



Noise Impact Assessment

Site Address: Glovers Brow, Kirby Park, Kirby, Knowsley, Liverpool, L32 2AE

Client Name: RJG Architecture Ltd

Project Reference No: NP-013820



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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a new build mixed use development comprising 3no. ground floor commercial units, a ground floor bar / restaurant, and 7no. apartments located at first floor level ('the proposed development'). The site will be located off Glovers Brow, Kirby Park, Kirby, Knowsley, Liverpool, L32 2AE ('the site').

The applicant is preparing to submit a planning application to Liverpool City Council. This report has been prepared to accompany the planning application to be submitted to the Local Planning Authority ('LPA').

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have been subsequently used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

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

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (NPPF, 2024)
- Noise Policy Statement for England (NPSE, 2010)
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- British Standard BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'
- Approved Document O: Overheating (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)
- The IOA 'Good Practice Guide on the Control of Noise from Pubs & Clubs' (2003)
- 'Noise from Pubs & Clubs' (NANR92, 2005)

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for a new-build two-storey mixed use development comprised of the following:

- Ground floor:
 - o 3no. non-food commercial units
 - o 1no. bar / restaurant with associated outdoor seating
- First floor:
 - o 7no. apartments

At this stage, it is unknown whether there will be any items of external fixed mechanical plant. However, it is likely that service plant will be required, and therefore, the impact of this will be assessed in the event proposals confirm that plant will be installed.

The operating hours of the commercial units and bar / restaurant are unknown at this stage. No operators are confirmed for any of the four units; however, it is expected that the bar / restaurant would be open no later than 23:00 hours, and the commercial units could operate for 24 hours a day, seven days a week. This is deemed sufficiently robust at this time.

The figure below shows the layout of the proposed development.



Drawing Ref No. 01826/SK/01/A from 'DJG Architecture Ltd'

Figure 1 – Proposed Development Layout

1.3 Local Planning Authority & Background

It is understood that pre-application advice has been received from Liverpool City Council. As part of this submission, a previous noise impact assessment was completed by the client, however, the following response was received from the LPA in relation to this:

“Noise - The noise assessment is not adequate to assess the potential noise risk to the proposed development and that of the surrounding residents. The noise assessment must be completed by an accredited noise / acoustic consultant and is required to ensure the development is suitable with a proposed mitigation scheme for the protection of proposed dwellings from noise from the railway surrounding commercial businesses; furthermore the mitigation scheme will need to protect both existing and proposed dwellings from noise from the proposed commercial businesses on the ground floor, including the bistro / bar. This will be required prior to decision.”

The following noise impact assessment aims to address the above points and will consider the guidance and legislation documents presented in Section 1.1.

2. Environmental Noise Survey

2.1 Measurement Methodology

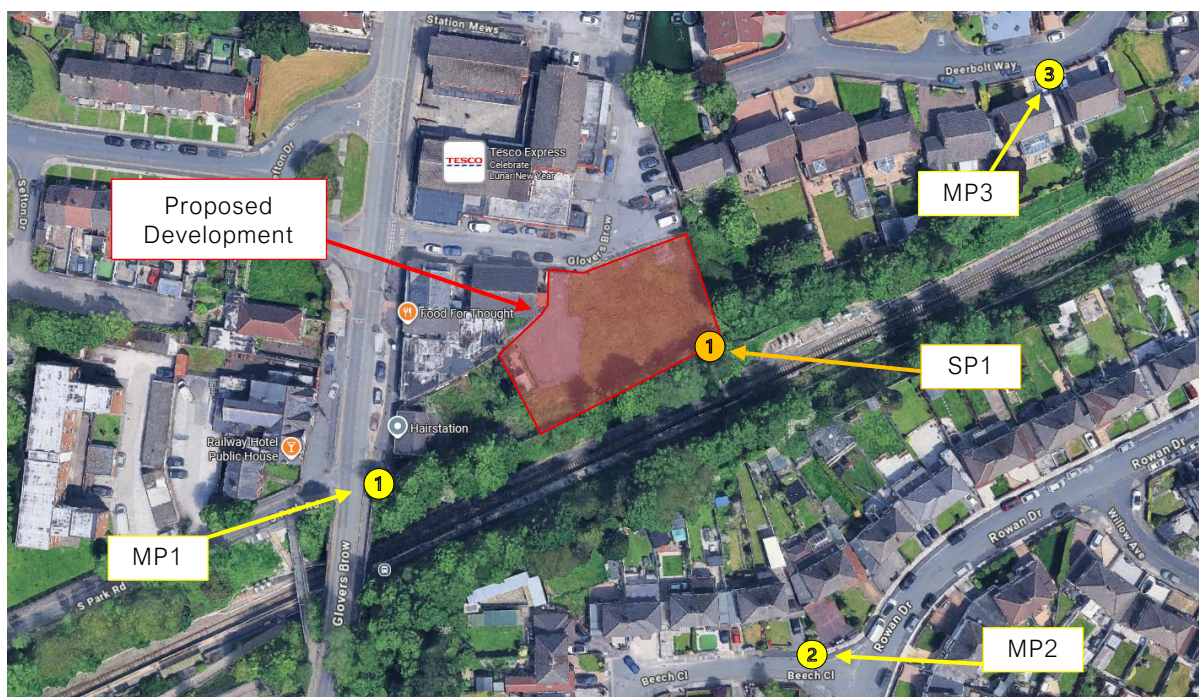
An attended and unattended environmental noise survey was undertaken at the site to determine the existing noise climate affecting the proposed development. Outlined in the following table are the measurement dates and particulars. Unattended monitoring was undertaken at MP1 – MP3. A spot measurement location was setup at SP1 to carry out attended monitoring of train pass-bys on the railway line that forms the southern boundary of the site.

All measurements were undertaken under free-field conditions. A 130mm diameter windshield was fitted to each microphone. The equipment was field calibrated before and after the survey; negligible drift was noted.

Location	Survey Dates	Measurement Particulars
MP1	30/01/2026 – 02/02/2026	Equipment mounted on a lamp post at a height of 3.5m on Glovers Brow.
MP2	30/01/2026 – 02/02/2026	Equipment mounted on a lamp post at a height of 3.5m on Beech Close.
MP3	30/01/2026 – 01/02/2026	Equipment mounted on a lamp post at a height of 3.5m on Deerbolt Way.
SP1	02/02/2026, 11:14 – 13:12 hours	Equipment mounted on a tripod at a 1.5m above ground approximately 12m away from the railway line.

Table 1 – Measurement Methodology

Outlined in the following figure are the site surroundings and measurement locations.



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Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site comprises vacant land located off Glovers Brow in Liverpool, which forms the site's northern boundary. Beyond this boundary are the rear service yards and entrances to several commercial premises, including a Tesco store, a pharmacy and a takeaway. The takeaway operates until 23:00 hours, extending to 00:00 hours on Fridays and Saturdays.

The eastern boundary adjoins the rear gardens of residential properties located off Deerbolt Way to the north-east.

To the south, the site is bounded by the Kirkby railway line, with Kirkby Station situated approximately 100m to the south-west. As a result of the station's proximity, trains decelerate and stop at Kirkby and therefore do not pass the site at high speed. A large residential estate is located on the opposite side of the railway line.

The western boundary is formed by the rear elevations of commercial units fronting Glovers Brow. These include a hair salon, betting shop, convenience store and the 'Food for Thought' takeaway. The takeaway operates until 23:00 hours, extending to 00:00 hours on Fridays and Saturdays.

On the opposite side of Glovers Brow in this direction is the Railway Hotel Public House. This operates no later than 23:00 hours on any day. According to online source it regularly showcases live sport and has live DJ's. During both attended measurements, noise breakout was inaudible against the prevailing noise climate due to road traffic. In any case, a review of noise breakout particularly to MP1 is discussed in Section 2.6.

Associated plant equipment serving the commercial premises in the area is located either at rear façade level or on rooftops and is understood to operate in accordance with the respective business opening hours.

The prevailing acoustic environment was considered to be subjectively moderate. The dominant noise source was road traffic along Glovers Brow, with additional contribution from more distant traffic on the M57 motorway, approximately 1km to the west. Railway movements also influenced the site, albeit to a lesser extent due to trains slowing to serve the station.

2.3 Environmental Noise Survey Results – Ambient and Maximum Noise Levels

Presented below is a summary of the ambient sound levels measured during the unattended noise survey. The typical maximum sound levels measured over a 1-minute sampling period are also presented. The time history results can be found in Appendix C.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, dB)							Overall (dBA)
		63	125	250	500	1k	2k	4k	
MP1	L _{eq,16hr} (Day)	66	61	61	61	64	61	58	68
	L _{eq,8hr} (Night)	59	55	55	55	58	55	60	64
	L _{Fmax,2min} (Night)	63	56	54	54	57	69	84	86

Location	Measurement Period ('T')	Octave Frequency Band (Hz, dB)							Overall (dBA)
		63	125	250	500	1k	2k	4k	
MP2	L _{eq,16hr} (Day)	56	51	50	49	51	49	45	55
	L _{eq,8hr} (Night)	50	45	43	42	42	37	46	50
	L _{Fmax,2min} (Night)	56	53	53	51	51	58	73	76
MP3	L _{eq,16hr} (Day)	55	50	47	46	48	44	46	53
	L _{eq,8hr} (Night)	49	44	42	41	42	36	43	47
	L _{Fmax,2min} (Night)	56	53	52	52	54	54	66	69

Table 2 – Sound Level Results Summary

2.4 Environmental Noise Survey Results – Background Noise Levels

Outlined below is a summary of the typical background sound levels measured during the noise survey.

Background sound levels were derived via statistical analysis of the measured L_{A90,15min} data. Background sound levels were chosen depending on the range and distribution of the recorded L_{A90,15min} sound levels. Full noise survey time histories and histograms can be found in Appendix C.

Location	Period	Typical Background Sound Level L _{A90,15min} (dB)
MP1	Day: 07:00 – 23:00	57
	Night: 23:00 – 07:00	42
MP2	Day: 07:00 – 23:00	48
	Night: 23:00 – 07:00	38
MP3	Day: 07:00 – 23:00	48
	Night: 23:00 – 07:00	38

Table 3 – Background Sound Level Results Summary

The above background sound levels will be used to inform the basis of any BS4142 assessments.

2.5 Environmental Noise Survey Results – Train Movements

Attended monitoring was undertaken at SP1 to determine noise impacting the proposed development from railway movements.

Ambient noise levels were 56dB L_{Aeq,3hr}. A review has been carried out of the sound exposure levels (SEL) from individual railways pass bys in accordance with The Department of Transport Calculation of Railway Noise (CRN, 1995).

Throughout the measurement period, 20 trains passed by the measurement position. All were passenger trains with four carriages. A review of online noise sources indicates that this correlates with a typical scenario throughout the daytime period. According to Realtime Trains®, there are approximately 10

passenger trains per every daytime hour (07:00 – 23:00) and 5 passenger trains per every night-time hour (23:00 – 07:00), although, there are no trains between 01:00 and 05:00 hours.

Considering the above, a summary of the measured ambient noise levels, the length of each train pass by, and the calculated sound exposure level, L_{Ae} , is presented in Appendix E.

An average train pass by took 16 seconds. The typical sound exposure level of each train pass by was **77dB L_{Ae}** . For reference, typical maximum noise levels at SP1 from train pass bys were no greater than **76dB L_{AFmax}** .

Please note that for reference, typical maximum noise levels

2.6 Environmental Noise Survey Results – Amplified Music Noise

The Railway Hotel Public House does have a live DJ and, therefore, amplified music. Whilst the site is located approximately 50m away from the western boundary, the potential for low frequency impact is assessed, nonetheless.

Presented in the figures below are the ambient noise levels measured at MP1 between 18:00 and 01:00 hours on Friday and Saturday nights. Only the low frequency $L_{eq,T}$ at 31.5Hz, 63Hz and 125Hz are presented. Based on NOVA Acoustics' experience, where amplified music noise is present within the noise climate, these are typically the only frequencies affected. For reference, the periods where a DJ is understood to have been playing are highlighted in red.

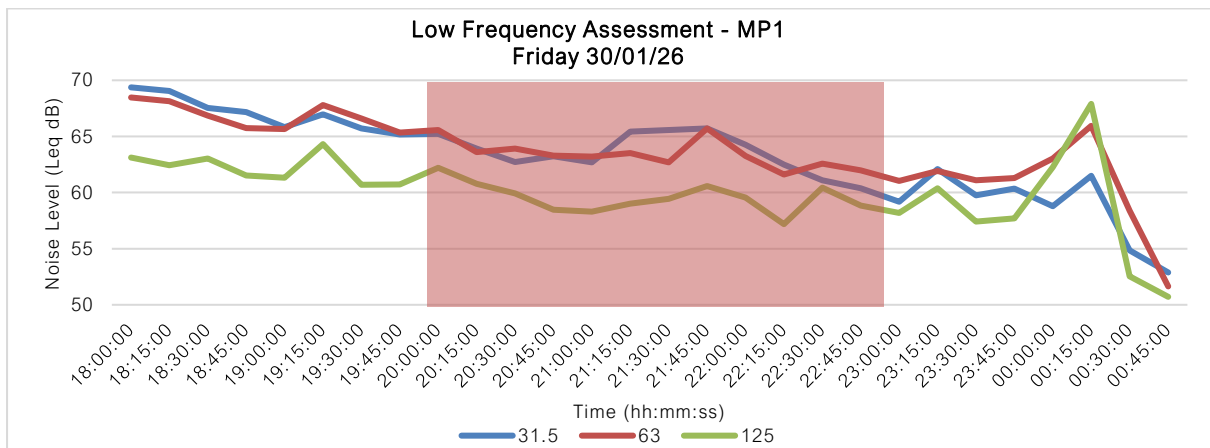


Figure 3 – Low Frequency Review – MP1 – Friday 30/01/26

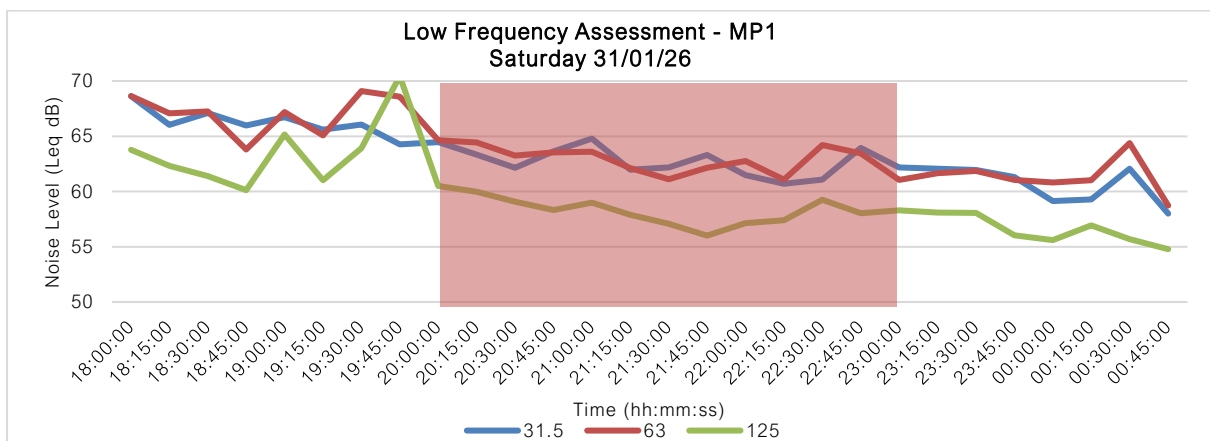
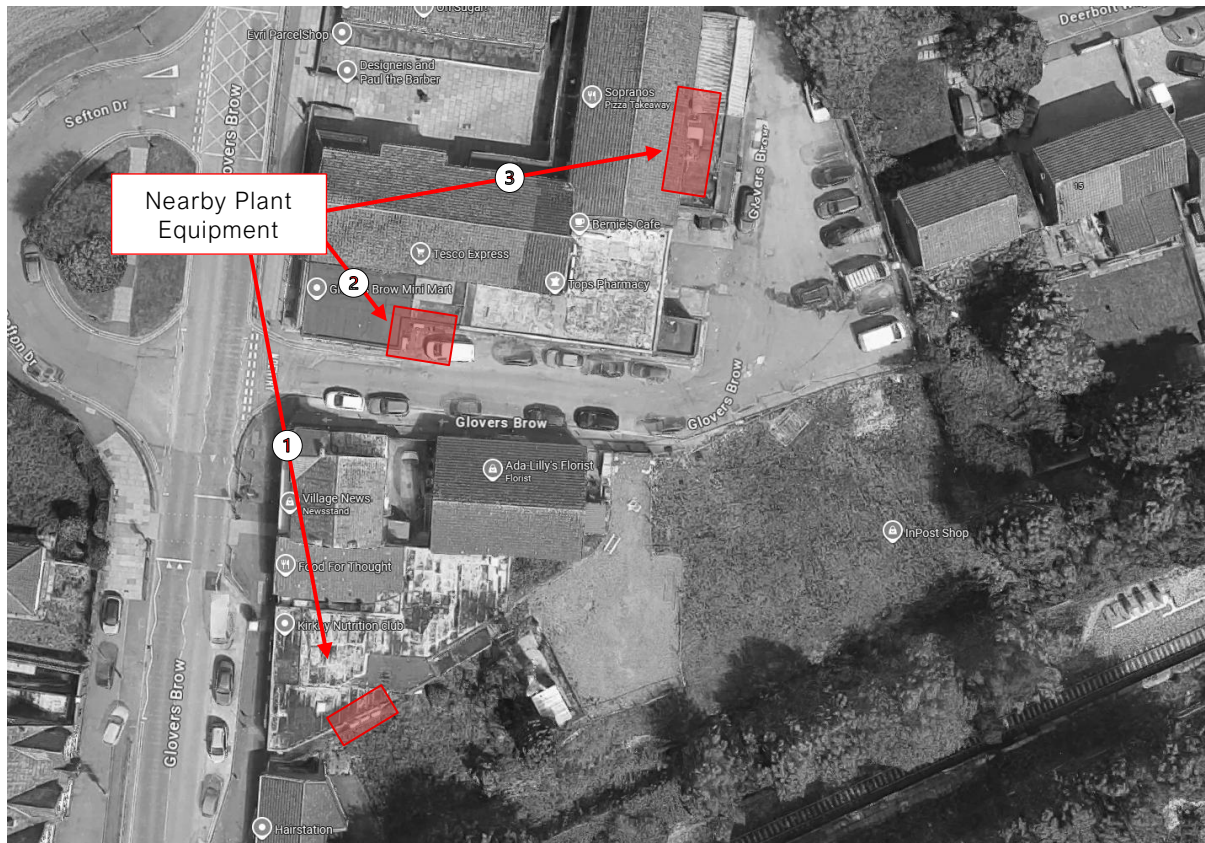


Figure 4 – Low Frequency Review – MP1 – Saturday 31/01/26

As identified, there are no increases in low frequency noise breakout during the period where it is understood that a DJ was playing. It can be concluded that low frequency noise breakout from these events is likely to be inaudible against the prevailing noise in the area which is dominated by road traffic emissions on Glovers Brow. Considering this, noise breakout from these events is not deemed a concern and has not been included in the assessment further.

2.7 Environmental Noise Survey Results – Nearby Plant

There are various nearby items of plant associated with the surrounding commercial uses. The locations of which are identified in red on the figure below.



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Figure 5 – Non-associated Plant Equipment

Considering the above, plant items 1 and 2 are condensing units. These are believed to serve the 'Food for Thought' takeaway and the Tesco Express / Glovers Brow Mini Mart. Plant equipment 3 is a ductwork extract believed to be from 'Sopranos' takeaway.

Images of the above units are shown in the figures overleaf.



Figure 6 – Plant Equipment 1



Figure 7 – Plant Equipment 2



Figure 8 – Plant Equipment 3

Details of the plant equipment are as follows:

Plant Equipment	Comprising	Distance from Proposed Development
1	3no. Condensing Units (unknown model number)	20m
2	2no. Condensing Units (J&E Hall JEHS-0300-B2-M-1)	30m
3	3no. Extract Units	40m

Table 4 – Installed Plant Equipment

Whilst on-site, only Plant Equipment 2 was in operation. Measurements were undertaken of both units in operation and ambient noise levels were circa 60dB $L_{Aeq,1min}$ at a distance of 3m. According to manufacturer data, a single unit operates at 56dB(A) at 1m. Considering that the measurements were undertaken with a Q factor of 8, this aligns with the manufacturer noise level data. Considering distance attenuation of 30m, calculations indicate that noise levels back to the proposed development would be ~28dB(A).

Due to access constraints, it was not possible to get closer to items 1 or 3 to obtain a manufacturer number, nor were they in operation during either visit. A full assessment of all plant is detailed in Section 3.2.

3. Noise Break-in Assessment and Sound Insulation Scheme

3.1 Internal Noise Level Criteria

To provide appropriate levels of internal amenity from external noise intrusion, noise break-in assessments are typically based on the limits presented in BS8233 and ProPG, which have been reproduced below.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$ / NR30	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$ / NR35	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$ / NR30	30 dB $L_{Aeq,8hr}$ / NR25 45 dB L_{AFmax} *

Notes:

[1] The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.

[2] ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".

[3] BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

[4] BS8233:2014 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.

Table 5 – Internal Acoustic Design Criteria

It should be noted though that the above is typically only based on transportation noise sources. As the site has the potential to be affected by nearby plant, where these items are anticipated to influence the acoustic climate at the development site, noise break-in should be controlled to 5dB below the criteria presented above.

3.2 Determined External Noise Levels

The determined noise levels in the area are affected primarily by road traffic, railway movements and distant plant equipment associated with the businesses in the area. The determined noise levels from these sources impacting the site in the area are discussed below.

Road Traffic Movements

As previously stated, ambient noise levels in the area are dominated by Glovers Brow to the west. At MP1, daytime and night-time ambient noise levels at this location were 68dB $L_{Aeq,16hr}$ and 64dB $L_{Aeq,8hr}$.

As the measurements were carried out at 5m from the carriageway, when considering distance attenuation back to the nearest façade of the proposed development which is 35m away, calculations indicate that ambient noise levels would reduce by 8dB (60dB $L_{Aeq,16hr}$ and 56dB $L_{Aeq,8hr}$).

Due to the buildings located in between the site and Glovers Brow, it is expected that screening attenuation would reduce these noise levels by a further 5dB. Therefore, daytime and night-time ambient noise levels are predicted to be no greater than **55dB $L_{Aeq,16hr}$** and **51dB $L_{Aeq,8hr}$** , respectively from road traffic on Glovers Brow. This will be considered within the noise break-in assessment.

Based on the same principles above, maximum noise level events would not be predicted to be any greater than **65dB L_{AFmax}** .

Railway Movements

As previously stated, the typical sound exposure level of each train pass by was 77dB L_{Ae} . Considering that 10 passenger trains within a 1-hour daytime period (07:00 – 23:00 hours) and 5 passenger trains within a 1-hour night-time period (23:00 – 07:00 hours) pass by the site, the determined overall ambient noise levels are calculated below. These have been done so in accordance with the following:

$$L_{Aeq} = L_{Ae} - 10\log(t) + 10\log(n)$$

Where:

- t = time in seconds;
- n = number of events in that time period.

Considering the above, the overall daytime and night-time ambient noise levels from train movements alone would be **52dB $L_{Aeq,16hr}$** and **49dB $L_{Aeq,8hr}$** . Given that the 3-hour ambient noise level measured at SP1 was slightly higher at 56dB $L_{Aeq,3hr}$, this would indicate that ambient noise levels from other sources e.g. road traffic, impacts the noise levels at this position. This correlates with the observations on-site.

To form a robust approach, it is proposed that the highest maximum noise level measured from any train pass by (**76dB L_{AFmax}**) is used to inform the noise break-in assessment.

Plant Equipment

As previously stated, there are three areas where existing plant equipment is located. Only plant equipment 2 was operational whilst on-site and noise levels are predicted to be 28dB(A) at the nearest façade of the proposed development.

Plant equipment 1 and 3 are located at least 30m away from the site. It is understood that these only operate during daytime hours. For plant equipment to not constructively add to the prevailing noise climate (55dB $L_{Aeq,16hr}$), these would need to be no greater than 45dB(A) at the nearest façade of the proposed development. To not exceed this, each group of plant equipment would need to operate no greater than 85dB L_{WA} . This is deemed high considering the proposed use of the plant and it is highly unlikely that any plant items would operate this high. Given this and that there are existing residential units already located in the area, it is highly unlikely that that existing plant equipment would impact the proposed development. In any case, the above will be used to inform the noise break-in assessment.

Summary

Considering the above, the determined external noise levels are highlighted in the figure below and shown in the subsequent table.

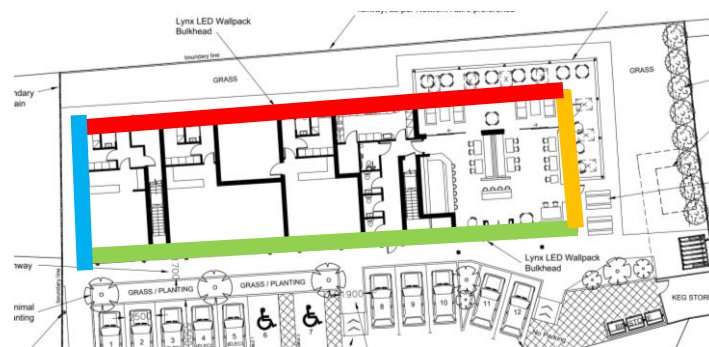


Figure 9 – Determined External Free-field Noise Levels

Elevation	Noise Source	Daytime Noise Levels (dB) (07:00 – 23:00)	Night-time Noise Levels (dB) (23:00 – 07:00)	
		Ambient ($L_{Aeq,16hr}$)	Ambient ($L_{Aeq,8hr}$)	Maximum (L_{AFmax})
Red	Road	52	48	62
	Rail	52	49	76
	Cumulative	55	52	76
Orange	Road	55	51	65
	Rail	49	46	73
	Cumulative	56	52	73
Green	Road	52	48	62
	Rail	≤45	≤40	≤65
	Cumulative	53	49	65
Blue	Road	≤45	≤40	≤55
	Rail	49	46	73
	Cumulative	50	47	73

Table 6 – Determined External Free-field Noise Levels

As the noise sources have been assessed separately, the noise breakout scheme has considered the ambient noise levels cumulatively. The highest maximum noise levels from either source has been used.

The sound levels predicted across the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve an appropriate internal acoustic environment.

3.3 Glazing and Whole Dwelling (Background) Ventilation Specification

Provided in the following table is a glazing and background ventilation specification that achieves the relevant internal noise criteria. The calculations considering the following sound insulation scheme can be found in Appendix D. Please note that there are no glazed elements on the blue façade and no bedrooms along the orange façade, so this is not considered below.

Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Red, Orange & Green Façade – Daytime Rooms E.g. Living Rooms & Night-time on Green								
6mm Glass / 16mm Air Cavity / 4mm Glass	20	21	20	26	38	37	39	32 R_W (-4 C_{tr})
Titon V25 + C25 (2no. Trickle) (D_{ne})	25	39	38	34	32	42	49	36 $D_{ne,W}$ (-2 C_{tr})
Red Façade – Night-time Rooms E.g. Bedrooms								
6mm Optiphon Glass / 16mm Argon / 6.8mm Optiphon Glass	21	21	28	37	48	48	54	40 R_W (-6 C_{tr})
Greenwoods 2500EA.AC1 (2no. Trickle) (D_{ne})	31	41	40	37	47	43	46	42 $D_{ne,W}$ (-2 C_{tr})
Notes: <i>[1] Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.</i> <i>[2] Please note that the above performance requirements for the trickle vents should be achieved with them in the 'open' position.</i>								

Table 7 – Glazing & Background Ventilation Specification

3.4 Remainder of External Envelope

In order to not downgrade the performance of the façade, the remaining elements of the external envelope, e.g., roof & external wall should be designed to achieve 10dB above the glazing sound insulation performances presented above. The full construction details should be confirmed during the design stages of the development.

4. Overheating Screening Assessment

In order to avoid excessively high temperatures and provide adequate levels of thermal comfort within dwellings, an overheating mitigation strategy must be developed. In low noise areas, this strategy can often rely upon opening windows as the primary source of ventilation, however, in areas with higher levels of noise, this would present a risk of adverse effects on health and quality of life.

4.1 Overheating Screening Assessment

The threshold levels at which adverse effects may occur are defined in Approved Document O ('ADO') and the 'Acoustics Ventilation and Overheating Design Guide' ('AVO'). Considering that a partially open window provides approximately 10 dB of attenuation in areas of moderate risk (as stated in the ADO supporting documentation), the proposed internal and external noise criteria are summarised below alongside an assessment.

Period	Proposed Criteria (dB)		External Level (dB)	
	Internal	External	Measured	Exceedance
Red and Orange Façades				
Daytime ($L_{Aeq,16hr}$)	50 [1]	60	56	-4
Night-time ($L_{Aeq,8hr}$)	40 [2]	50	52	+2
Night-time ($L_{AFmax,T}$) [3]	55 [2]	65	76	+11
Green Façade				
Daytime ($L_{Aeq,16hr}$)	50 [1]	60	53	-7
Night-time ($L_{Aeq,8hr}$)	40 [2]	50	49	-1
Night-time ($L_{AFmax,T}$) [3]	55 [2]	65	65	+0
Notes: [1] Criterion taken from the AVO guide. Above this level, it is stated: "Noise causes a material change in behaviour, e.g., having to keep windows closed most of the time." [2] Criteria taken from Approved Document O. Above this level, it is stated: "Windows are likely to be closed during sleeping hours." [3] L_{AFmax} exceeded fewer than 10 times per night.				

Table 8 – Overheating Screening Assessment

Only the noise levels incident on the red and orange facades at night exceed the external noise criteria shown in the table above. As such, an assessment of whether the development is at risk of overheating would need to be undertaken by a suitably qualified person. Should the outcome indicate the site is at low risk of overheating, then a secondary ventilation strategy may not be required. If the outcome is that the site is at moderate to high risk, then it is recommended that openable windows are not used as the primary source of ventilation.

Alternative forms of ventilation include passive systems (such as acoustic louvres) and mechanical systems (such as 'centralised mechanical extract ventilation' and 'mechanical ventilation with heat recovery'). The installation of passive systems is generally preferable; however, the precise requirements

must be confirmed with a ventilation specialist. Further to this, it must also be ensured that all ventilation strategies are compliant with the requirements of Approved Document F.

It should be noted that this assessment relates exclusively to overheating mitigation, and as such, open windows may be used for purge ventilation without acoustic constraint.

Further advice can be provided by NOVA Acoustics if required.

The noise levels determined on the red and orange façades during the day and during all periods on the green façade, are below the threshold criteria. Given this, it is thought that opening windows can be used as the primary means of mitigating overheating. However, it must also be ensured that all ventilation is compliant with the requirements of Approved Document F.

5. Internal Mechanical Plant Design

5.1 Mechanical Ventilation Regenerated Noise Considerations

Please note that where a mechanical ventilation system is to be installed, consideration will need to be made to ensuring that regenerated noise within the apartments from these systems, is appropriately controlled.

ADF and AVO provide desirable internal ambient noise levels that should be met during periods where these systems are in use for the provision of background ventilation; these figures are presented below. Criteria during periods when the system is to be used for periods of overheating are also provided.

Ventilation Condition	Desirable Internal Ambient Noise Levels for Mechanical Services (dB L _{Aeq,T})		
	Bedrooms	Living / Dining Rooms	Bathroom / WC / Kitchen
ADF – Whole Dwelling (Background) Ventilation	≤ 26 or 30 ^[1]	≤ 30	--
ADF – Extract Ventilation	≤ 26 or 30 ^[1]	≤ 35	≤ 45
ADF – Purge Ventilation	-- ^[2]		
AVO – Overheating Provision	≤ 30 ^[3]	≤ 35	--

Notes:

[1] AVO states that a figure of 26dB(A) may be more appropriate 'to prevent an adverse reaction from most occupants while falling asleep'.

[2] AVO states that 'no desirable noise levels are currently proposed based on the lack of evidence of acceptable noise levels when providing purge ventilation for the purpose of rapidly diluting indoor pollutants'.

[3] Section 1.10.10 of CIBSE Guide A 2015 states that a range of +/- 5 dB may be acceptable depending on the situation.

Table 9 – Internal Noise Level Design Criteria

Based on the above, the mechanical ventilation system should be designed to no greater than 30dB L_{Aeq,T} (NR25) in bedrooms at night and 35dB L_{Aeq,T} (NR30) in living rooms during the daytime. However, should there be any terminal units located in rooms, a 5dB relaxation may be acceptable as the occupant will have control over these units and the noise would be broadband and steady state (considered less acoustically characterful).

In line attenuators may be required to the room supply and extract branches of the system. This will require final confirmation. In addition, the heat recovery units should only be fixed to the soffit of the slab.

Based on the above and as a general design guide, the following maximum duct velocities for conventional low velocity systems should not be exceeded. The below information has been taken from Table 2.16 of CIBSE Guide B2 'Ventilation and ductwork: 2016'.

Noise Level (dBA)	Duct Velocity (m/s)		
	Main Duct	Branch Duct	Final Runout
30 (NR25)	3.0	2.5	<2.0
35 (NR30)	5.0	4.5	2.5
45 (NR40)	7.5	6.0	3.5

Table 10 – Indicative Maximum Duct Velocities

6. Noise Breakthrough / Breakout Assessment

Based on the latest site plans, the proposed apartments on the first floor will share a separating floor with the following spaces:

- Ground Floor Commercial Unit (x3)
- Ground Floor Bar / Restaurant
- Ancillary Areas (not confirmed but likely to include:)
 - o Refuse stores
 - o Plantrooms
 - o Lobbies

To ensure residential amenity is protected, both noise breakthrough and breakout has been assessed indicatively.

6.1 Ground Floor Unit – Noise Breakthrough

Based on NOVA Acoustics' experience, it would be appropriate to ensure that maximum noise levels from the commercial units and the bar / restaurant are controlled to no greater than NR30 during the daytime and NR25 at night in the rooms above. At this level, whilst noise may be audible, it is unlikely to be deemed intrusive.

Additionally, maximum noise level events within the apartments above should be controlled to not exceed 47dB and 41dB in the 63Hz and 125Hz frequency bands, respectively.

Where amplified music is to be installed, it is likely that this system will need to be installed in conjunction with a noise limiting device. An example system capable of controlling specific frequencies is the 'MRC Audio EQ Limit' from 'StageGear' (other products may also suffice).

A typical separating floor construction for a building this size would be as follows:

- 200mm composite concrete deck (min. density 2100kg/m³)
- 250mm suspended light steel grid ceiling
- 2no. 15mm Gyproc SoundBloc (each min. 12.6kg/m²)

This construction would allow for noise levels within the areas to be as high as the spectrum shown in Table 11, below. At this level, noise transfer would be controlled and would not exceed the suggested criteria.

The maximum amplified music limit levels presented in the following should be set as a baseline, and during the calibration of the equipment, they must be adjusted to achieve relative inaudibility within/at the closest NSRs. Furthermore, the below should be included within any tenancy agreement to ensure that the end occupier does not exceed these levels.

Description	Octave Frequency Band (Hz, L _{Fmax} dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Maximum Amplified Music Limit Levels	85	85	85	85	85	83	80	90

Table 11 – Maximum Amplified Background Music Limit Levels – Breakthrough

The above would facilitate the use of a café / restaurant or retail store with low level background music. If a loud bar or gym operator were to occupy this unit, an enhanced floor construction may be required, and NOVA Acoustics should be notified. This will be detailed further during the design stages of the development once full constructions are confirmed.

6.2 Ground Floor Unit – Noise Breakout

Noise breakout via the external envelope should also be appropriately controlled. It is proposed that if amplified music is to be used in any of the ground floor units, maximum noise level breakout should be controlled to not exceed the typical background sound level in each octave band, at the nearest receptor. The full spectrum of the typical background sound level for this assessment is based on those measured the typical background at MP2 and MP3 which represents a 'worst-case' scenario. These are presented below for the full daytime and the more sensitive evening period (20:00 – 23:00 hours).

Description	Octave Frequency Band (Hz, dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Daytime Background Sound Level ($L_{90,T}$)	48	46	45	44	45	37	27	48
Evening Background Sound Level ($L_{90,T}$)	42	41	41	40	42	33	20	44

Table 12 – Typical Background Sound Level Spectrums

Based on the layout of the site, only the bar / restaurant will have open areas via rear doors that open out onto the outdoor seating. This will therefore be the worst-case area for assessing noise breakout from the site.

Considering the above, noise breakout from the restaurant / bar is presented below. At this stage, the determined noise level within the unit has been based on the noise limit levels from Table 11.

The latest floorplans indicate that the rear doors are approximately 7.4m² in size when open. This has been used in the assessment. An R_w of 0dB will be used to inform the calculations.

At this stage, only an evening assessment has been carried out. This would assume that the doors cannot be opened after 23:00 hours and this would need to be maintained within a noise management plan.

Description	Octave Frequency Band (Hz, dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Max Amplified Music Limit Levels (L_{Fmax})	85	85	85	85	85	83	80	90
Lw of Open Door	89	89	89	89	89	87	84	94
Total Attenuation	(x=1, y=1, d=45)							-38
Resultant Noise Level	51	51	51	51	51	49	46	56
Evening Background Sound Level ($L_{90,T}$)	42	41	41	40	42	33	20	44
Exceedances	+9	+10	+10	+11	+9	+16	+26	+12

Table 13 – Indicative Noise Breakout Assessment

As identified above, during periods when the doors are left opened for sustained periods, there would be exceedances in all octave bands. To mitigate this, a reduced limit level from that presented in Table 11 would be required; these are shown below.

Description	Octave Frequency Band (Hz, L _{Fmax} dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Amplified Music Limit Levels – Door Closed	85	85	85	85	85	83	80	90
Amplified Music Limit Levels – Door Open	76	75	75	74	76	67	54	78

Table 14 – Maximum Amplified Background Music Limit Levels – Breakout

The above would need to be maintained by a noise limiting device. Once the doors are closed, the noise levels from any amplified system could be increased back to the higher levels. Where there is a desire to have the doors open into the night-time (23:00 – 07:00 hours), the limit would need to be reduced further, and NOVA Acoustics should be notified.

If there is a requirement for internal noise limits to be higher, NOVA Acoustic should be made aware for review. It should also be acknowledged that lobbied door systems may be required in such circumstances.

In terms of the front entrance to all units, it is assumed noise breakout would be kept to a minimum, provided entrance doors are not left opened for sustained periods. Where this is a concern, this could occur, lobbied entrance doors should be installed, and it should be ensured that door orientation does not allow for both door sets to remain open simultaneously.

6.3 Refuse Stores, Plantrooms & Lobbies

Based on NOVA Acoustics' experience, from refuse stores, it would be appropriate to ensure that maximum noise level events are controlled to not exceed NR25 max in any apartments directly above.

For plant rooms, it would be appropriate to ensure that ambient noise levels within these areas are controlled to no greater than NR15 – 20 in the rooms above assuming continuous broadband noise.

Provided that the same composite deck floor construction was installed, as per Section 6.1, with the same suspended ceiling system finished with 2no. 15mm Gyproc SoundBloc Board, this would appropriately control noise from an adjacent plantroom that does not exceed ambient noise levels of 77dB(A), or ~NR75. This would be appropriate for most plantrooms.

Within refuse stores, maximum noise levels events from glass bottle drops are likely to be the dominant noise source. Provided these do not exceed 87dB L_{AFmax}, there should be no exceedance of the NR25 max criterion. These can reach 95dB L_{AFmax} and, therefore, provided the suspended ceiling is the same as in the plant room, however, 100mm mineral wool is installed within the cavity, the requirements would be met.

7. Patron Noise Breakout

In the following section of the report, the potential impact arising from the noise emissions of external patrons is assessed.

7.1 Adopted Criteria

There are no standards or guidance that are specifically designed for the assessment of noise from an external patron area. However, considering the context of the area and to ensure significant adverse impact is avoided, it is proposed that the most stringent of the following criteria is used in the assessment:

- Noise from patrons should not exceed the background noise level by more than **5dB**. The background sound level recorded during the more **sensitive opening hours** (20:00 – 23:00) was **~44dB L_{A90,15min}**.
- The cumulative ambient noise level should not increase by more than **3dB**. This is line with an IEMA 'Increase in Ambient Noise Level Assessment'. This would result in the level of impact being considered as 'Not Significant'. Over the more **sensitive opening hours** (20:00 – 23:00) the lowest measured ambient sound level was circa **43dB L_{Aeq,1hr}**; specific patron noise emissions should not exceed this.

7.2 External Patron Noise Calculations

Calculations have been carried out below, assuming the following:

- As per the drawings and available space, it is anticipated that there would be 12 patrons outside in the seating area at maximum occupancy. The calculations account for 50% of people talking at once, 4 talking with a 'normal' voice and 2 with a 'raised' voice.
- The source noise levels are taken from ANSI S3.5-1997 (R2017) from the 250Hz to 4kHz octave frequency bands.
- No acoustic shielding is included in the calculations.
- The calculations are considered to the receptors Beech Close which are approximately 45m away.
- It is assumed that the seating area would not be open past 23:00 hours. Where this is not case, the below assessment would need to be revised.

The calculations are shown in the table overleaf.

Description	Octave Frequency Band (Hz, dB)					Overall (dBA)
	250	500	1k	2k	4k	
1 No. Normal Voice Noise Level (L_w)	65	69	63	56	50	68
4 No. Normal Voices Noise Level (L_w)	71	75	69	62	56	74
Distance Correction to NSR (45m, Q4)	-38					--
Patron Noise Level at NSR (L_{eq})	33	37	31	24	18	36
1 No. Raised Voice Noise Level (L_w)	70	75	72	64	57	76
2 No. Raised Voices Noise Level (L_w)	73	78	75	67	60	79
Distance Correction to NSR (45m, Q4)	-38					--
Patron Noise Level at NSR (L_{eq})	35	40	37	29	22	41
Cumulative Patron Noise Level at NSR (L_{eq})	37	42	38	30	23	42
Most Onerous External Noise Criterion						43
Exceedance						-1

Table 15 – External Patron Noise Level Calculations & Assessment

As can be seen in the assessment above, for all periods, the noise emissions from the external patron area are predicted to be 'Not Significant'.

When compared against the background noise level of 44dB $L_{A90,T}$, there would also be no exceedance. For reference there would also be no +5dB exceedance of the night-time background sound level (38dB $L_{A90,T}$). Based on the above, the requirements are deemed to have been met and that 'adverse effects' are unlikely provided a robust noise management plan is implemented and maintained throughout the lifetime of the development. Any noise management plan would likely be a requirement of the end commercial tenants.

8. BS4142 Noise Impact Assessment

8.1 BS4142 Fixed Plant Noise Limit Levels

The proposed plant equipment specification has not yet been finalised. Consequently, plant noise limit levels have been defined to ensure that the noise emissions do not exceed 5dB below the background sound levels at the closest NSRs. Based on the layout of the site, these would be the properties located to the northeast off Deerbolt Way and to the south off Beech Close. Based on the noise levels measured at MP2 and MP3, the background noise climate is identical at both locations.

The limit levels are inclusive of any rating penalties that should be applied to account for audible characteristics of the noise which could be deemed to cause increased annoyance, such as intermittency, impulsivity, or tonality. The limit levels have been calculated for the daytime and night-time periods, depending on when the plant will be operational.

The calculated plant noise limit levels are shown in the table below.

Description	Daytime Period (dBA)	Night-time Period (dBA)
Background Sound Level ($L_{90,15min}$)	48	38
Cumulative Plant Noise Limit Level at NSR ($L_{r,Tr}$)	43	33
BS4142 Assessment Outcome	'Low Impact'	
NPSE & NPPF Assessment Outcome	'No Observed Adverse Effect Level' ('NOAEL')	

Table 16 – BS4142 External Plant Noise Limit Levels

As can be seen in the assessment above, provided the plant limit levels are adhered to, all noise emissions from the external plant units would be controlled to not exceed 5dB below the existing background sound levels. When assessed in accordance with BS4142 this indicates 'low impact', and when assessed with the NPPF and NPSE this is classed as 'No Observed Adverse Effect Level' ('NOAEL').

Once the plant units are specified the noise emissions should be calculated by an appropriately qualified person to ensure that the limit levels are achieved.

9. Noise Management Plan

An example Noise Management Plan ('NMP') is provided below, outlining methods by which the commercial units and restaurant / bar will systematically assess and minimise the potential impacts of noise generated by the site. The NMP is a working document with the specific aim to ensure that:

- Noise impact is considered as part of routine inspections,
- Noise is primarily controlled at source by good operational practices, including physical and management control measures,
- All appropriate measures are taken to prevent or, where that is not reasonably practical, to reduce noise emissions from the venue.

9.1 Hours of Operation

- It is expected that the commercial units and restaurant / bar will only operate during daytime hours (07:00 – 23:00 hours).

9.2 Internal Background Music

- The background music level will have to be played to a level to create ambience while ensuring that the customers do not need to raise their voices.
 - o In terms of the restaurant bar, the limiting device for any amplified music should be set to the following:
 - Noise limits presented in Table 14 when the rear doors are closed and open.
- For all other doors, these should remain closed at all times. All heating and cooling will be provided by air-conditioning systems so there will be no requirement for the ventilation systems to penetrate the façade and compromise the sound insulation of the buildings.
- Any external door sets will provide a minimum sound reduction of 40dB R_w and lobbied door systems shall be installed where any external door sets open into a space where amplified music is to be played.

9.3 External Patron Noise

- Patrons shall not be allowed to congregate outside the premises other than the proposed outdoor area.
- Patrons using the external areas will be made aware that the venue has residential neighbours and that shouting and raised voices are unacceptable. If patrons frequently violate this, they will be asked to move inside the venue.
- A maximum of 12no. patrons must be ensured on the new external area.
- Staff should actively encourage the gradual dispersal of customers to minimise the nuisance at closing time.

9.4 Continuous Subjective Noise Monitoring

- All staff will, as part of their induction, be made aware of the surrounding NSRs and the effects of noise on residential amenity. It is the responsibility of all staff to be aware of noise on site and to report any potential noise issues to the premises manager at the earliest opportunity.
- All staff will have refresher training on noise issues, prevention and managements at six-monthly intervals.

9.5 Noise Complaint Investigation

An Issue Management System ('IMS') will be implemented and completed by the venue manager. This will include records of subjective noise monitoring and complaints. Further to this, a complaints procedure will be implemented. This procedure will allow for all complaints, feedback and requests made by third parties regarding the premises operational activities. An example complaints logging form is included in Appendix A.

A phone number for the premises will be made available online to allow any member of the public to lodge a complaint without entering the premises. The premises manager will be specifically assigned to deal with complaints.

All complaints received from third parties including statutory authorities, statutory consultees, members of the general public and representatives of the company will be forward to the premises manager to action as below within 1-hour (where feasible). The complaint will be logged in the complaints log within 24-hours.

The operations manager will ensure that:

- The complaint is investigated to identify the cause, if necessary, this may involve direct communication with the complainant.
- In the event of elevated noise being detected, action will be taken immediately to prevent a recurrence of the same problem. These actions must be documented.
- The complainant will be contacted and given information on the investigations conducted and actions taken as appropriate.
- Details of other complaints are sent to other company personnel as appropriate.
- If the investigation indicates that the complaint has not been justified this will be clearly recorded on the incident report.
- All complaints will be logged.

The NMP will be reviewed annually or as agreed appropriate to ensure it is streamlined and effective. New and innovative approaches to problem-solving or incidents and any lessons learnt will be incorporated accordingly.

This is considered to be a 'live document' which evolves by experience in agreement with the Local Authority.

A subjective monitoring guide is shown below:

Premises: _____ Event: _____

Date: _____ Event start time: ____:____ Event End time: ____:____

Pre-start checklist:

- Windows & doors closed: Y/N
- Sound check and volume set: Y/N
- Agree who will complete objective noise monitoring & when: Y/N
- Check sound limiter is fully operational: Y/N
- Set end-time with performer(s): Y/N
- Complete monitoring form: Y/N

Subjective Noise Monitoring Guide			
Assessment		Description	Guide / Action
A	Not audible at NSRs.	No Entertainment Sound audible.	Okay
B	Just audible at NSRs.	Muffled sound, vocals/music not clear, easily masked by other ambient noise in area.	Okay, but adjust noise level to A.
C	Clearly audible at NSRs.	Clear vocals/music and likely to be heard by neighbours.	Reduce to B immediately, and aim to reduce to A.
D	Loud at NSRs.	Vocals/music are dominant and would be clearly heard by neighbours.	Not acceptable.

Figure 10 – Subjective Noise Monitoring Record

10. Ground-Borne Vibration Screening Assessment

Due to the proximity of the railway line, it is possible that the site may be affected by ground borne vibration. For this reason, vibration measurements have been undertaken at the nearest proposed façade to the railway line.

10.1 Ground-Borne Vibration Criteria

BS6472-1:2008 provides criteria for assessing ground-borne vibration in the form of the “likelihood of adverse comment” that might result from given Vibration Dose Values (‘VDV’) within buildings. The following table outlines the criteria presented within BS6472-1:2008.

Description	VDV $\text{mm.s}^{-1.75}$		
	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential 16-hour Day	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential 8-hour Night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Table 17 – BS6472-1:2008 Ground-Borne Vibration Criteria Inside Dwellings

The guidance above relates to vibration measured at a point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper-storey floor, rather than the point of entry into the building, a foundation element for example.

Where the vibration is measured at another location, BS6472-1:2008 states that a transfer function should be applied; however, no further guidance is provided in BS6472-1:2008. It does however reference other publications that contain transfer functions. It is necessary to estimate the effect that any building will have on the magnitude of vibration at the point of entry to the human body.

Two key aspects in terms of building structure effect the measured vibration levels:

- Generally, a reduction occurs as the vibration passes into the foundations of a building.
- Typically, amplification occurs as the vibration propagates up the building to the upper storeys and across the potentially suspended floors.

10.2 Ground-Borne Vibration Measured Results

VDV measurements were undertaken using a Vibrock V9000 vibration monitor.

The highest calculated day and night-time vibration dose values are detailed in the table below. The calculation method is taken from Example 1 in Appendix B of BS6472-1:2008.

Location	Description	Calculated VDV mm.s ^{-1.75}		
		X Axis (W _d)	Y Axis (W _d)	Z Axis (W _b)
Ground Level	16-hour Day	< 0.003	< 0.003	< 0.017
	8-hour Night	< 0.002	< 0.002	< 0.014

Table 18 – Summary of Calculated VDV Levels

Based on the above, the calculated vibration dose values across daytime and night-time would remain below the 'low probability of adverse comment' criteria considering an onerous amplification factor of 4 to the first floor of the development site.

11. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in **section 3**.
2. An overheating assessment is presented in **section 4**.
 - a. In summary, an alternative means of ventilation must be provided for the provision of overheating during the night-time on the red and orange facades. This is dependent on the development being at risk of overheating which would need to be confirmed by others. This is typically assessed via completion of a TM59 overheating assessment.
 - b. On all other facades and during the daytime on the red and orange facades, the external noise levels are low enough such that openable windows can be utilised as the ventilation strategy during periods of overheating.
3. General design advice and criteria is provided for any mechanical ventilation systems. This is provided in **section 5**.
4. The separating floor between the structurally adjoining ground floor commercial units and restaurant / bar should be designed to achieve the required sound insulation. An indicative specification has been provided in **section 6**. Further design assistance can be provided by NOVA Acoustics if required.
5. A patron noise breakout assessment has been presented in **Section 7**. In summary, the predicted noise breakout is not expected to adversely impact nearby noise sensitive receptors.
6. A noise level limit has been set for any potential fixed mechanical plant at the site. Where plant is proposed, a full assessment would need to be carried out. This is detailed in **section 8**.
7. An indicative noise management plan has been presented for the ground floor commercial uses and restaurant / bar. This is shown in **Section 9**.
8. An assessment of ground borne vibration impacting the proposed development is shown in **Section 10**.

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

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Background Sound	Underlying level of sound over a period, T , which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T , has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for $N\%$ of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10 \log_{10} (p/p_0)^2$. Where: p is the root-mean-square sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

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

B.1 – National Planning Policy Framework (2024)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), updated in 2024. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 187e, it states:

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

Paragraph 198 states:

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

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

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

Paragraph 198 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

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

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

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

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

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

SOAEL – Significant Observed Adverse Effect Level

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

LOAEL – Lowest Observed Adverse Effect Level

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

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: *“where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.”*

This is further expanded using the updated “Noise Exposure Hierarchy Table” which includes an additional level of impact referred to as the ‘No Observed Adverse Effect Level’ (‘NOAEL’). It is stated that at this level: *“noise can be heard, but does not cause any change in behaviour, attitude or other physiological response”*. In addition, noise at this level *“can slightly affect the acoustic character of the area but not such that there is a change in the quality of life”*.

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

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

B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

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

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{AFmax}^*

Table 19 – BS8233:2014 Internal Ambient Noise Level Criteria

**ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB L_{AFmax} more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

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

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

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

B.4 – Approved Document O: Overheating (2021)

Approved Document O states the following in relation to noise:

1. In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).
2. Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.
 - a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
 - b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).
3. Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.

NOTE: Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).B.6 - Acoustics Ventilation and Overheating – Residential Design Guide 2020

B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's' ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

Risk category for Level 1 assessment ^[Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 assessment
LAeq,T ^[Note 3] during 07:00 - 23:00 LAeq,8hr during 23:00 - 07:00 High 65 dB 55 dB Medium 60 dB 50 dB Low 55 dB 50 dB Negligible 50 dB 45 dB	Increasing risk of adverse effect	Recommended Optional
	Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Not required

Table 3-2 of AVO Guide (2020)

Figure 11 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Risk Category	Mitigation
≥ 63 dB $L_{Aeq,16hr}$	≥ 55 dB $L_{Aeq,8hr}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hr}$	52 – 54 dB $L_{Aeq,8hr}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hr}$	49 – 51 dB $L_{Aeq,8hr}$	Low Risk	
≤ 53 dB $L_{Aeq,16hr}$	≤ 48 dB $L_{Aeq,8hr}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 20 – AVO Guide (2020) Level 1 Risk Assessment

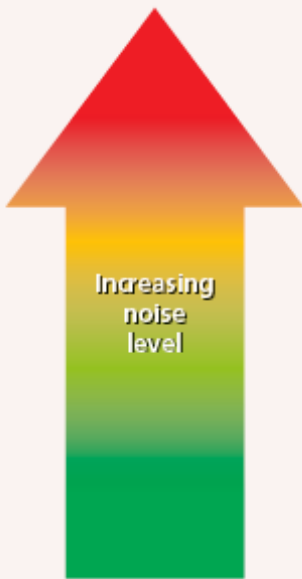
Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are >50 dB $L_{Aeq,16hr}$ (day) or >42 dB $L_{Aeq,8hr}$ (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

Internal ambient noise level [Note 2]			Examples of Outcomes [Note 5]	
$L_{Aeq,T}$ [Note 3] during 07:00 – 23:00 [Note 6]	$L_{Aeq,sh}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 [Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{A, Fmax}$	Noise causes a material change in behaviour e.g. having to keep windows closed most of the time	Avoiding certain activities during periods of intrusion. 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 change in acoustic character of the area.
			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods. As noise levels increase, small behaviour changes are expected e.g. turning up the volume on the television; speaking a little more loudly; having to close windows for certain activities, for example ones which require a high level of concentration. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in quality of life. At lower noise levels, limited behavioural change is expected unless conditions are prevalent for most of the time. [Note 8]
≤ 35 dB	≤ 30 dB	Do not normally exceed $L_{A, Fmax}$ 45 dB more than 10 times a night	Noise can be heard, but does not cause any change in behaviour	Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response [Note 9]. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.

Note 1 The noise levels suggested in Tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

Table 3-3 of AVO Guide (2020)

Figure 12 – AVO Guide Level 2 Internal Ambient Noise Levels

B.6 – BS4142:2014+A1:2019 – ‘Methods for rating and assessing industrial and commercial sound’

Overview

BS4142 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{A,r,T}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

Rating Penalty

Section 9 of BS4142 describes how the rating sound level should be derived from the specific sound level, by deriving a rating penalty.

BS4142 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

- a) subjective method;*
- b) objective method for tonality;*
- c) reference method."*

Due to the nature of the development the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed. Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

a) Tonality

A rating penalty of +2dB is applicable for a tone which is "just perceptible", +4dB where a tone is "clearly perceptible", and +6dB where a tone is "highly perceptible".

b) Impulsivity

A rating penalty of +3dB is applicable for impulsivity which is "just perceptible", +6dB where it is "clearly perceptible", and +9dB where it is "highly perceptible".

c) Other Sound Characteristics

BS4142 states that where *"the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3dB can be applied."*

d) *Intermittency*

BS4142 states that when the *“specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time ... if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3dB can be applied.”*

Background Sound Level

The background sound level is the underlying level of sound over a period, T, and is indicative of the relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds.

To ensure the background sound level values used within the assessment are reliable and suitably represent both the particular circumstance and periods of interest, efforts have been made to quantify a ‘typical’ background sound level for a given period. The purpose has not been to simply select the lowest measured value. Diurnal patterns have also been considered as they can have a major influence on background sound levels, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes.

Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound.

Assessment of Impact

BS4142 states: *“The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs”*. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *“Typically, the greater this difference, the greater the magnitude of the impact.”*
- *“A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.”*
- *“A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.”*
- *“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.”*

Interpreting the guidance given in BS4142, with consideration of the guidance given in the NPSE and NPPG Noise, an estimation of the impact of the rating sound is summarised in the following text:

- A rating sound level that is +10dB above the background sound level is likely to be an indication of a ‘Significant Observed Adverse Effect Level’;

- A rating sound level that is +5dB above the background sound level is likely to be an indication of a 'Lowest Observed Adverse Effect Level';
- The lower the rating sound 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 sound level does not exceed the background sound level, this is an indication of the specific sound source having a low impact and would therefore classify as 'No Observed Adverse Effect Level';
- At levels significantly below the measured background sound level (i.e. greater than 10dB), this is an indication of a 'No Adverse Effect Level'.

During the daytime, the assessment is carried out over a reference time period of 1-hour. The periods associated with day or night, for the purposes of the Standard, are 07.00 to 23.00 and 23.00 to 07.00, respectively.

Appendix C – Environmental Survey

C.1 – Time History Noise Data

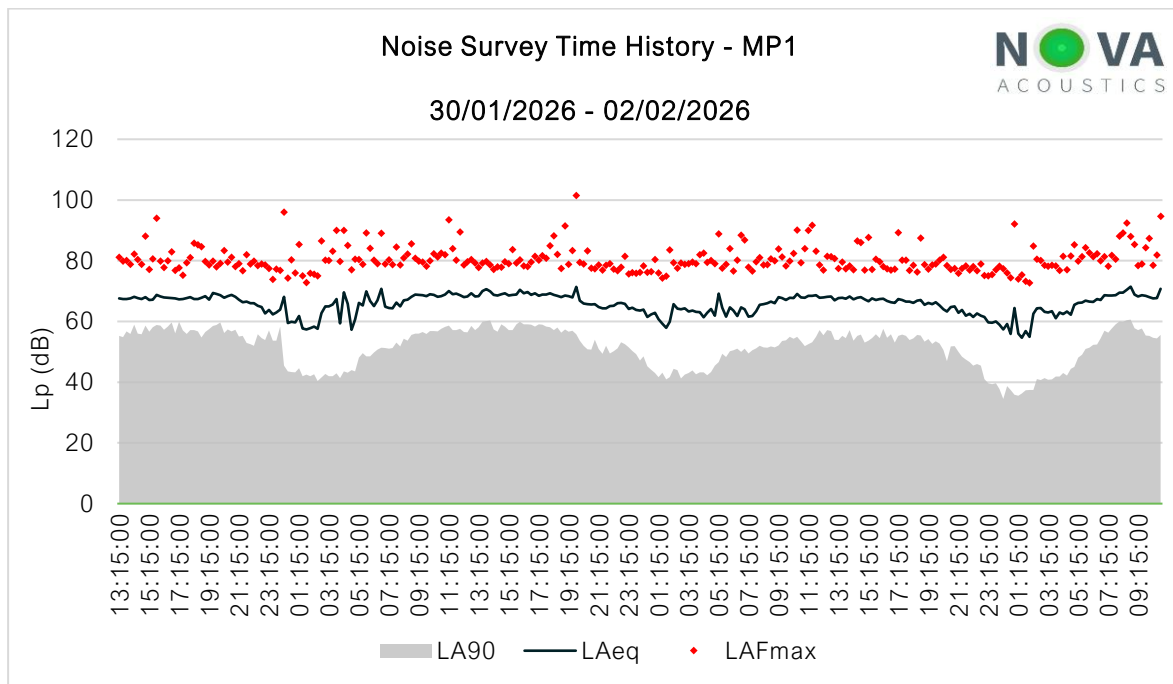


Figure 13 – MP1 Noise Survey Time History

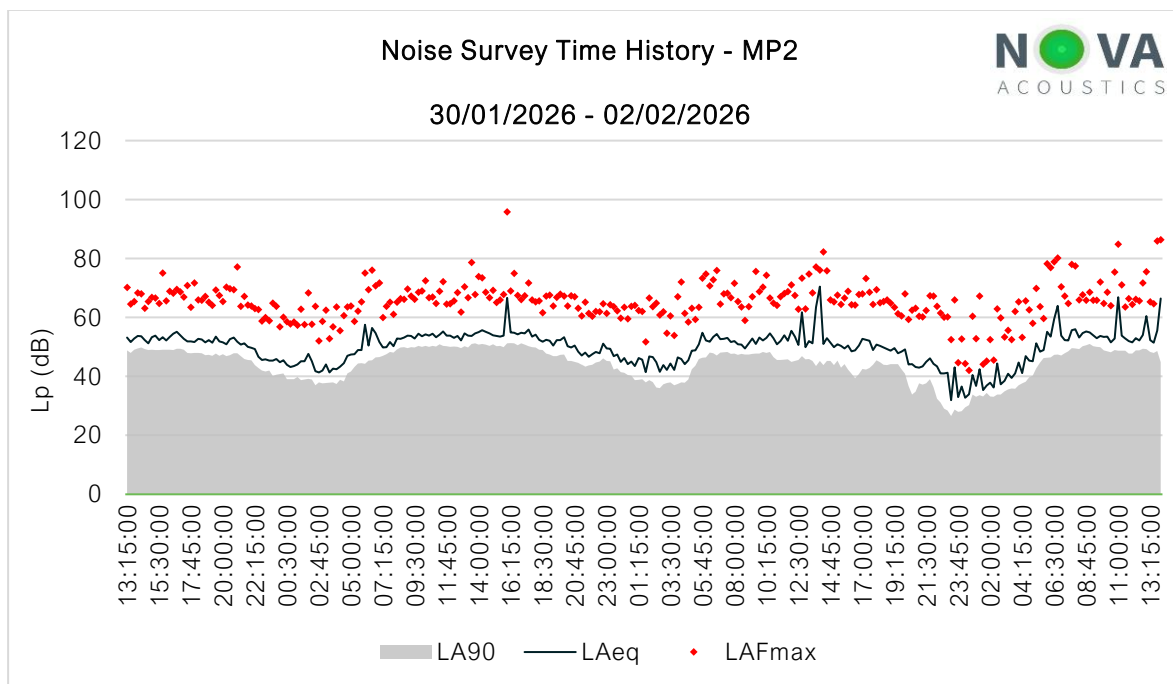


Figure 14 – MP2 Noise Survey Time History

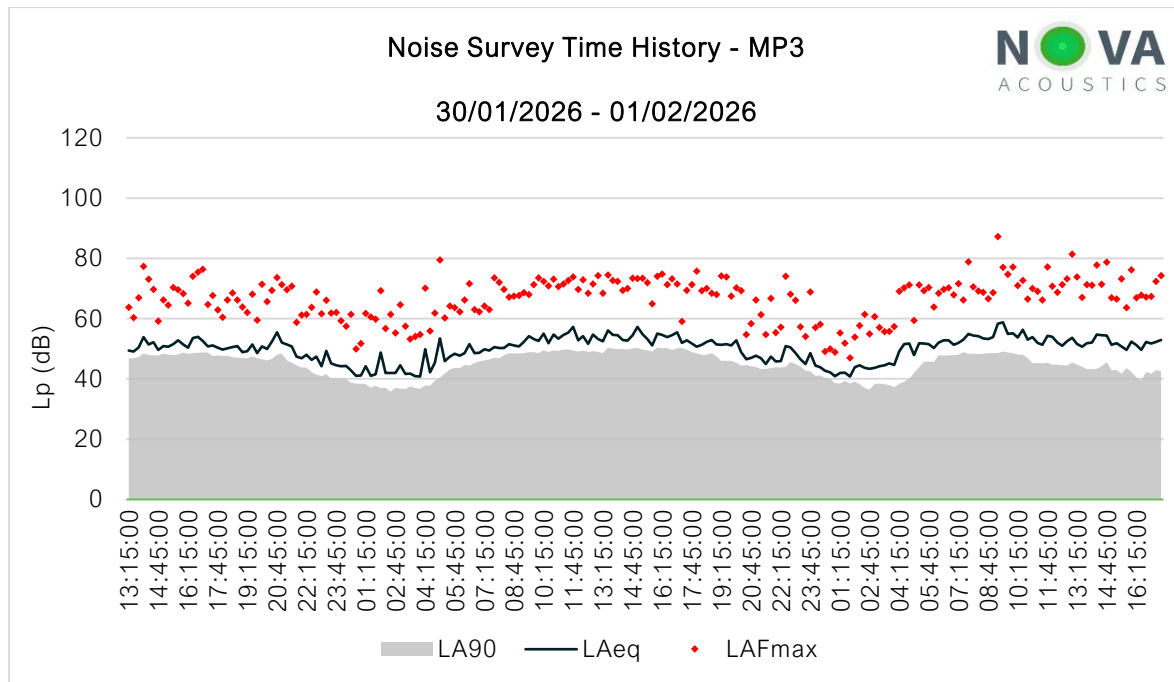


Figure 15 – MP3 Noise Survey Time History

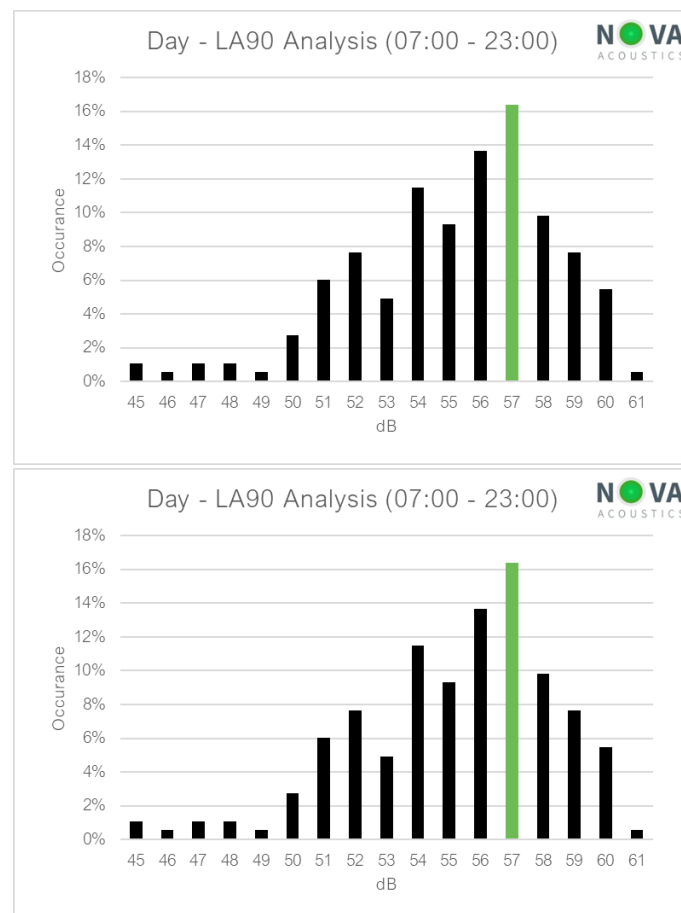


Figure 16 – MP1 Noise Survey Background Noise Level Histogram

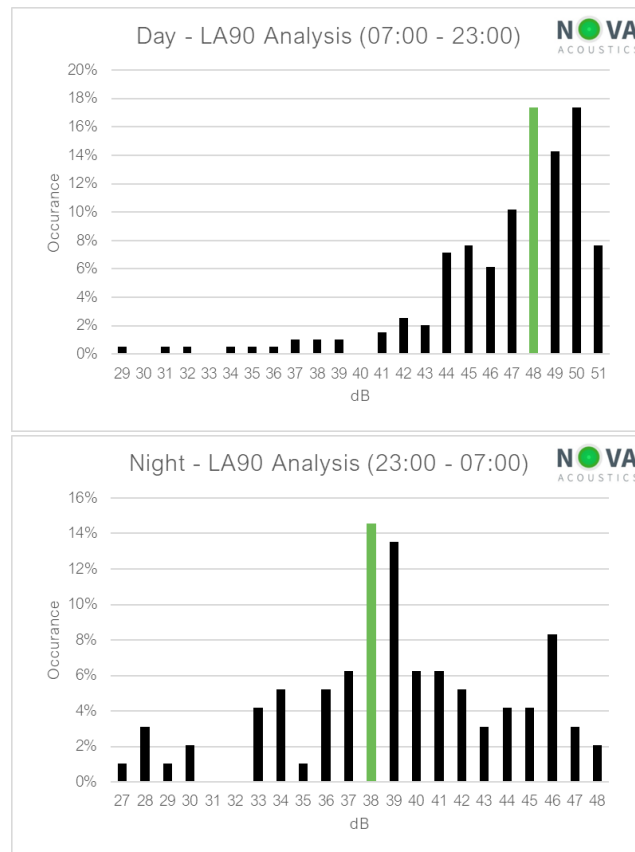


Figure 17 – MP2 Noise Survey Background Noise Level Histogram

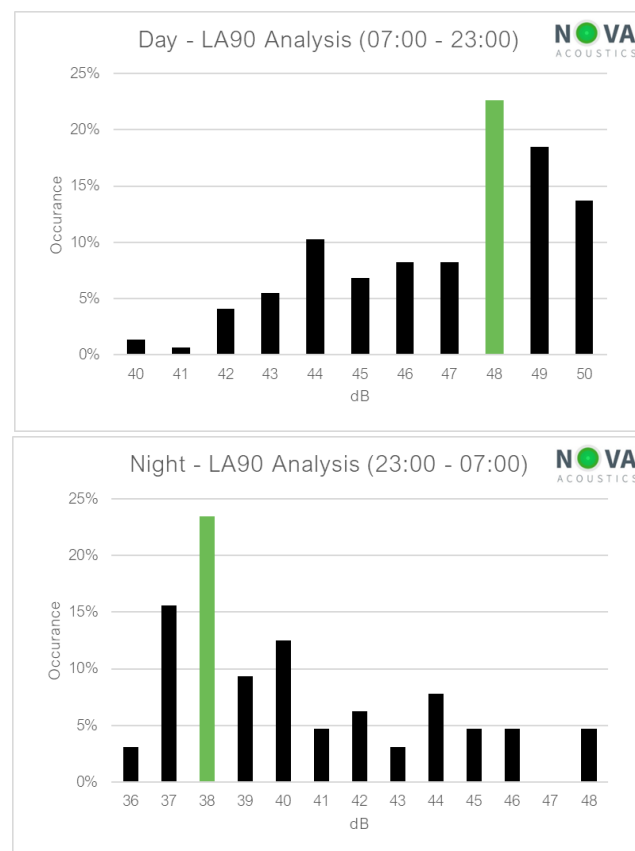


Figure 18 – MP3 Noise Survey Background Noise Level Histogram

C.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SV971A Class 1 Sound Level Meter	141359	≤0.2
Svantek SV31 Class 1 Calibrator	32569	
Svantek SV971A Class 1 Sound Level Meter	143564	≤0.2
Svantek SV31 Class 1 Calibrator	32569	
Svantek SV971A Class 1 Sound Level Meter	162046	≤0.2
Svantek SV31 Class 1 Calibrator	32569	

Table 21 – Surveying Equipment

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

C.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted.

The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Dodge Ecowitt (Approx. 5km W of Site)				
Time Period	Air Temp (°C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
30/01/26: 10:00 – 23:59	3.1 – 7.5	0.0 – 1.8	E	0.0 – 2.0
31/01/26: 00:00 – 23:59	6.7 – 8.7	0.0 – 1.8	ESE	0.0 – 1.5
01/02/26: 00:00 – 23:59	4.7 – 8.3	0.0	SSW	0.0 – 1.0
02/02/26: 00:00 – 23:59	4.9 – 8.7	0.0	SE	0.0 – 2.3

Table 22 – Survey Weather Conditions

The rainfall noted on 30/01/26 and 31/01/26 did not impact the time history results. These periods have therefore been retained within the assessment.

Appendix D – Noise Break-in Calculations

D.1 – Façades with Background Ventilation

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided to NOVA Acoustics, the following window percentage areas have been used:
 - o Red Elevation: Daytime 31%, Night-time 35%
 - o Orange Elevation: Daytime 56%
 - o Green Elevation: Daytime 36%, Night-time 40%
 - o Where these figures increase as the design develops, these calculations will need to be revised.
- The acoustic performance of the façade elements are taken from the relevant manufacturer's technical information or the sound reduction has been predicted using INSUL 10.0.
- For background trickle ventilation a total Equivalent Area of 5000mm² per habitable room has been used in the calculations, which equates to 2no. trickle vents (2500mm² each).

Red Elevation - Living Room (Flat 6) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	55	53	48	48	48	51	48	45	42
Glazing Noise Ingress	15	24	18	19	13	4	2	-3	-6
Ventilation Noise Ingress	18	26	7	8	12	17	4	-6	-9
Wall Noise Ingress	-8	6	-4	-6	-16	-14	-17	-20	-23
Roof Noise Ingress	11	30	21	12	6	3	0	-4	-7
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	27	40	30	27	22	24	13	5	1
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-8	-19	-18	-12	-11	-6	-13	-19	-21

Red Elevation - Bedroom (Flat 6) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	55	53	48	48	48	51	48	45	42
Glazing Noise Ingress	7	23	18	11	2	-6	-9	-18	-21
Ventilation Noise Ingress	12	22	7	8	11	4	5	-1	-4
Wall Noise Ingress	-9	5	-5	-7	-17	-15	-18	-21	-24
Roof Noise Ingress	11	30	21	12	6	3	0	-4	-7
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	22	39	30	22	19	13	12	6	1
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-13	-20	-18	-17	-14	-17	-14	-18	-21

Red Elevation - Bedroom (Flat 6) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	52	45	41	41	41	44	41	46	46
Glazing Noise Ingress	1	16	12	5	-4	-12	-15	-16	-16
Ventilation Noise Ingress	7	15	1	2	5	-2	-1	1	1
Wall Noise Ingress	-14	-3	-12	-14	-24	-22	-25	-20	-20
Roof Noise Ingress	6	22	14	5	-1	-4	-7	-3	-3
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	16	31	23	15	12	6	6	7	5
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-14	-24	-20	-20	-16	-19	-15	-12	-12

Red Elevation - Bedroom (Flat 6) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	76	75	74	70	70	68	70	70	62
Glazing Noise Ingress	31	45	44	33	24	12	13	7	-1
Ventilation Noise Ingress	34	44	33	30	33	22	27	24	16
Wall Noise Ingress	12	27	21	15	5	2	4	4	-4
Roof Noise Ingress	34	52	47	34	28	20	22	21	13
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	44	61	56	44	41	31	34	30	21
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-1	-6	0	-5	-2	-9	-3	-4	-12

Orange Elevation - Living Room (Flat 7) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	56	54	49	49	49	52	49	46	43
Glazing Noise Ingress	17	27	21	22	16	7	5	0	-3
Ventilation Noise Ingress	18	26	7	8	12	17	4	-6	-9
Wall Noise Ingress	-11	3	-7	-9	-19	-17	-20	-23	-26
Roof Noise Ingress	13	32	23	14	8	5	2	-2	-5
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	27	40	31	28	23	23	13	6	2
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-8	-19	-17	-11	-10	-7	-13	-18	-20

Green Elevation - Living Room (Flat 3) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	53	51	46	46	46	49	46	43	40
Glazing Noise Ingress	13	23	17	18	12	3	1	-4	-7
Ventilation Noise Ingress	16	24	5	6	10	15	2	-8	-11
Wall Noise Ingress	-11	3	-7	-9	-19	-17	-20	-23	-26
Roof Noise Ingress	9	28	19	10	4	1	-2	-6	-9
Room Absorption Correction		5	4	4	3	3	3	2	0
Total Noise Ingress	25	38	28	25	21	22	11	4	-1
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-10	-21	-20	-14	-12	-8	-15	-20	-23

Green Elevation - Bedroom (Flat 3) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	53	51	46	46	46	49	46	43	40
Glazing Noise Ingress	13	23	17	18	12	3	1	-4	-7
Ventilation Noise Ingress	18	26	7	8	12	17	4	-6	-9
Wall Noise Ingress	-12	3	-7	-9	-19	-17	-20	-23	-26
Roof Noise Ingress	9	28	19	10	4	1	-2	-6	-9
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	26	38	28	25	22	24	12	4	0
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-9	-21	-20	-14	-11	-6	-14	-20	-22

Green Elevation - Bedroom (Flat 3) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	49	42	38	38	38	41	38	43	43
Glazing Noise Ingress	7	14	9	10	4	-5	-7	-4	-4
Ventilation Noise Ingress	11	18	0	1	5	10	-3	-5	-5
Wall Noise Ingress	-17	-6	-15	-17	-27	-25	-28	-23	-23
Roof Noise Ingress	3	19	11	2	-4	-7	-10	-6	-6
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	19	30	21	18	14	16	5	5	3
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-11	-25	-22	-17	-14	-9	-16	-14	-14

Green Elevation - Bedroom (Flat 3) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	65	64	63	59	59	57	59	59	51
Glazing Noise Ingress	26	36	34	31	25	11	14	12	4
Ventilation Noise Ingress	28	39	24	21	25	26	17	10	2
Wall Noise Ingress	1	16	9	4	-6	-9	-7	-8	-16
Roof Noise Ingress	23	41	36	23	17	9	11	10	2
Room Absorption Correction		4	4	4	3	3	3	2	0
Total Noise Ingress	37	51	45	38	34	32	25	20	10
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-8	-16	-11	-11	-9	-8	-12	-14	-23

Appendix E – Railway Pass-by Noise Summary

Train Number	Ambient Noise Level (dB L _{Aeq,T})	Period (s)	Determined SEL (dB L _{Ae})
1	64	21	77
2	65	12	76
3	62	17	75
4	64	17	77
5	65	15	76
6	60	15	72
7	60	14	71
8	65	16	77
9	65	15	77
10	66	12	77
11	65	13	76
12	66	13	77
13	64	16	76
14	65	15	77
15	65	14	76
16	65	16	77
17	64	15	76
18	61	29	75
19	66	13	77
20	63	15	75

Table 23 – Sound Exposure Levels of Train Pass Bys



NOVA
ACOUSTICS