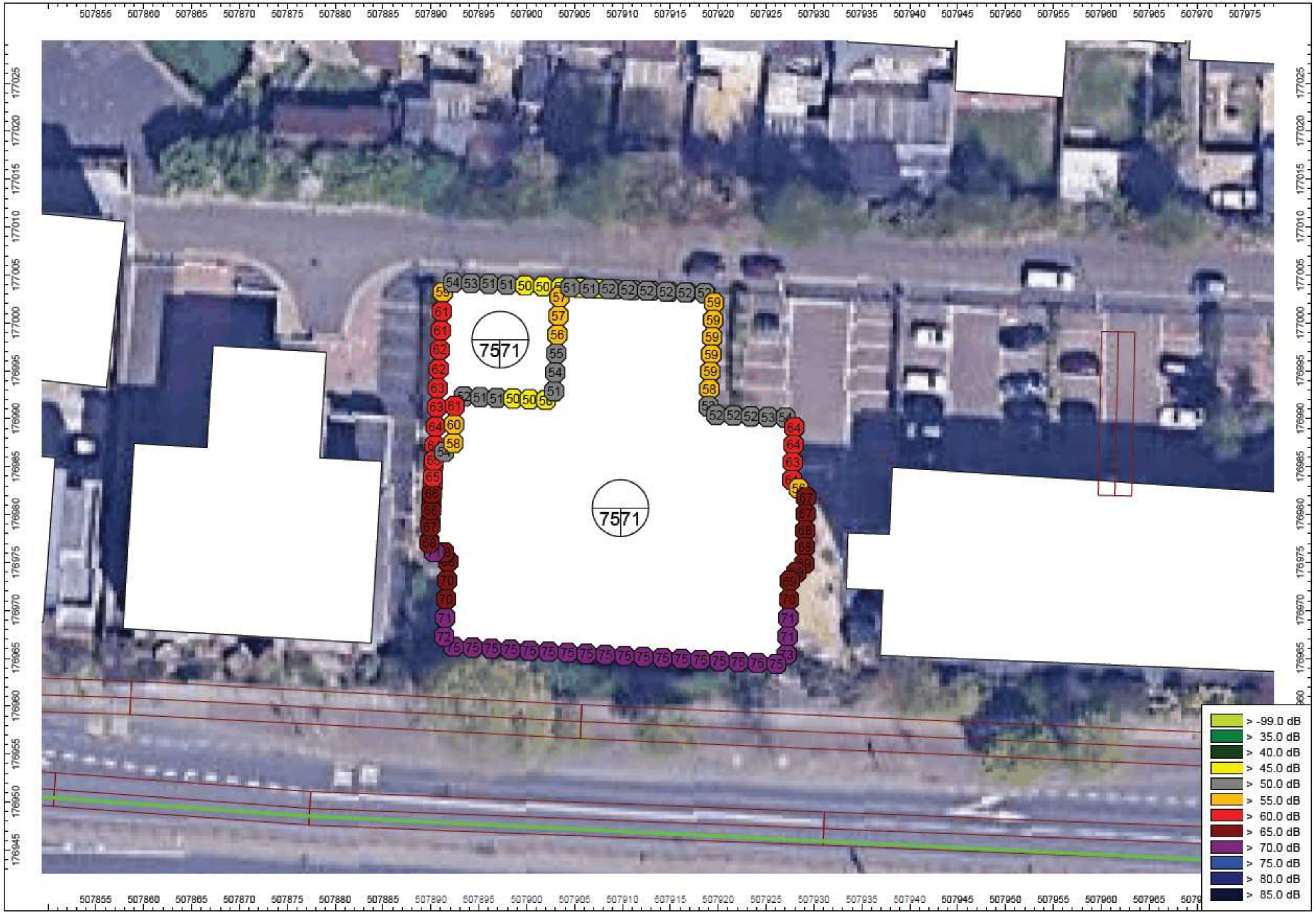
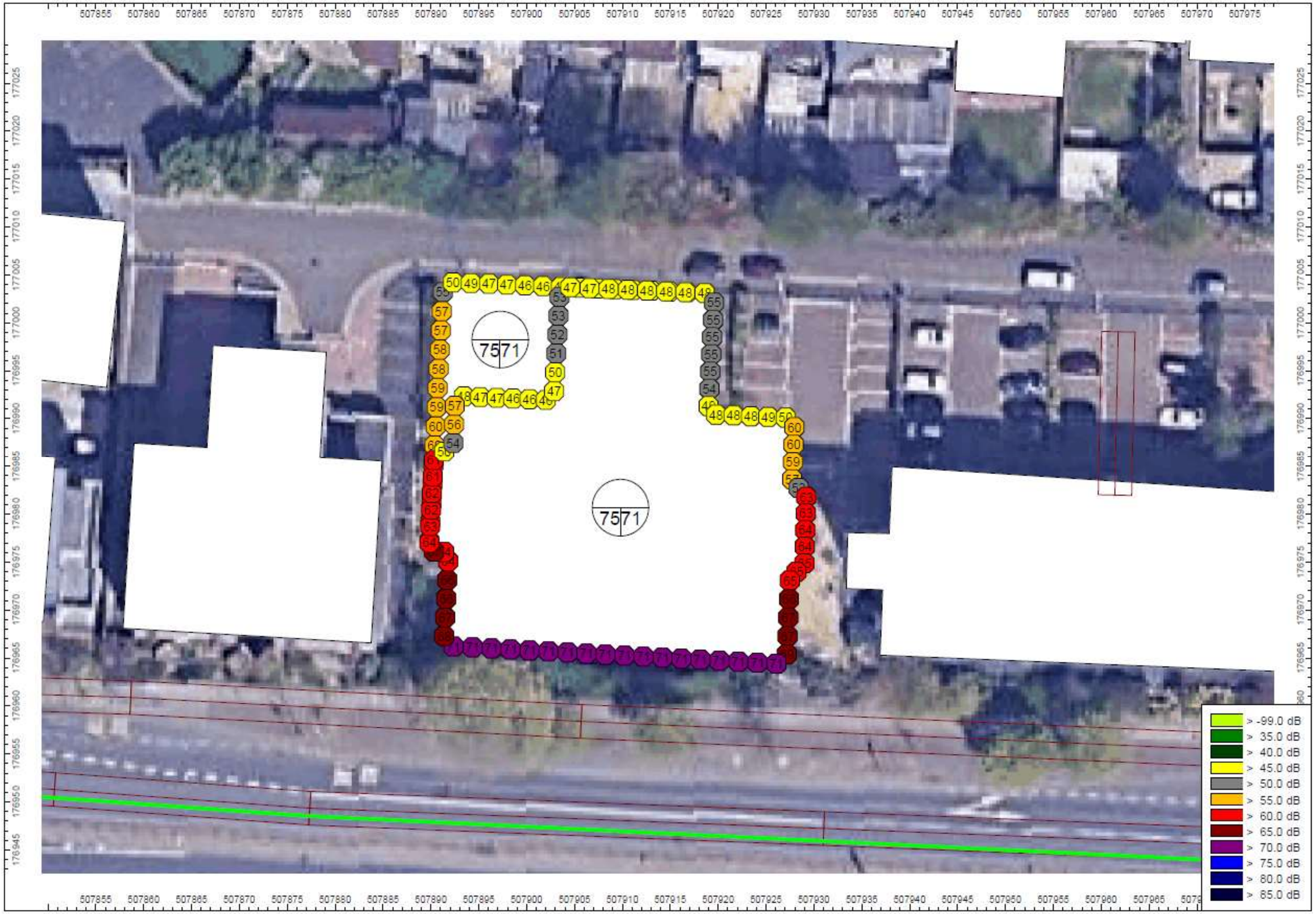


Figure D.7 – Proposed development - Predicted façade dB $L_{Aeq,8hr}$ exposure levels – Night-time (23:00 – 07:00)



Appendix E – Example Façade Constructions

E.1 - Glazing

Table E.1 – Example 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.2 – 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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