NOVA ACOUSTICS

Residential Noise Assessment

Site Address: Roxburgh House, 12 Hill Street, Wrexham, LL11 1SN

Client Name: M1 Trade Ltd

Project Reference: NP-014316

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01	23/06/2026	First Issue
02	26/06/2026	Amendment to Overheating Assessment

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the proposed development') at Roxburgh House, 12 Hill Street, Wrexham, LL11 1SN ('the site').

The applicant has submitted planning application ref. P/2025/0833 ('the application') to the Local Planning Authority ('LPA'), Wrexham County Borough Council. This report has been prepared to accompany the application.

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have been used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts 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:

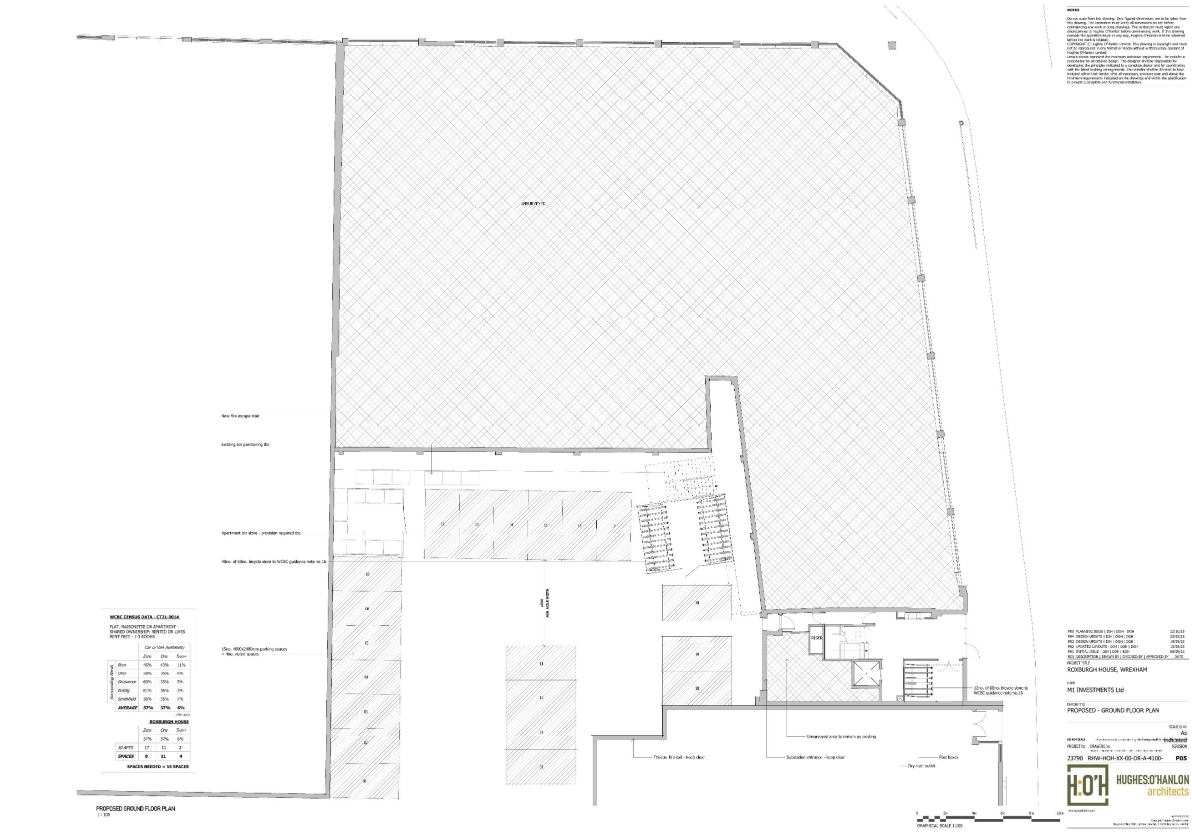
- The LPAs conditional commentary – Refer to section 1.3
- National Planning Policy Framework (NPPF, 2024)
- Noise Policy Statement for England (NPSE, 2010)
- Planning Policy for Wales (PPW, 2024)
- Planning Guidance (Wales), Technical Advice Note (TAN) 11 – Noise
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- British Standard BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'
- ProPG: 'Planning and Noise 2017' (including supplementary documents 1 & 2)
- Approved Document F: Volume 1 Dwellings (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)

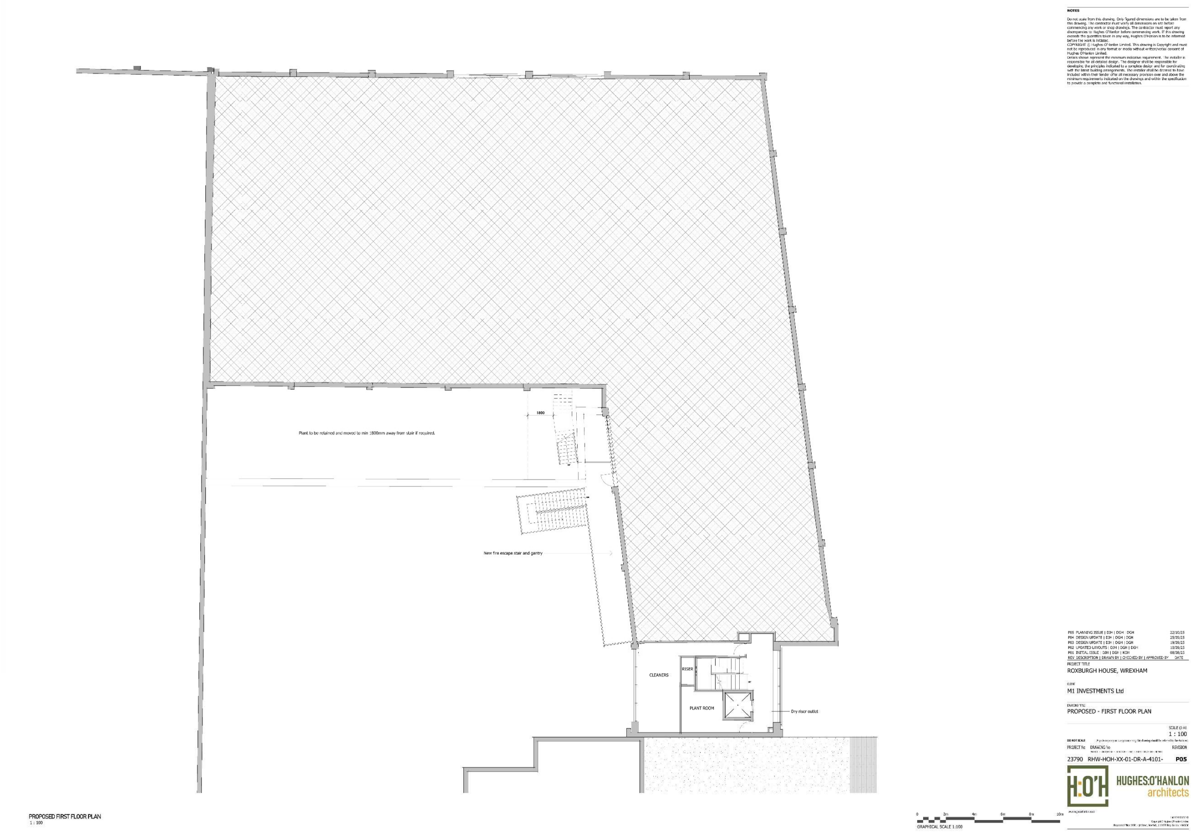
Further information regarding the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the *"change of use of second and third floor of building from Class B1 (offices) to create 30 No apartments (class C3) including creation of additional parking spaces, bin store, cycle storage and means of escape".* The proposed layout of the development is shown overleaf.

At this stage, it is unknown whether there will be any items of externally fixed mechanical plant at the development. Therefore, to form a robust approach, plant noise limit levels have been defined in the event proposals confirm that plant will be installed.


UNSURVEYED
WCBC CENSUS DATA - CT21-0014
ROXBURGH HOUSE
SPACES NEEDED = 15 SPACES
PROPOSED GROUND FLOOR PLAN
1 : 100
ROXBURGH HOUSE, WREXHAM
M1 INVESTMENTS Ltd
PROPOSED - GROUND FLOOR PLAN
HUGHES:O'HANLON
architects
GRAPHICAL SCALE 1:100


CLEANERS
PLANT ROOM
PROPOSED FIRST FLOOR PLAN
1 : 100
ROXBURGH HOUSE, WREXHAM
M1 INVESTMENTS Ltd
PROPOSED - FIRST FLOOR PLAN
1 : 100
HUGHES:O'HANLON
architects
GRAPHICAL SCALE 1:100



Drawings for Ground, 1st, 2nd, & 3rd stories from 'Hughes O'Hanlon Architects'

Figure 1 – Proposed Development Layout

1.3 Local Planning Authority & Background

Following the initial application, the following comments were made by the LPA:

"Due to the presence of city centre nightlife and noise generated by trading businesses in close proximity to the proposal site, this section is unable to make a recommendation without a noise assessment being carried out. The assessment is required to establish the potential impact of existing noise sources on future residential occupiers and to determine whether appropriate mitigation measures should be implemented.

The report should be In line with Technical Advice Note (TAN) 11: Noise, and the associated guidance documents, the proposal to convert a building from offices to apartments must be supported by a comprehensive noise impact assessment. This should include baseline measurements of existing noise levels, an evaluation of how those levels may affect the internal and external living environment of the proposed dwellings, and recommendations for mitigation where necessary.

Furthermore, the assessment must demonstrate compliance with BS 8233:2014, which sets out appropriate internal noise level criteria for residential developments. This ensures that habitable rooms such as bedrooms and living areas achieve acceptable acoustic conditions, safeguarding the health, comfort, and quality of life of future residents.

Such reports are essential to demonstrate compliance with national planning policy and acoustic standards, and to ensure that the development will provide acceptable living conditions. Without this report, this department is unable to make further consideration of the proposal, and it cannot proceed."

A noise impact assessment had previously been submitted as part of an application for the same proposed us, however, the application was refused on various grounds. This noise impact assessment has been independently compiled using and interpreting the latest and most appropriate guidance and standards.

2. Environmental Noise Survey

2.1 Measurement Methodology

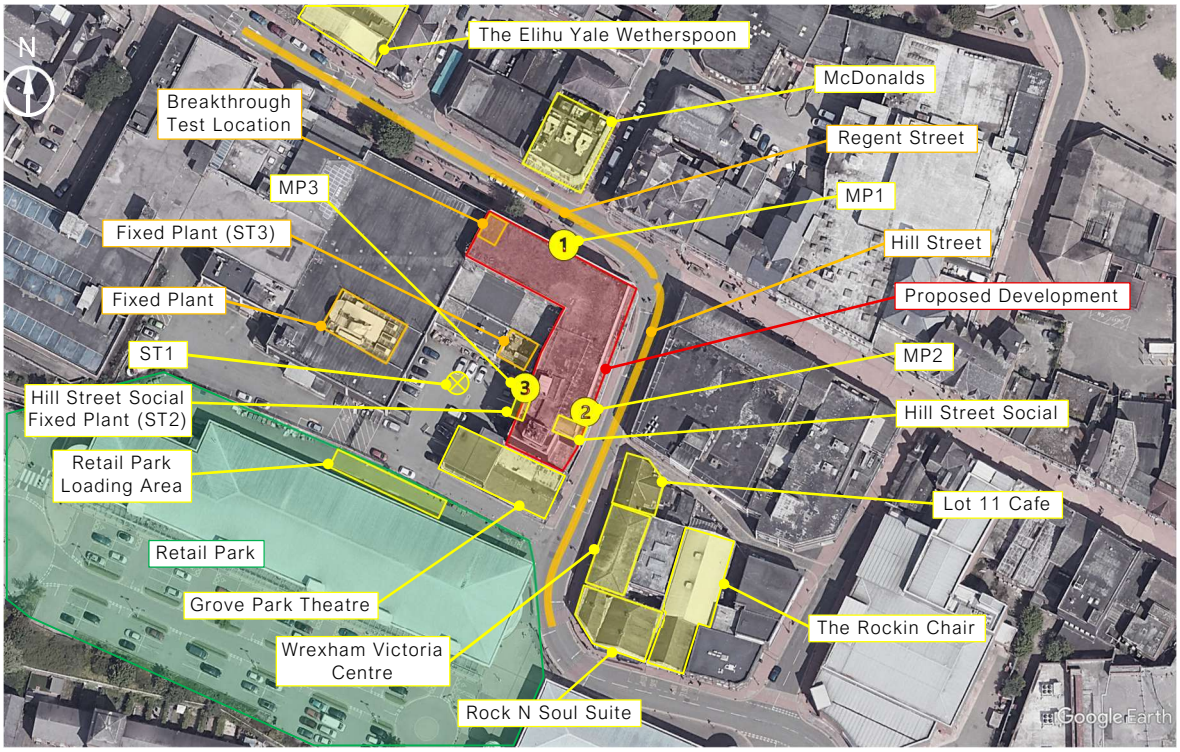
An attended and unattended environmental noise survey was undertaken at the site to determine the existing noise climate affecting the proposed development. Outlined in the following table are the measurement dates and particulars.

As the long-term monitoring was undertaken under façade conditions, the results been corrected to convert them to a free-field level. A 130mm diameter windshield was fitted to each microphone. The equipment was field calibrated before and after the survey with negligible levels of drift noted. An airborne sound insulation test was conducted between the 1st floor above 'The Works', into a 2nd floor open office area.

Location	Survey Dates	Measurement Particulars
MP1	05 – 08/06/2026	Equipment tripod mounted protruding approximately 1m from the 2nd floor window overlooking Regent Street.
MP2		Equipment tripod mounted protruding approximately 1m from the 2nd floor window overlooking Hill Street.
MP3		Equipment tripod mounted protruding approximately 1m from the 2nd floor window overlooking the rear parking/loading area.
ST (Short-Term)	08/06/2026	Equipment tripod mounted in various locations.

Table 1 – Measurement Methodology

The site surroundings and measurement locations are highlighted in the following figure.



Imagery ©2026 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2026

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site is formed of the Roxburgh House, 12 Hill Street, Wrexham. The 2nd and 3rd stories are to be converted into residential apartments and alterations are to be made to the external rear parking area.

The ground and 1st stories of the building shall remain commercial, which includes mostly retail and banking, with only office spaces adjoining the proposed residential apartments. The only exception to this would be the 'Hill Street Social' sports bar which lies beneath apartment 102 of the proposed development.

Nearby commercial properties and operating times include:

- Hill Street Social – Open 14:30 – 22:30 (Mon – Thurs), 14:30 – 23:00 Fri, 12:00 – 23:00 Sat, 12:00 – 22:00 Sun. A sports bar / eatery, with no live music events, just an upper floor projector and small wall mounted speakers.
- Grove Park Theatre – No strict opening times, however, shows are likely to continue until 00:00 hours. Based on the theatres' website, one show every 2-3 months appears typical.
- Lot 11 Café – Open 08:30 – 16:00 (Mon – Sat), 10:00 – 14:00 Sun.
- Wrexham Victoria Centre (Youth Centre) – Open 18:30 – 21:00 Fri, 12:30 – 15:00 Sat.
- Rock N Soul Suite – Open 09:30 – 16:00 (Mon – Thurs), 09:30 – 21:00 Fri, 09:30 – 16:00 & 22:00 – 04:00 Sat.
- The Rockin Chair – Open during live music and club nights which can start as early as 18:00 are likely to extend into the night-time period. However, not official published closing time can be found.
- The Elihu Yale Weatherspoon – Open 08:00 – 00:00 (Sun – Thurs), 08:00 – 01:00 (Fri – Sat). No amplified music is played or licenced.

During the setup and collection of the survey equipment, the acoustic environment was deemed to be moderate in level, and the noise profile was dominated by road traffic noise emissions along the northern and eastern façades, with fixed plant being dominant at the rear when active.

It is noted that there were no live music or theatre events booked throughout the survey period, however, there was a DJ driven type event at The Rockin Chair on the evening of the 06/06/26 between 17:00 – 23:00.

2.3 Environmental Noise Survey Results – Ambient and Maximum Noise Levels

A summary of the ambient sound levels measured during the unattended noise survey is presented in the table below. The maximum sound levels ($L_{AFmax,2min}$) exceeded fewer than 10 times during the night-time periods measured are also shown. The time history results can be found in Appendix D.

Also shown below and highlighted in grey, are the noise levels that deviate from the 16-hour and 8-hour (day & night) average ambient noise levels suggested in BS8233. Further in the report it is explained that the highest of any of the sound levels presented below have been used to derive the enhanced sound insulation scheme.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, dB)							Overall (dBA)
		63	125	250	500	1k	2k	4k	
MP1	Average $L_{eq,16hr}$ (Day)	65	60	58	56	55	51	47	59
	Sensitive Evening Hours, $L_{eq,2hr}$ (21:00 – 23:00)	63	58	57	54	55	49	42	58
	Average $L_{eq,8hr}$ (Night)	60	55	55	53	53	50	45	57
	Early Night-time Hours, $L_{eq,2hr}$ (23:00 – 01:00)	62	58	57	54	53	49	43	57
	Typical $L_{Fmax,2min}$ (Night)	74	67	70	73	79	76	71	82
MP2	Average $L_{eq,16hr}$ (Day)	65	59	57	54	54	50	45	58
	Sensitive Evening Hours, $L_{eq,2hr}$ (21:00 – 23:00)	64	58	55	52	53	48	41	56
	Average $L_{eq,8hr}$ (Night)	60	53	51	50	51	47	41	54
	Early Night-time Hours, $L_{eq,2hr}$ (23:00 – 01:00)	62	56	53	50	51	46	38	54
	Typical $L_{Fmax,2min}$ (Night)	75	73	71	77	77	71	64	80
MP3	Average $L_{eq,16hr}$ (Day)	55	57	50	48	47	43	42	52
	Loudest Hour $L_{eq,1hr}$ (Day)	56	60	53	51	49	49	55	59
	Sensitive Evening Hours, $L_{eq,2hr}$ (21:00 – 23:00)	54	58	51	46	43	37	30	49
	Average $L_{eq,8hr}$ (Night)	52	55	48	44	42	38	37	47
	Loudest Hour $L_{eq,1hr}$ (Night)	49	48	45	43	43	43	48	52
	Early Night-time Hours, $L_{eq,2hr}$ (23:00 – 01:00)	52	55	49	44	41	36	28	47
	Typical $L_{Fmax,2min}$ (Night)	61	61	55	53	61	60	51	65

Table 2 – Long-term Sound Level Results Summary

Location	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							Overall (dBA)	$L_{A90,T}$ (dB)
	63	125	250	500	1k	2k	4k		
ST1 (Rear Service Yard)	59	55	53	51	52	49	45	56	48
ST2 (Hill Street Social Chiller 2m)	65	63	63	55	54	50	45	59	59
ST3 (Roof Top Fixed Plant 8m)	60	54	54	51	49	44	38	53	50

Table 3 – Short-Term Sound Level Results Summary

2.4 Environmental Noise Survey Results – Background Noise Levels

A summary of the typical background sound levels measured during the noise survey is shown in the table below. The levels have been derived via statistical analysis of the measured $L_{A90,15min}$ data and were chosen depending on the ranges and distributions of measurement results. Full noise survey time histories and histograms can be found in Appendix D.

Location	Period	Typical Background Sound Level $L_{A90,T}$ (dB)
MP1	Day: 07:00 – 23:00	52
	Night: 23:00 – 07:00	48
MP2	Day: 07:00 – 23:00	48
	Night: 23:00 – 07:00	38
MP3	Day: 07:00 – 23:00	46
	Night: 23:00 – 07:00	40

Table 4 – Background Sound Level Results Summary

2.5 Consideration of Fixed Plant Equipment Noise Impact

When analysing the time history of MP3, there is an indication of fixed plant noise dominance. When plant noise is a dominant feature in an acoustic environment, this typically presents as a flat line in the L_{A90} (background noise) measurement, as the plant noise forms a 'noise floor' that is apparent when other sources of noise fluctuate to lower levels.

To further illustrate this, the 125Hz low frequency time history is shown overleaf with the periods of clear fixed plant noise annotated in red aligning with the L_{A90}.

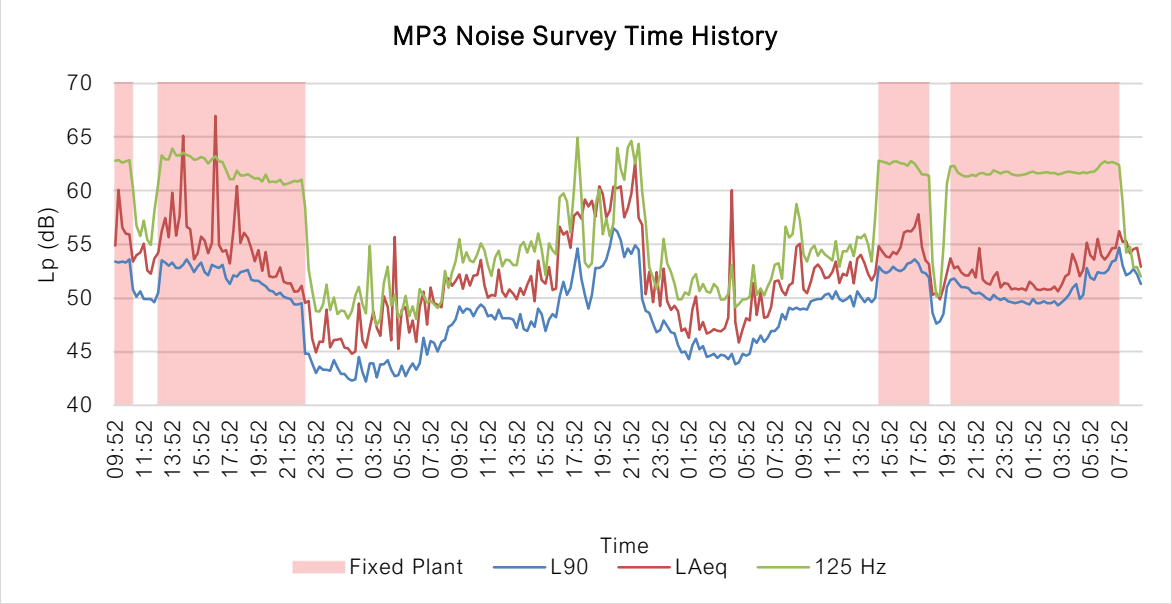


Figure 3 – MP3 Noise Survey Time History

It is noteworthy that the periods of fixed plant noise appear sporadic and not to a fixed pattern, however, it does continue throughout the night-time period. As such, a BS4142 assessment has been undertaken in Section 4.

2.6 Consideration of Entertainment Noise Impact

As previously noted, noise emissions from the nearby entertainment venues have the potential to cause adverse impact for future residents during evening and late-night periods, particularly whilst live events are taking place. To assess whether entertainment noise is likely to have been audible during the monitoring periods, analysis has been undertaken of the 63Hz and 125Hz octave band measurements.

The time history graphs are presented in the following figures, with annotations showing the periods with events at nearby venues.

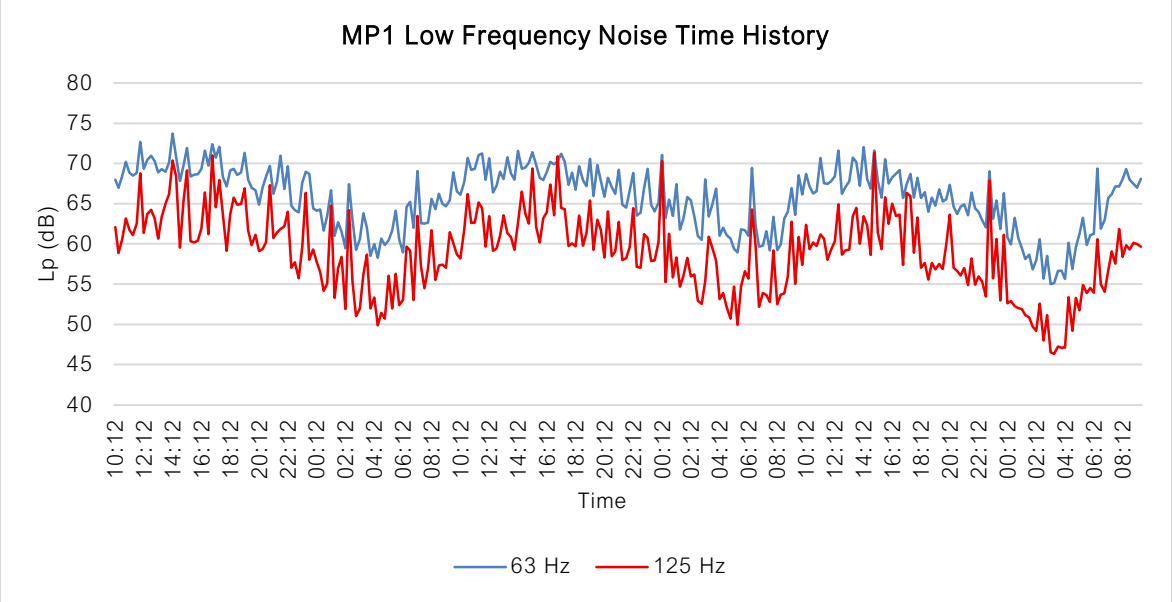


Figure 4 – MP1 Low Frequency Analysis

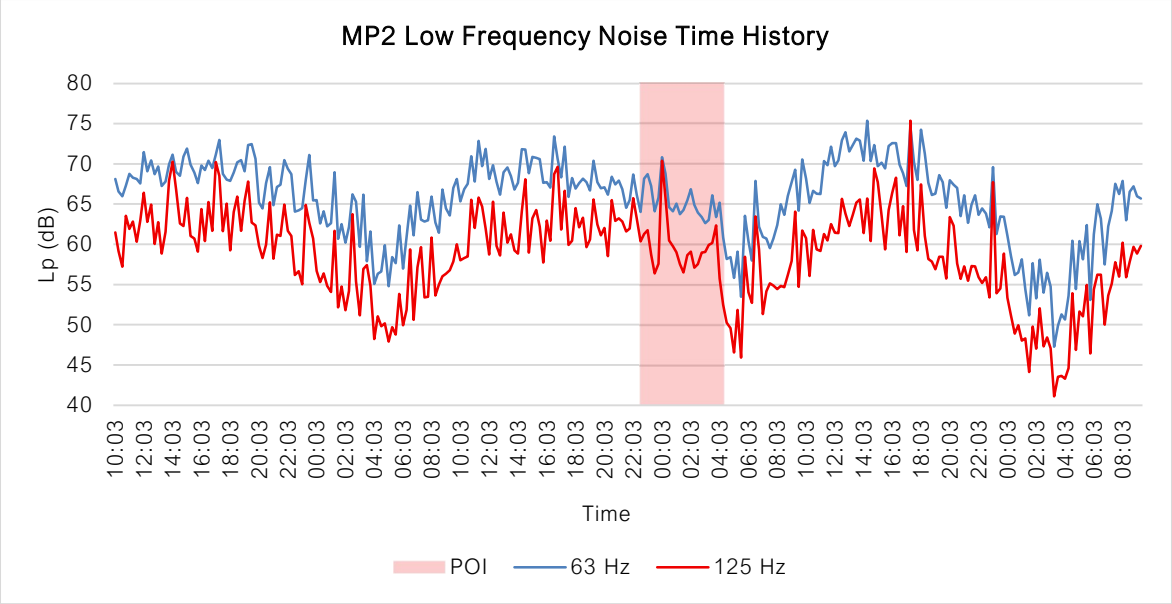


Figure 5 – MP2 Low Frequency Analysis

As can be seen, low frequency noise persists from approximately 22:00 – 04:00 hours at MP2 on the 06/05/26 Saturday night which aligns with the operational hours of the Rock N Soul Suite.

There are low frequency peaks but no sustained levels that would indicate entertainment noise impact at MP1.

Entertainment Noise Breakout Screening Calculations

Given the limited events that took place during the survey, screening calculations have been undertaken to establish the 'worst-case' possible noise levels incident upon the proposed development site.

Hill Street Social

It should be recognised that the 'Hill Street Social' sports bar does not host live music but has the capability to host live sporting events within the first-floor space of the bar. In this space is a large projector and small wall mounted speakers.

The noise breakout emissions have been calculated assuming loud music being played and up to 20 patrons speaking with raised voices in the 1st floor area of the sports bar. Given the ground floor portion of the bar is fully screened by a hard overhanging canopy, the assessment has been carried out from the 1st floor sports bar area exclusively.

The noise breakout levels predicted to the closest 2nd floor window of the proposed development (apartment 102) can be seen in the table overleaf. A comparison to the highest noise levels measured at MP2 has also been made.

The windows are assumed to be approximately 6m^2 in surface area, and Apt 102 windows are approximately 1.5m above the 1st floor windows. The 1st floor area is assumed to be approximately 6m x 8m x 3m in dimensions.

Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
20no. Patron Speaking with Raised Voices (L_{eq}) [1]	--	--	81	85	81	76	70	86 (A)
Internal Noise Level of Bar (L_{eq})	93	85[2]	85[2]	87	91	85	77	93 (A)
Cumulative Internal Ambient Noise Levels (L_{eq})	93	85	86	89	91	86	78	94 (A)
Assumed Front Façade Windows SRI (R')[3]	21	22	25	30	33	31	35	32 (R_w)
Internal to External Correction (C_d)	-6							--
Sound Power Level of Window ($6m^2$, L_w)	74	65	63	61	60	57	45	64 (A)
Total Attenuation (2.5m, Q=4)	-17							--
Total External Noise Level at NSR1 (L_{eq})	56	47	46	44	43	40	28	47 (A)
Highest measurement at MP2 (L_{eq}, daytime)	65	59	57	54	54	50	45	58 (A)

Notes:
[1] *The source noise levels are taken from ANSI S3.5-1997 (R2017) and assumed that 40 patrons are speaking, with one talking and the other listening.*
[2] *Internal ambient noise level measurements recorded by NOVA Acoustics of a similar type of pub/events space, report ref: NP-019746-2. This level was taken at a mixing desk location central to a high-capacity venue with loud music; this is deemed sufficiently robust.*
[3] *Assumed 6mm single glazing.*

Table 5 – Indicative Noise Breakout Calculations from Hill Street Social Sport Bar

As can be seen in the table above, based on conservative assumptions, the predicted noise breakout from the Hill Street Social Bar is lower than the highest daytime measurements obtained at MP2. Given that the sports bar ceases trading at 23:00 hours, it is assumed that the amenity of future occupant can be protected provided the noise levels measured at MP2 are utilised.

Grove Park Theatre

From experience the worst-case internal noise sources are likely to be pre-recorded music as accompaniment to stage performances. Levels recorded by NOVA Acoustics of an indoor event with pre-recorded music in a similar space have been used, report ref: 8619GW.

Plans have been sourced showing the theatre façade is likely to be of a cavity wall construction (100mm brick, 90mm gap with 50mm fiberglass insulation, 100m lightweight concrete block), with no windows or direct access doors.

Presented in the following table is predicted level of noise breakout at the closest façade of the proposed development site; to Apt 101.

Description	Octave Frequency Band (Hz, dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Internal Noise Level (L_{eq})	92	95	80	84	82	76	75	87 (A)
Assumed Cavity Wall SRI (R')	53	68	67	80	>80	>80	>80	80 (R_w)
Internal to External Correction (C_d)	-6							--
Sound Power Level of Facade (36m^2, L_w)	49	37	23	14	<12	<6	<5	25 (A)
Total Attenuation (5m, Q=4)	-20							--
Total External Noise Level at NSR1 (L_{eq})	29	17	-3	-12	-14	-20	-21	0

Table 6 – Indicative Noise Breakout Calculations from Grove Park Theatre

As can be seen above, the predicted levels of noise breakout form the Grove Park Theatre are sufficiently low enough to ensure than any noise impact is highly unlikely.

2.7 Commercial Noise Emissions

The identified external fixed plant equipment can be characterised via the measurements obtained at MP3. However, there are other varying activities that are likely to take place at the rear of the development site, these include:

- Weekly beer keg deliveries via the BoH to Hill Street Social, and;
- Unloading / loading of stage equipment via the BoH to the Grove Park Theatre.

As the Grove Park Theatre hosts shows once everyone 2-3 months, it is highly likely that associated BoH (un)loading will only take place up to 2 times every 2-3 months. From experience, it is thought that given the small size of the theatre, it is likely that (un)loading would take place during more social hours, e.g., not during the night or early hours of the morning.

Moreover, due to the noise impact from external fixed plant to the rear of the site, it will be necessary for secondary mechanical ventilation systems to be installed that allow for appropriate internal conditions to be achieved without the need for opening windows.

In light of the above, it is thought that the residential amenity can be protected from BoH (un)loading to the Grove Park Theatre, provided the façade sound insulation scheme accounts for the associated noise emissions.

However, as deliveries to the BoH of Hill Street Social are expected to be weekly during the day, a BS4142 noise impact assessment has duly been undertaken.

Outlined the following section are the predicted specific sound levels calculated at the closest windows of the proposed development site.

Hill Street Social – Keg Delivery

Highly impulsive noise associated with keg delivery is common to the rear of bars. To assess the noise levels from beer barrel deliveries, measurements of a beer barrel being dropped at various heights have been conducted by NOVA Acoustics Ltd, report ref: 8296AS. The table below presents the average $L_{Aeq,2s}$ of numerous barrel drops at 2m and the subsequent SEL value.

Description	Value (dB)
Average $L_{Aeq,2s}$ of Beer Barrel Drops (2m)	96 (A)
Resultant SEL at 2m	99 (A)

Table 7 – Beer Barrel Noise SEL Data

The predicted cumulative noise level of a single delivery over a 1-hour daytime assessment period can be seen in the table below. Given the size of the Hill Street Social, it is assumed that 5 barrels are loaded into the bar.

Noise Source	SEL (dBA)	No. of Actions	$L_{Aeq,1hr}$ at 2m (dBA)
Beer Barrel Drop	99	5	70
Resultant Sound Power Level (dB)	84 (A)		
Propagation Loss to Apt 101 Window (dB)	-28 (Q4, 21m)		
Specific Sound Level at Apt 101 (L_{eq1hr})	**56 (A)**		

Table 8 – Predicted Beer Barrel Delivery Noise Levels

Grove Park Theatre – BoH Stage Equipment Movements

In this section the (un)loading noise emissions from the BoH area associated with the Grove Park Theatre has been indicatively predicted. Levels recorded by NOVA Acoustics (report ref: 7471JB) taken during the loading of stage equipment at a larger theatre venue have been assumed; the measurement includes the loading of 2no. 16-wheeled HGV, which is deemed suitably robust.

Shown int eh following table are predicted specific sound level emissions predicted to Apt 101.

Description	Distance	$L_{Aeq,T}$ (dB)
Ambient of Loading Both HGVs (21:53 – 00:17)	10m from closest BOH Loading Bay Door	64
Residual (00:17 – 00:27)		50
Specific Sound Level of Loading Both HGVs		64
Calculated Specific Sound Level at Apt 101	12m (*20log (r1/r2)*	62[1]

Table 9 – Predicted Specific Sound Level of Theatre BoH (un)Loading

As can be seen above, the robustly predicted noise emissions from the theatre stage (un)loading are ~3dB higher than the highest 1-hour measurement obtained at MP3. As such, the noise emission associated with theatre (un)loading have been used to specify the façade sound insulation scheme.

3. TAN 11: Noise Assessment

TAN 11 is used to categorise noise level for proposed development sites. Annex A offers four noise exposure categories (NECs) for dwellings. The categories range from A-D, where A is the lowest noise levels and D is the highest. The tables below provide a breakdown of the NECs and relative advice.

Time	Noise Exposure Category (dB $L_{Aeq,T}$)			
	A	B	C	D
07:00 - 23:00	<55	55-63	63-72	>72
23:00 – 07:00	<45	45-57	57-66	>66

Table 10 – TAN 11 Threshold for Road Traffic Noise

A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 11 – TAN 11 Noise Exposure Categories

In order to categorise the proposed development site, one must compare the measured levels with those presented in Table 10, above.

As can be seen in Section 2.3, the worst-case average noise levels incident upon the proposed façades are predicted to be 59dB $L_{Aeq,16hr}$ during the daytime period and 57 dB $L_{Aeq,8hr}$ during the night-time period. As such, the proposed development site would be classified under noise exposure category B.

However, further consideration has been given to the 'Agent of Change' principle in Section 5.

4. BS4142 Noise Assessments

4.1 External Fixed Plant BS4142 Noise Impact Assessment

As was identified in Section 2.5, external fixed plant equipment influences the acoustic environment to the rear of the development site. As such, a BS4142 noise impact has been undertaken to establish likelihood of noise impact.

The specific level of the fixed plant has been calculated by logarithmically deducting the measured residual level from that measured with the plant operating during its highest observed level (ambient) at MP2; this is shown below. As the fixed plant is dominant during the night-time, the ambient sound level is representative of the specific sound and no correction for residual noise was deemed necessary.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							Overall $L_{Aeq,T}$ (dB)
		63	125	250	500	1k	2k	4k	
MP3	Ambient Sound Level (Daytime 1-hour)	56	60	51	48	48	44	34	52
	Residual Sound Level (Daytime 1-hour)	52	48	46	44	44	38	29	47
	Calculated Daytime Specific Level	54	59	50	46	47	43	31	51
	Specific Sound Level (Night-time 15-min)	53	59	50	45	42	36	28	48

Table 12 – Specific Sound Levels of External Fixed Plant at MP2 (rear of development)

The BS4142 noise impact assessment at the closest bedroom window is presented in the following table.

BS4142 Noise Impact Assessment – External Fixed Plant			
Description	Notes	Daytime	Night-time
Specific Sound Level (dB $L_{Aeq,T}$)	No on-time correction as the plant can operate continuously over the 1-hour daytime and 15-min night-time periods	51	48
Subjective BS4142 Acoustic Feature Corrections	A +2dB penalty has been applied to account for a low frequency hum that may be 'just perceptible' A +3dB penalty has been applied for perceptible intermittent noise emissions.	+5	
Rating Sound Level (dB $L_{Ar,Tr}$)		56	53
Background Sound Level (dB $L_{A90,15min}$)	Obtained from periods where fixed plant equipment was switched off.	46	40
Exceedance of $L_{A90,15min}$		**+10**	**+13**
Initial BS4142 Assessment Outcome	**'Significant Adverse Impact' at the closest windows.**		

Table 13 – BS4142 Noise Impact Assessments of External Fixed Plant

The assessment indicates that a 'significant adverse impact' is predicted at the rear façades overlooking the fixed plant equipment. It should also be recognised that internal noise levels due to plant noise alone are expected to be in the order of 38dBA and 35dBA during the daytime and night-time, respectively, assuming a partially open window used for background ventilation purposes.

In light of the above, the 'Agent of Change' principle outlined within the NPPF must duly be considered.

4.2 BS4142 Noise Impact Assessment – Hill Street Social Beer Deliveries

The BS4142 noise impact assessment at the closest bedroom window is presented in the following table.

BS4142 Noise Impact Assessment – Hill Street Social Beer Delivery		
Description	**Notes**	**Daytime**
Specific Sound Level (dB $L_{Aeq,T}$)	As calculated in Table 8.	56
Subjective BS4142 Acoustic Feature Corrections	A +6dB penalty has been applied for 'clearly perceptible' impulsivity.	+6
Rating Sound Level (dB $L_{Ar,Tr}$)		62
Background Sound Level (dB $L_{A90,15min}$)	Obtained from periods where fixed plant equipment was switched off.	46
Exceedance of $L_{A90,15min}$		**+16**
Initial BS4142 Assessment Outcome	**'Significant Adverse Impact' at the closest windows.**	

Table 14 – BS4142 Noise Impact Assessments of Hill Street Social Beer Deliveries

Given the anticipated noise impact from beer keg deliveries, the 'Agent of Change' principle must duly be considered.

5. Agent of Change Principle

Considering that commercial noise is likely to be clearly dominant at the site, the 'Agent of Change' principle must be considered in order to reduce the likelihood of complaints from future residents and avoid placing undue restrictions on the nearby venues.

Regarding this, the following is stated in paragraph 200 of the NPPF:

"Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

The 'ProPG Planning and Noise' (May 2017) guidance, was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. ProPG aims to encourage better acoustic design of new residential developments by promoting good health and wellbeing through the effective management of noise. It outlines four key elements which should be considered in the assessment of noise:

- Element 1 – demonstrating a "Good Acoustic Design Process"
- Element 2 – observing internal "Noise Level Guidelines"
- Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
- Element 4 – consideration of "Other Relevant Issues"

The ProPG supplementary document 2 provides the following 'Good Acoustic Design' hierarchy of noise management measures which are considered to be relevant to this development:

1. Reduction of noise at the source

As there is no affiliation between the applicant and the nearby establishments, there is no scope to reduce the associated noise emissions at source. However, the applicant should investigate whether other controls are feasible, such as ensuring the operators of the venues are adhering to the best available techniques including but not limited to:

- quiet delivery plans,
- switching off vehicles and not leaving them idle,
- placing matting down when (un)loading beer barrels / kegs
- avoiding unnecessary (un)loading times

2. Reorientation of the development and acoustic shielding

Given the expected noise impact to the rear of the development site (the inner service yard façades), it would be prudent to investigate whether circulation areas can be established along the rear service yard elevations.

This would yield an acoustic buffer zone and mitigate any expected noise impact, however, there may be a loss of usable apartment floor space and there would be restriction on natural light ingress, reducing the quality of life throughout the development.

3. Enhanced façade sound insulation treatment

To ensure the possibility of adverse impact across the development is reduced by as much as is reasonably practicable, it is recommended that an enhanced façade sound insultation treatment is implemented.

To avoid disturbance due to low-frequency noise emissions, the Moorhouse Curve should not be exceeded in the 63Hz and 125Hz octave bands.

It is thought that the internal noise level criteria can be achieved with windows closed; however, the criteria are likely to be significantly exceeded if future occupants open their windows for whole dwelling (background) ventilation purposes.

Given this, it is recommended that secondary mechanical ventilation systems are installed that allow for appropriate internal conditions to be achieved without the need for opening windows. The acceptability of this strategy will have to be agreed with the LPA as there will still be an inherent risk in developing residential accommodation in this location.

The ventilation systems must be compliant with the requirements of Approved Document F and should be capable of providing the following:

- Background ventilation
- Purge ventilation
- Overheating mitigation

The façade sound insulation scheme has been derived based on the highest of the noise levels measured during the survey, or the predicted commercial noise emissions shown in Sections 2.6, 2.7 and 4.

Noise Break-in Assessment and Sound Insulation Scheme

5.1 Internal Noise Level Criteria

The internal acoustic design criteria as defined by the LPA planning condition used in the following assessment are outlined in the tables below.

Due to the potential for of low frequency noise within the immediate area during night-time hours, the Moorhouse Curve criteria are applied, as presented in the table below; this will safeguard against low-frequency entertainment noise.

Location	Night-Time Criteria (Moorhouse Curve)
All Rooms	63Hz limit of 47dB L_{eq} 125Hz limit of 41dB L_{eq}

Table 15 – Low Frequency Acoustic Design Criteria (Moorhouse)

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: "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".*
[4] *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.*
[5] *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 16 – Internal Acoustic Design Criteria

Due to the predicted noise impact to the rear of the development site, the internal ambient noise criteria has been reduced by 5dB from those presented above; circa 30dBA and 25dBA during the daytime and night-time, respectively.

5.2 Determined External Noise Levels

The worst-case external free-field noise levels incident on the façades of the proposed development have been determined and are presented in the figure and table below.



Figure 6 – Determined External Free-field Noise Levels

Elevation	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	59	57	82
Orange	58	54	80
Green	62[1]	53[2]	65

Notes:
[1] *Overall noise level based on the BoH (un)loading to the Grove Park Theatre (Table 9)*
[2] *Based on the BS4142 rating sound level predicted in Table 9.*

Table 17 – Determined External Free-field Noise Levels

5.3 Glazing and Whole Dwelling (Background) Ventilation Specification

Glazing and ventilation specifications that achieve the relevant internal noise criteria are shown in the table below. Detailed noise ingress calculations can be found in Appendix E.

Due to the expected noise impact to the rear of the development, it will be necessary for an alternative mechanical ventilation system to be installed for all apartments along the green elevation. As such, no passive trickle ventilators have been specified.

Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Red & Orange Façade Living Rooms								
6mm Glass / 16mm Air Gap / 4mm Glass (SRI)	20	21	20	26	38	37	39	32 R_w (-4 C_{tr})
Greenwood 2500EA.AC1 (D_{ne}) (2no. trickle vents)	31	41	40	37	47	43	46	42 $D_{ne,w}$ (-2 C_{tr})
Red & Orange Façade Bedrooms								
6mm Glass / 16mm Argon / 6.8mm Optiphon Glass	21	21	28	37	48	48	54	40 R_w (-6 C_{tr})
Greenwood 2500EA.AC1 (D_{ne}) (2no. trickle vents)	31	41	40	37	47	43	46	42 $D_{ne,w}$ (-2 C_{tr})
Green Façade Living Rooms & Bedrooms								
6mm Glass / 16mm Argon / 8.8mm Optiphon Glass	24	25	27	38	48	47	55	41 R_w (-6 C_{tr})
Mechanical Ventilation (ADF Compliant)	--	--	--	--	--	--	--	--

Notes:
[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.*
[2] *Please note that the above performance requirements for the trickle vents should be achieved with them in the 'open' position.*

Table 18 – Glazing & Background Ventilation Specification

5.4 Structural Building Envelope Elements

In order to not downgrade the performance of the façade, the remaining elements of the external envelope, e.g., the roof & external wall should be designed to achieve 10dB above the glazing sound insulation performances presented above.

In relation to the external walls, this would be readily achievable with a standard cavity or solid masonry wall construction. It is assumed that the roof is of minimum 150mm thick 1800kg/m^3 concrete with a weatherproof barrier on top and standard 10mm plasterboard underneath; this is deemed sufficient.

If the construction varies from that shown above, NOVA Acoustics should be informed and reassessment may be required.

6. 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.

6.1 Overheating Screening Assessment

Considering that the development is a change of use and not new build, it is not a requirement to achieve the criteria defined in Approved Document O ('ADO'). However, to allow for a reasonable living environment, it is recommended that the less onerous criteria given in the 'Acoustics Ventilation and Overheating Design Guide' ('AVO') should be applied.

Considering that a partially open window provides approximately 13dB of attenuation (as stated in 'AVO') the proposed internal and external noise criteria are summarised below alongside an assessment.

Given the predicted noise impact along the green façades, an alternative mechanical ventilation system will be required and should be capable of overheating mitigation.

Period	Proposed Criteria (dB)		External Level (dB)	
	Internal	External	Measured	Exceedance
Red Façade				
Daytime ($L_{Aeq,16hr}$)	50 [1]	63	59	-4
Night-time ($L_{Aeq,8hr}$)	42 [1]	55	58	+3
Night-time ($L_{AFmax,T}$) [2]	65 [1]	78	82	+4
Orange Façade				
Daytime ($L_{Aeq,16hr}$)	50 [1]	63	58	-5
Night-time ($L_{Aeq,8hr}$)	42 [1]	55	54	-1
Night-time ($L_{AFmax,T}$) [2]	65 [1]	78	80	+2

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] *L_{AFmax} exceeded fewer than 10 times per night.*

Table 19 – Overheating Screening Assessment

The noise levels determined at the facades of the proposed development 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. 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.

Note, as discussed previously, it is recommended that MVHR systems be installed given the nature and level of external commercial noise.

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.

NOVA Acoustics Ltd has been informed that dedicated FCUs (Monobloc AC Units) will be installed throughout the development to control overheating. Therefore, windows are unlikely to be opened for the purposes of overheating control.

Regardless of the ventilation strategy, it must be ensured that all designs 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.

7. Internal Mechanical Plant Design

7.1 Mechanical Ventilation Regenerated Noise Considerations

Please note that where a mechanical ventilation system is to be installed, it must be ensured that regenerated noise within the apartments is appropriately controlled.

Desirable internal ambient noise levels that should be met during periods where these systems are in use are defined in ADF and AVO. These figures are presented below.

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 20 – 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 (which is 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 21 – Indicative Maximum Duct Velocities

8. Noise Breakthrough Assessment and Sound Insulation Scheme

8.1 Noise Breakthrough Criteria

The proposed development structurally adjoins ground/1st floor commercial spaces which includes the "Hill Street Social" sports bar.

It is stated in BS8233 that the internal noise thresholds include 'overall noise' which is the sum of structure borne and airborne noise sources. As such, noise breaking through from the structurally adjoining businesses is considered to ensure the cumulative noise does not exceed the required criteria. Guidance on sound insulation between adjoining domestic and non-domestic properties is discussed in section 0.8 of Approved Document E (ADE) of the Building Regulations, where it is stated that:

"A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations, the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level."

The higher standard of sound insulation required is dependent on the level of noise generated within the commercial property. Noise from structurally adjoining commercial sources can lead to elevated impact and as such further consideration is given to the level of audibility, dominance, attention grabbing features, spectral distribution, regularity, change in level, duration, and time of day the sound is occurring.

8.2 Noise Breakthrough Assessment (Retail/Office Type Spaces)

The expected level of risk associated with the 'Class Use' of the structurally adjoining commercial property is outlined in the following table.

Planning Class	Level of Risk from Noise	Required Sound Insulation Standard (dB)
Ea E(a) Display or retail sale of goods, other than hot food *OR* E(c) Provision of: E(c)(i) Financial services, E(c)(ii) Professional services (other than health or medical services) E(c)(iii) Other appropriate services in a commercial, business or service locality	Medium	$\geq 55\ D_{nT,w} + C_{tr}$
Discussion: The noise emissions produced by general food and drink premises includes both amplified music, noise from patrons and noise from kitchen / food preparation areas. Amplified music associated with primarily dining premises is normally of a background level to facilitate conversation and as such is not a primary concern. The noise from patrons can vary significantly and is highly dependent on the nature of the establishment. The required level of sound insulation should consider raised and elevated vocal efforts occurring regularly. The noise emissions produced by office and storage spaces includes computing equipment, staff movements and possible background amplified music. The permitted opening hours do not extend into the night-time period (23:00 – 07:00) and as such the sensitivity of the adjoining residential requires no additional consideration during this period.		

Table 22 – Noise Breakthrough Assessment Criteria

It is understood that the floor buildup is comprised of approximately 280mm concrete (likely beam and block, assumed min. density 1800kg/m^3), and 1no. layer of nomial 10mm plasterboard underneath. Steel MF ceilings are likely to vary throughout the ground/1st floor level constructions.

Airborne sound insulation testing was conducted on site using a Svantek 977 Class 1 sound level meter (S/N:97493) and a Svantek 103 Dodecahedral Speaker. The sound level meter was field calibrated before and after testing and a negligible calibration drift was noted.

The testing was conducted following the procedures and guidance specified within Annex B of the Building Regulations Approved Document E (ADE) 2003 edition which incorporates 2004, 2010, 2013 and 2015 amendments. The results are assessed in accordance with Section 0: performance - table 1.0a and 1.0b of ADE to indicate compliance.

The results below are indicative of the sound insulation performance of the separating partition between the proposed development and the office spaces above. Sound insulation testing certificates can be produced upon request.

Test Ref.	Test Location	1/1 Octave Band (Hz, dB $D_{n,T}$)							Overall ($D_{nT,w}$ + C_{tr}, dB)
		63	125	250	500	1k	2k	4k	
NP-014316–A	1st floor storage – 2nd Floor Office Area	36	48	54	56	59	65	74	57

Table 23 – Sound Insulation Test Results

As shown above, the exisiting concrete floor construction is sufficiently resisitive to airbourn noise that the higher standard of sound insualtion is met for appartments above the retial/office spaces of the ground floor commercial premeises.

8.3 Noise Breakthrough Assessment (Hill Street Social)

The “Hill Street Social” pub is located directly below apartments 102 and 103. There is a projection screen display with small, fixed speakers showing sporting events. There will likely be noise from loud music and patrons shouting during sporting events.

Due to the above, it is recommended that the NR20 curve and Moorhouse low-frequency curve criteria are not exceeded in the apartments above. The assumed internal ambient noise levels are based on those calculated in Table 5 of this report.

Description	1/1 Octave Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Internal Noise Level of Bar (L_{eq})	93	85	86	89	91	86	78	94 (A)
Tested Sound Reduction of Existing Floor (D_{nT})	36	48	54	56	59	65	74	61 ($D_{nT,w}$)
Furnished Bedroom Reverberation Time Correction	-0.1	-0.5	-0.8	-1.2	-1.2	-1.7	-2.8	--
Predicted Internal Noise Level within Adjacent Residential (L_{eq})	57	37	31	32	31	19	1	35 (A)
NR20 & Moorhouse Curve Criteria	47[1]	41[1]	30	23	20	16	14	25 (A)
Exceedance of Criteria	+10	-4	+1	+9	+11	+3	-13	+10

Notes:
[1] *Moorhouse Curve at 63Hz and 125Hz.*

Table 24 – Noise Breakthrough Assessment – Existing Party Floor from Hill Street Social

As can be seen, the predicted noise levels within the proposed residential spaces exceed the target criteria. As such, further sound insulation measures are required.

Recommendations & Mitigation Measures

To achieve the required criteria, it is recommended that the existing concrete floor be upgraded, as outlined below. This must be implemented in apartment spaces above the “Hill Street Social” pub.

Proposed Upgrade:

- Minimum 18mm Flooring Particle board (min. surface mass 12kg/m^2)
- 1no. 22m Cement Particle board (min. surface mass 28kg/m^2)
- Batten and cradle suspended timber flooring system with 50mm mineral wool insulation (minimum density 45kg/m^3)
- Existing 280mm concrete floor (assumed density 1800kg/m^3)

The noise breakthrough assessment considering the proposed sound insulation upgrades is shown in the table overleaf.

Description	1/1 Octave Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Internal Noise Level of Bar (L_{eq})	93	85	86	89	91	86	78	94 (A)
Predicted Sound Reduction of Upgraded Floor (D_{nT})	46	60	70	>80	>80	>80	>80	70 ($D_{nT,w}$)
Furnished Bedroom Reverberation Time Correction	-0.1	-0.5	-0.8	-1.2	-1.2	-1.7	-2.8	--
Predicted Internal Noise Level within Adjacent Residential (L_{eq})	47	25	15	8	10	4	-5	22 (A)
NR20 & Moorhouse Curve Criteria	47[1]	41[1]	30	23	20	16	14	25 (A)
Exceedance of Criteria	**0**	**-16**	**-15**	**-15**	**-10**	**-12**	**-19**	**-3**

Notes:
[1] *Moorhouse Curve at 63Hz and 125Hz.*

Table 25 – Noise Breakthrough Assessment – Upgraded Party Floor from Hill Street Social

It should be noted that this is an indicative specification that can achieve the required acoustic performance and considers that all flanking routes for sound have been appropriately suppressed. As with any construction project, the ability to meet the specification will rely upon the quality of the built structure. As such the works should be carried out to a high standard of workmanship to ensure that any sound insulation measures are not breached, for example by installing a rigid connection across an isolated connection.

The development cannot achieve compliance until sound insulation testing is carried out by a UKAS accredited sound insulation testing company upon completion and assessed against the required sound insulation standard.

9. BS4142 Plant Noise Limit Levels

9.1 BS4142 Fixed Plant Noise Limit Levels

As there may be a requirement to install secondary mechanical ventilation systems to the rear of the development site, plant noise limit levels have been defined to ensure that the noise emissions do not exceed the background sound levels at the closest NSRs.

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)
Lowest Background Sound Level (Table 4, $L_{90,15min}$)	46	38
Cumulative Plant Noise Limit Level at NSR ($L_{r,Tr}$)	46	38
BS4142 Assessment Outcome	**'Low Impact'**	
NPSE & NPPF Assessment Outcome	**'No Observed Adverse Effect Level' ('NOAEL')**	

Table 26 – BS4142 External Plant Noise Limit Levels

As can be seen, provided the plant limit levels are adhered to, the cumulative noise emissions from the external plant equipment should not exceed the 'lowest typical' background sound levels at any NSR.

When assessed in accordance with BS4142 this would be an indication of 'low impact', and when assessed with the NPPF and NPSE this would be considered to align with a 'No Observed Adverse Effect Level' ('NOAEL').

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

10. 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 can be achieved.

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

1. The proposed glazing specifications, or suitable alternatives, should be installed as shown in Section 5.3.
2. Due to the expected noise impact predicted in Section 4 and the 'Agent of Change' principle outlined in Section 5, it is recommended that an alternative means of ventilation is provided for all dwellings along the green façades. The ventilation systems must be compliant with the requirements of Approved Document F and should be capable of providing the following:
    a. Background ventilation
    b. Purge ventilation
    c. Overheating mitigation
3. An overheating screening assessment is presented in Section 6. In summary, an alternative means of ventilation must be provided for the provision of overheating. NOVA Acoustics LTD has been informed that FCU (Monobloc AC Units) shall be installed across the development, therefore, occupants will not be required to rely on open windows for overheating control.
4. General design advice and criteria is provided for any mechanical ventilation systems. This is provided in Section 7.
5. The separating floor between the structurally adjoining commercial property and the proposed development has been assessed in Section 8. An indicative specification has been provided to mitigate noise predicted to breakthrough from the "Hill Street Social" pub. Further design assistance can be provided by NOVA Acoustics if required.
6. BS4142 plant limit levels have been defined for any externally fixed mechanical plant equipment that may be required to service the proposed development. This is detailed in Section 9.

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 $p0$ is the reference sound pressure (20 µPa)
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 $p0$ is the reference sound pressure (20 µPa)
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 27 – 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 – 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 13dB. 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.

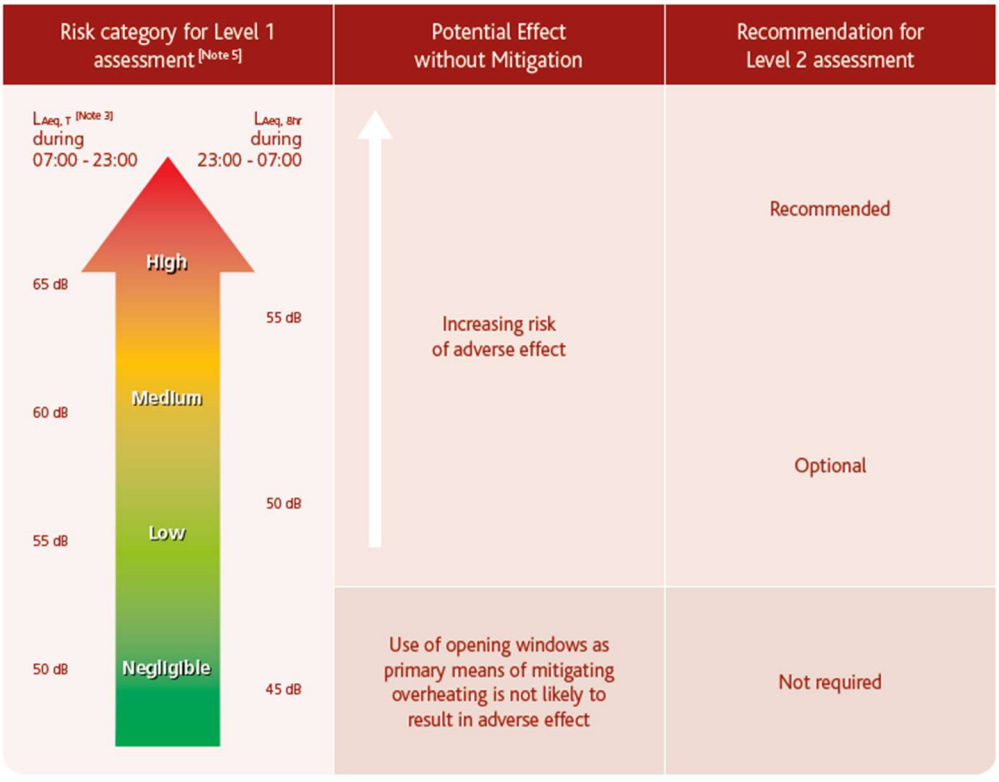


Table 3-2 of AVO Guide (2020)

Figure 7 – 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 $L_{Aeq,16hour}$	≥55 dB $L_{Aeq,8hour}$	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 $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤53 dB $L_{Aeq,16hour}$	≤48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 28 – 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.

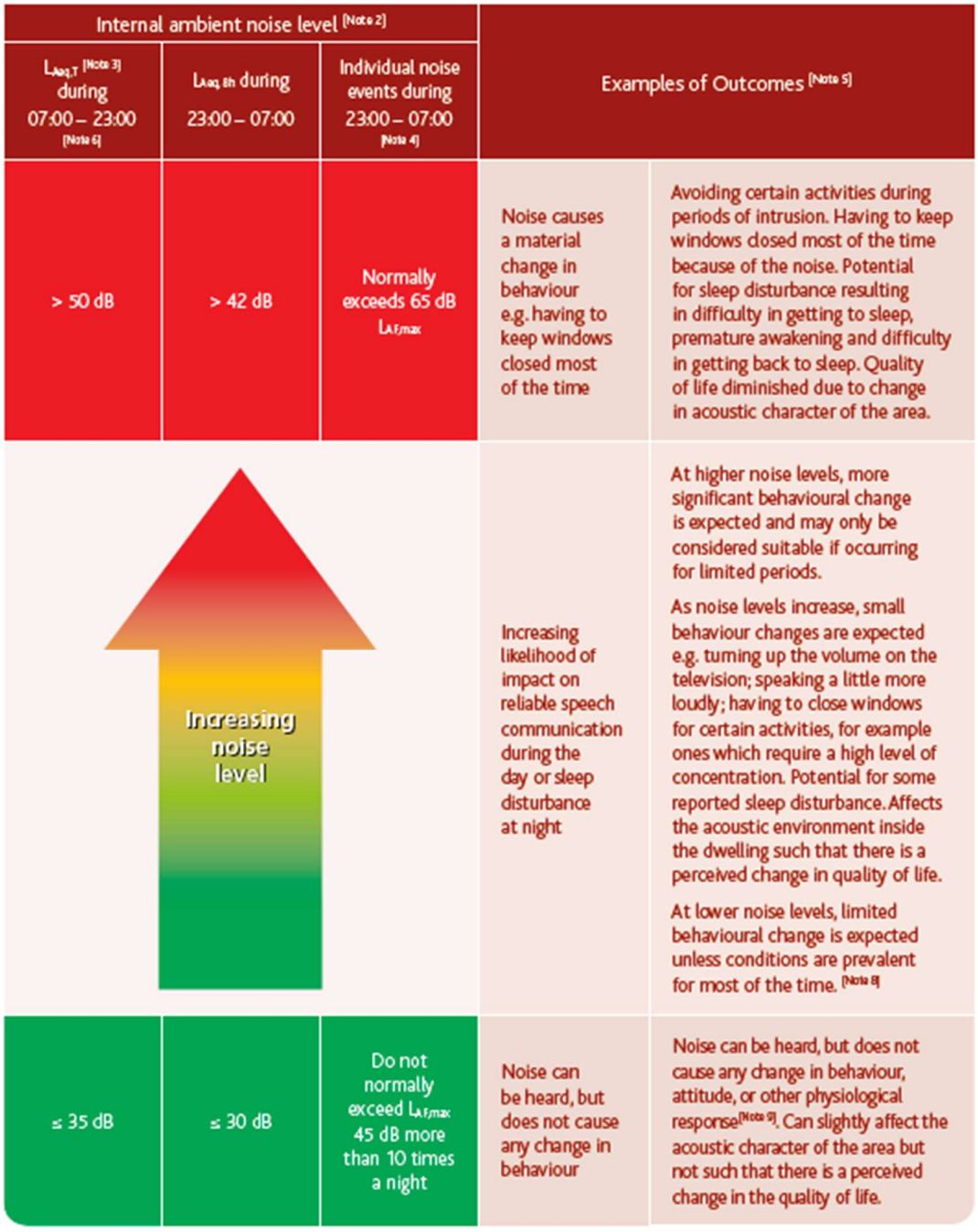


Table 3-3 of AVO Guide (2020)

Figure 8 – AVO Guide Level 2 Internal Ambient Noise Levels

B.5 – 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 $L_{Ar,Tr}$ '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."*

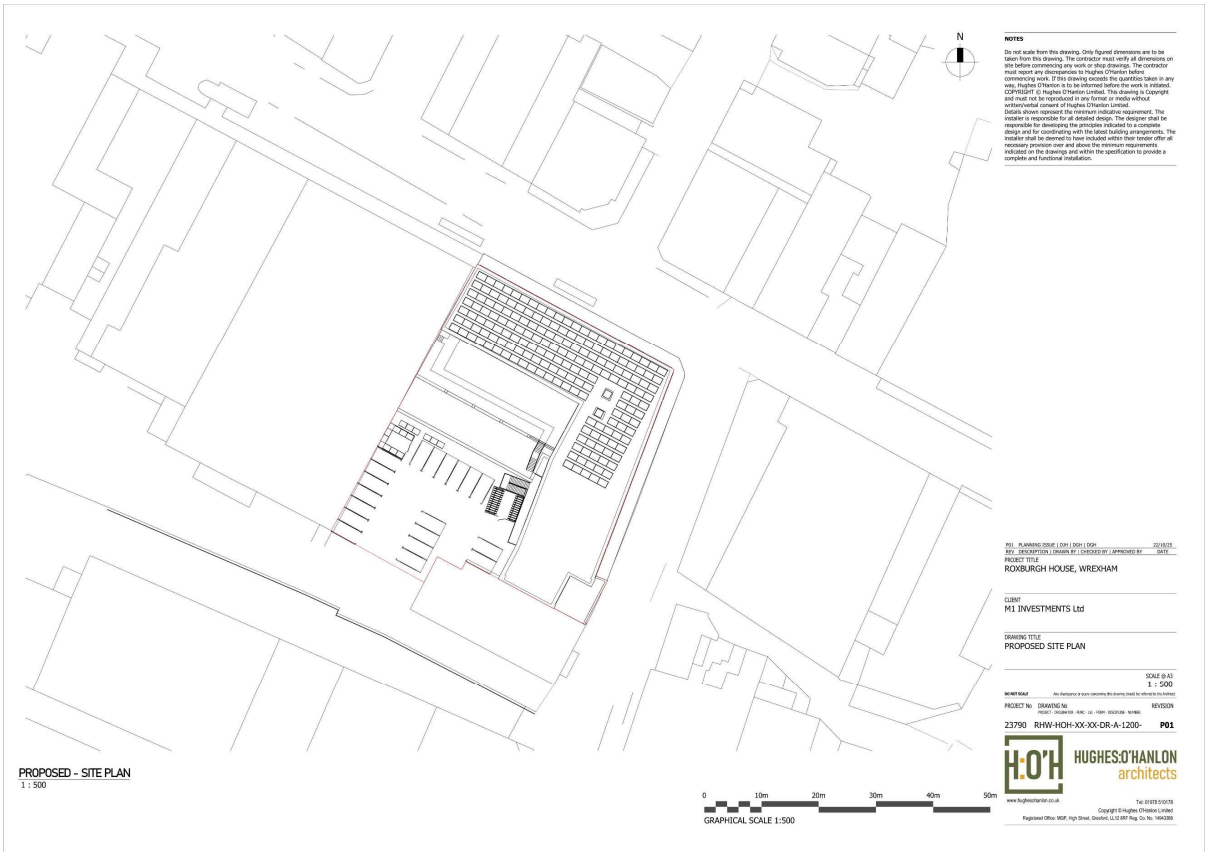
Interpreting the guidance given in BS4142, with consideration of the guidance given in the NPSE and NPPG Noise, an estimation of the impact of the rating sound is summarised in the following text:

- 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'.

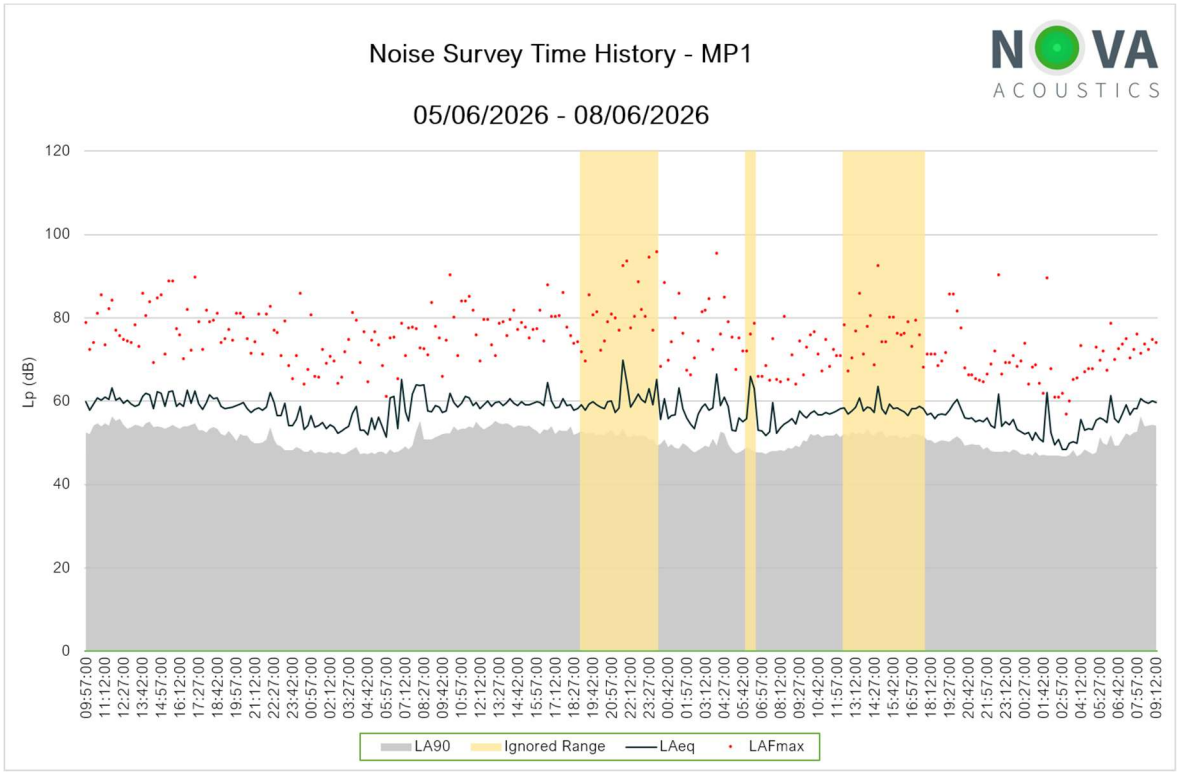
During the daytime, the assessment is carried out over a reference time period of 1-hour. The periods associated with day or night, for the purposes of the Standard, are 07.00 to 23.00 and 23.00 to 07.00, respectively.

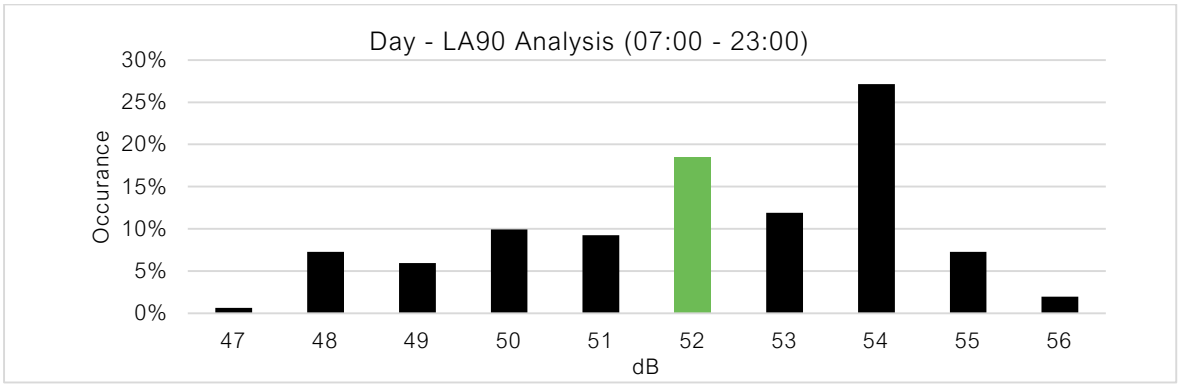
Appendix C – Site/Location Plans



Appendix D – Environmental Survey

D.1 – Time History Noise Data





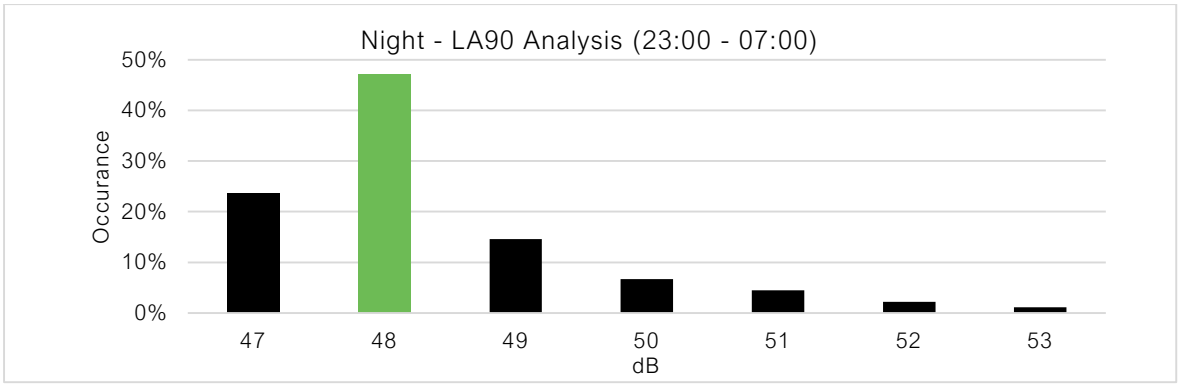
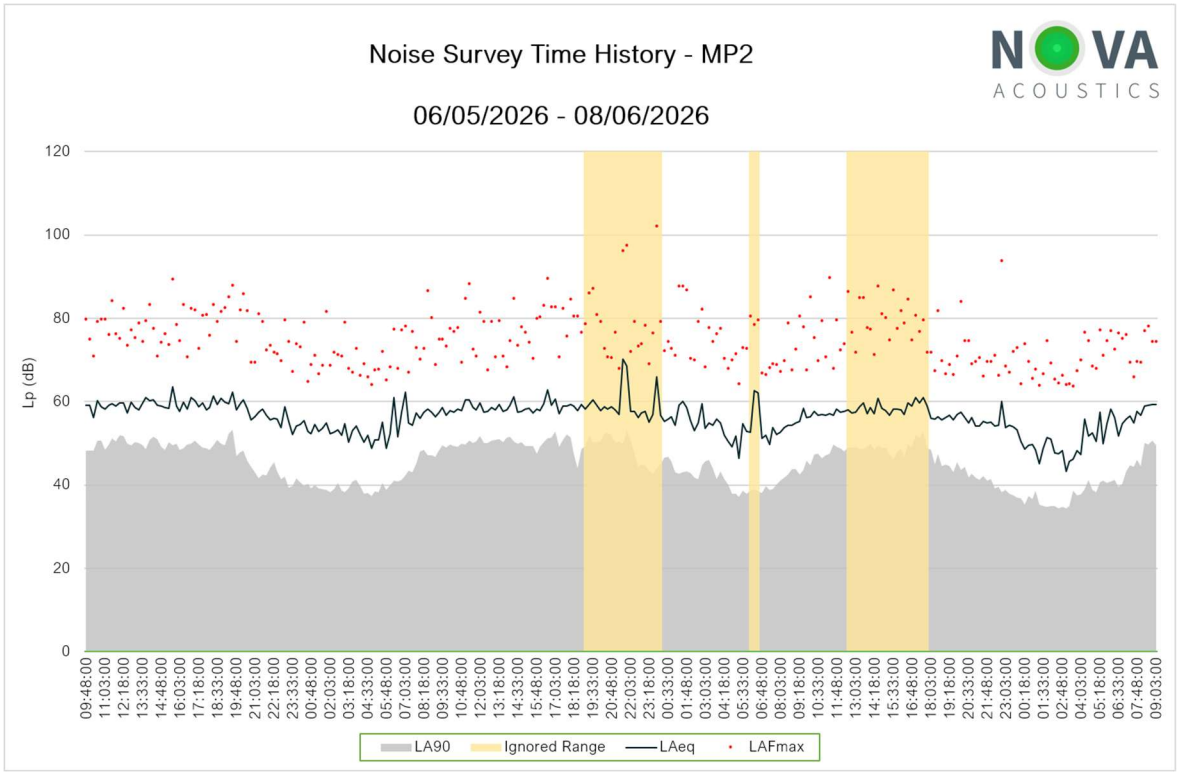
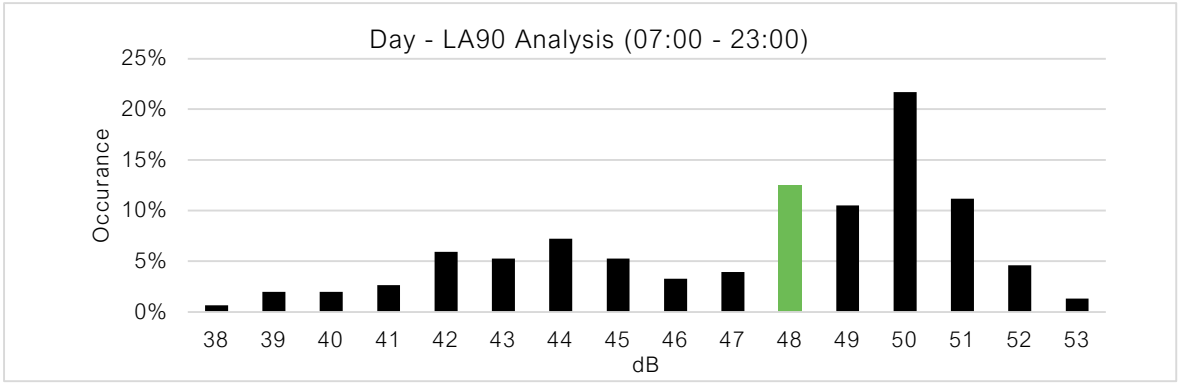


Figure 9 – MP1 Noise Survey Time History & Histograms





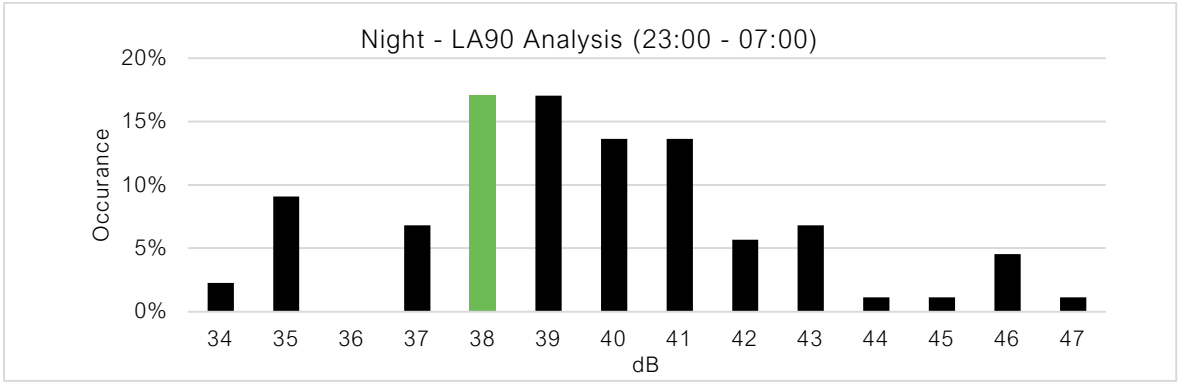


Figure 10 – MP2 Noise Survey Time History & Histograms

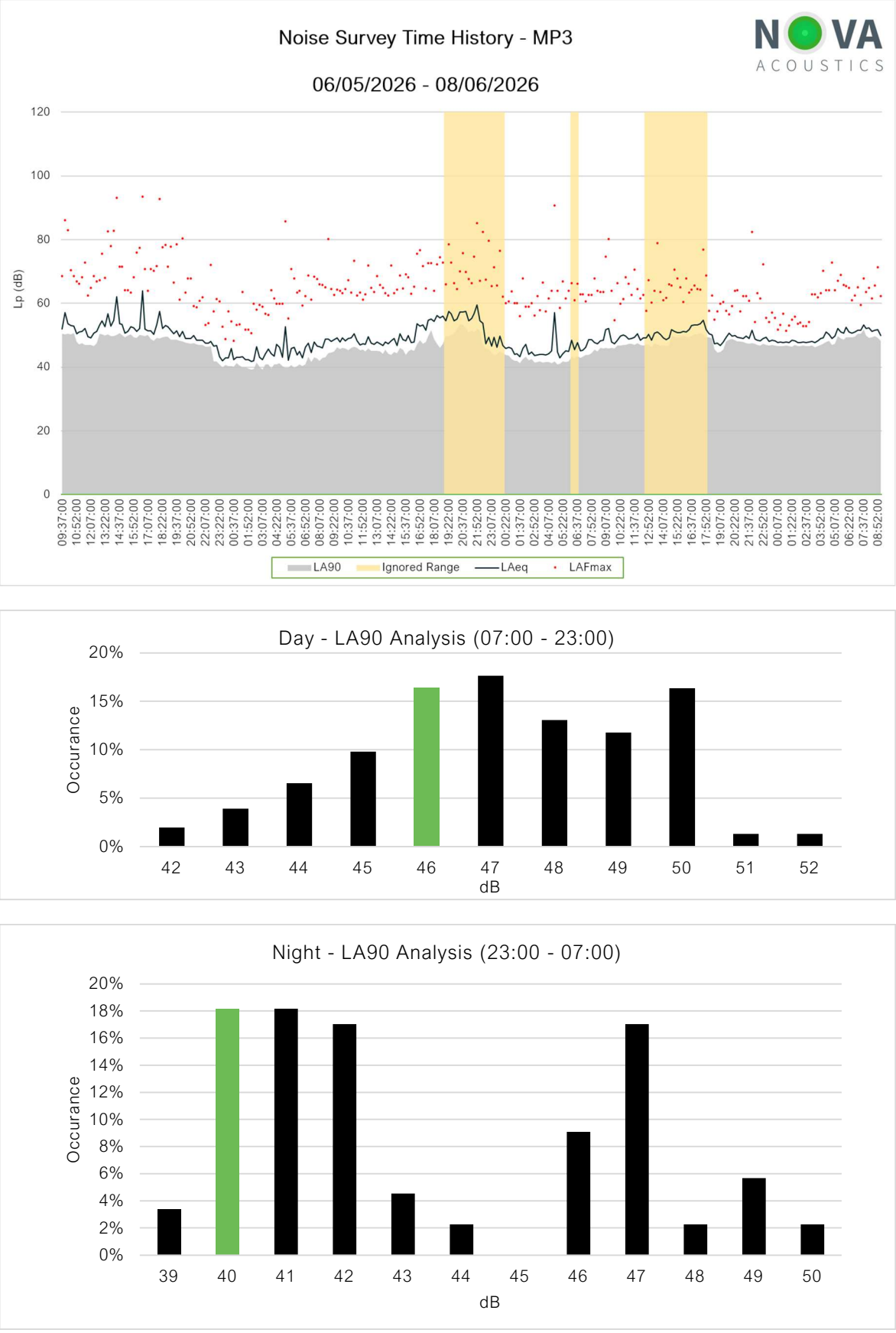


Figure 11 – MP3 Noise Survey Time History & Histograms

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SV971A Class 1 Sound Level Meter	141346	≤0.1
Svantek SV971A Class 1 Sound Level Meter	143583	≤0.1
Svantek SV971A Class 1 Sound Level Meter	141414	≤0.1
Svantek SV977 Class 1 Sound Level Meter	97493	≤0.1
Cesva CB006 Class 1 Calibrator	901927	--

Table 29 – 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.

D.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 – Erbistock (Approx. 7.3km S of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
05/06/26: 00:00 – 23:59	12.6 – 16.6	0.0	SW	0.8 – 3.1
06/06/26: 00:00 – 23:59	12.9 – 17.4	0.0	W	0.2 – 3.2
07/06/26: 00:00 – 23:59	12.4 – 20.2	0.0	SW	0.1 – 6.4
08/06/26: 00:00 – 23:59	11.8 – 17.0	0.0 – 3.6	W	0.1 – 3.8

Notes:
When cross referencing the weather data time history with the recorded noise level, it is apparent that gusty window conditions affected the noise level on three separate occasions. These periods are annotated on the time histories in appendix D. Rain had no adverse effect on noise levels.

Table 30 – Survey Weather Conditions

Appendix E – Noise Break-in Calculations

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 in living rooms and 0.3 seconds in bedrooms across the relevant frequency range for unfurnished and furnished living spaces in the UK respectively. These figures have been used in break-in calculations.
- Based on the technical drawings provided to NOVA Acoustics, the window areas and room volumes below were used as a worst-case scenario for calculations:

Room / Building Element	Glazing Area (m^2)	Room Volume (m^3)
MP1 Living Rooms	7.4	53.6
MP1 Bedrooms	2.6	29.8
MP2 Living Rooms	7.4	52.9
MP2 Bedrooms	5.2	32.3
MP3 Living Rooms	7.4	41.6
MP3 Bedrooms	5.2	30.1

- 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.
- For background trickle ventilation a total Equivalent Area of 5000mm^2 per habitable room has been used in the calculations, which equates to 2no. trickle vents (2500mm^2 each).

Living Room (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	60	65	60	58	56	55	51	47	43
Glazing Noise Ingress	25	38	31	31	22	10	6	0	-4
Ventilation Noise Ingress	15	31	15	15	15	5	5	-3	-7
Wall Noise Ingress	7	20	16	12	1	-4	-13	-18	-22
Roof Noise Ingress	8	28	18	10	2	-6	-23	-62	-66
Room Absorption Correction		5	5	5	4	4	4	3	1
Total Noise Ingress	**33**	**47**	**39**	**38**	**30**	**18**	**15**	**7**	**2**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-2	0	-2	-1	-3	-12	-11	-17	-20

Bedroom (MP1) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	60	65	60	58	56	55	51	47	43
Glazing Noise Ingress	16	34	28	20	8	-3	-7	-18	-22
Ventilation Noise Ingress	17	33	17	17	17	7	7	-1	-5
Wall Noise Ingress	8	21	18	13	3	-3	-12	-16	-20
Roof Noise Ingress	7	27	18	10	2	-6	-24	-62	-66
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**26**	**44**	**36**	**29**	**23**	**14**	**12**	**3**	**-2**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-9	-3	-5	-10	-10	-16	-14	-21	-24

Bedroom (MP1) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	58	63	58	57	54	55	49	42	37
Glazing Noise Ingress	14	32	26	19	7	-4	-9	-22	-28
Ventilation Noise Ingress	15	31	15	15	15	6	4	-5	-11
Wall Noise Ingress	6	19	16	12	1	-3	-14	-21	-26
Roof Noise Ingress	5	26	16	8	0	-7	-26	-66	-72
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**24**	**42**	**34**	**27**	**22**	**13**	**10**	**-1**	**-8**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-6	-5	-7	-8	-6	-12	-11	-20	-25

Bedroom (MP1) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	82	74	67	70	73	79	76	71	65
Glazing Noise Ingress	28	43	36	31	25	20	18	6	1
Ventilation Noise Ingress	37	41	25	28	34	30	32	23	18
Wall Noise Ingress	24	30	25	25	20	21	13	8	2
Roof Noise Ingress	21	36	25	21	19	17	1	-38	-43
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**43**	**52**	**43**	**40**	**40**	**37**	**37**	**27**	**21**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-2	-15	-13	-9	-3	-3	0	-7	-12

Living Room (MP2) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	58	65	59	57	54	54	50	45	39
Glazing Noise Ingress	23	38	31	29	20	9	6	-2	-8
Ventilation Noise Ingress	14	31	15	13	14	4	4	-5	-11
Wall Noise Ingress	5	20	16	10	0	-5	-14	-20	-26
Roof Noise Ingress	7	28	18	9	1	-7	-24	-64	-69
Room Absorption Correction		5	5	5	4	4	4	3	1
Total Noise Ingress	**32**	**47**	**39**	**37**	**29**	**17**	**15**	**5**	**-2**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-3	0	-2	-2	-4	-13	-11	-19	-24

Bedroom (MP2) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	58	65	59	57	54	54	50	45	39
Glazing Noise Ingress	18	37	31	21	9	-1	-5	-17	-23
Ventilation Noise Ingress	15	33	16	15	15	6	6	-3	-9
Wall Noise Ingress	6	21	17	11	0	-4	-13	-19	-25
Roof Noise Ingress	6	28	18	8	0	-7	-24	-64	-70
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**26**	**45**	**37**	**28**	**22**	**12**	**11**	**1**	**-6**
NR30 & Moorhouse	35	47	41	39	33	30	26	24	22
Exceedance of Criteria	-9	-2	-4	-11	-11	-18	-15	-23	-28

Bedroom (MP2) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	54	62	56	53	50	51	46	38	35
Glazing Noise Ingress	14	33	27	17	5	-5	-10	-24	-26
Ventilation Noise Ingress	11	29	13	11	11	2	1	-10	-13
Wall Noise Ingress	2	17	13	7	-4	-8	-18	-26	-28
Roof Noise Ingress	3	24	14	4	-4	-11	-29	-71	-73
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**23**	**42**	**34**	**25**	**18**	**9**	**7**	**-6**	**-10**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-7	-5	-7	-10	-10	-16	-14	-25	-27

Bedroom (MP2) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	80	75	73	71	77	77	71	64	55
Glazing Noise Ingress	33	47	44	36	32	21	15	2	-7
Ventilation Noise Ingress	36	42	30	29	38	28	26	16	7
Wall Noise Ingress	24	30	30	25	23	18	7	0	-9
Roof Noise Ingress	23	37	31	23	23	15	-4	-45	-54
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**44**	**55**	**51**	**43**	**45**	**35**	**32**	**20**	**10**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-1	-12	-5	-6	2	-5	-5	-14	-23

A 1-2dB exceedance of the NR criteria is deemed negligible as the overall BS8233 criterion is achieved.

Living Room (MP3) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	62	60	63	57	54	53	52	58	52
Glazing Noise Ingress	18	29	31	23	9	-2	-2	-4	-10
Ventilation Noise Ingress									
Wall Noise Ingress	7	14	19	10	-1	-7	-12	-6	-13
Roof Noise Ingress	7	22	22	8	1	-9	-22	-50	-57
Room Absorption Correction		6	5	5	4	4	4	3	1
Total Noise Ingress	**27**	**38**	**40**	**31**	**17**	**7**	**6**	**4**	**-4**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-3	-9	-1	-4	-11	-18	-15	-15	-21

Bedroom (MP3) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	62	60	63	57	54	53	52	58	52
Glazing Noise Ingress	18	28	30	22	8	-3	-2	-4	-11
Ventilation Noise Ingress									
Wall Noise Ingress	7	15	20	11	0	-6	-11	-6	-12
Roof Noise Ingress	7	22	21	8	0	-9	-23	-51	-57
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**24**	**36**	**38**	**29**	**15**	**5**	**3**	**2**	**-6**
NR25 & Moorhouse	30	47	41	35	28	25	21	19	17
Exceedance of Criteria	-6	-11	-3	-6	-13	-20	-18	-17	-23

Bedroom (MP3) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	53	50	49	46	44	44	44	49	32
Glazing Noise Ingress	6	19	17	12	-1	-11	-10	-13	-31
Ventilation Noise Ingress									
Wall Noise Ingress	-4	6	7	1	-9	-14	-19	-14	-32
Roof Noise Ingress	-5	13	8	-2	-9	-17	-30	-59	-77
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**13**	**27**	**24**	**18**	**6**	**-3**	**-4**	**-7**	**-26**
NR20 & Moorhouse	25	47	41	30	23	20	16	14	12
Exceedance of Criteria	-12	-20	-17	-12	-17	-23	-20	-21	-38

Bedroom (MP3) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	65	61	61	55	53	61	60	51	41
Glazing Noise Ingress	16	29	28	20	7	6	5	-12	-21
Ventilation Noise Ingress									
Wall Noise Ingress	7	16	18	9	-1	2	-4	-13	-23
Roof Noise Ingress	6	23	19	6	-1	-1	-15	-58	-68
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**23**	**37**	**35**	**27**	**14**	**14**	**11**	**-5**	**-16**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-22	-30	-21	-22	-29	-26	-26	-39	-49


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