

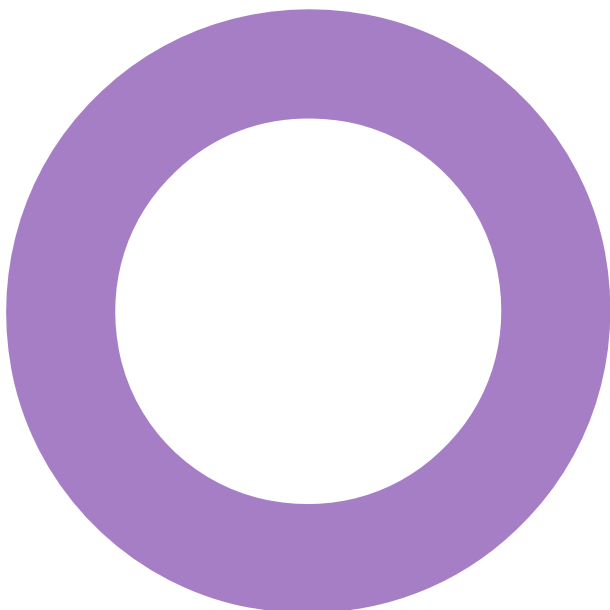
Albert Bridge House. Manchester.

Oval Real Estate.

ACOUSTICS

ENVIRONMENTAL NOISE SURVEY

REVISION 02 – 02 DECEMBER 2022



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	19/09/2022	For issue / comment	BRD	BRD/TH	BRD
02	02/12/2022	Updated following client comments	BRD	BRD/TH	BRD

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Project number: 10/13862

Document reference: REP-1013862-5A-BRD-20221202-Environmental Noise Survey-Rev02.docx

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Executive summary.

Hoare Lea has conducted an environmental noise survey for the proposed development known as Albert Bridge House, Manchester.

The following summarises the assessment procedure and findings contained within this report:

- Environmental noise monitoring was undertaken at the proposed development site across a seven-day period between Wednesday 2nd March 2022 and Wednesday 9th March 2022.
- Noise emission levels associated whilst nearby externally located amplified music events were happening was undertaken on 26 August 2022.
- Background noise levels typical of the daytime and night-time have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptors.
- The nearest receptors have been identified as the proposed development itself. Other commercial and residential properties adjacent to the development have also been identified.
- During the daytime and night-time, the combined building services plant noise emission contribution limit advised is 45 dB(A) and 39 dB(A) respectively, one metre from the nearest residential facade. This limit applies to all plant for both residential and office.
- An assessment of the residential building envelope acoustic performance is provided and indicates the ventilation strategy should allow for future residents to close windows if they choose to do so. This is because external noise levels are sufficiently high that would mean internal noise levels would exceed criteria considered reasonable when windows / doors are open for long periods. This means a suitable mechanical ventilation system is required to mitigate summertime overheating with relying on an open door / window. Short periods of opening a door or window would be acceptable, such as required for rapid ventilation.
- The proposed office building is exposed to noise levels where a mixed mode of ventilation could be possible. Further details of the ventilation strategy will be developed but in essence, the use of attenuated openings in the facades should be possible to help ventilate the building whilst maintaining a suitable internal noise climate. A mixed mode of ventilation as per the mechanical engineer design.
- Notional glazing requirements and indicative glazing configurations have been provided for guidance purposes only. It should be noted that the defined performances for glazed elements are for guidance purposes only. Detailed calculations will be required to determine refined glazing requirements during detailed design.
- On the basis of the guidance contained within this report, it is concluded that the Site is suitable for the proposed development.
- The guidance provided within this report is sufficient to satisfy the requirements of Manchester City Council, in our professional opinion.

1. Introduction.

Hoare Lea has been appointed by Oval Real Estate to conduct an environmental noise survey to support the planning application for the proposed development known as Albert Bridge House, Manchester.

The proposal comprises the construction of a mixed-use development across two buildings. One building is a residential tower whilst the other is a commercial building, and both have associated building services plant.

An environmental noise survey is required to quantify the existing ambient and background noise levels at the site in order to establish the design constraints on noise emissions from the operation of plant. The noise survey also provides information required to establish the acoustic performance of the building façade and ventilation strategy to ensure the residential accommodation and commercial building is in accordance with the Local Authority requirements and current guidance.

This report provides a description of the results from the noise survey undertaken, an assessment to determine the external noise limits for building services plant required to meet the Local Authority's general noise emission limits and advice regarding the building envelope and ventilation strategy.

To aid in the understanding of the assessment, definitions of technical terms used have been included in Appendix A.

2. Site description.

2.1 Existing site.

The site is located on land to the north of Bridge Street and bounded to the Southeast by St Mary's Parsonage and to the Northeast by the River Irwell in Manchester. There is an existing 18-storey office block and car parking.

The proposed site red line boundary (indicative only) is identified in Figure 1 below.

2.2 Local noise environment.

The surrounding noise climate is predominantly formed of road traffic noise on Albert Bridge Road. There are entertainment venues also in the local area which are also discussed later in this report.

Figure 1: Existing site (red line boundary indicative only) © Google Earth.



3. Basis of assessment.

3.1 National planning policy framework (NPPF): 2021.

The revised National Planning Policy Framework (1) published in July 2021 sets out the Government's current planning policies for England and how these are expected to be applied. The NPPF supersedes the previous NPPF published in June 2019.

With regards to local noise and vibration, paragraph 185 states:

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

- a) mitigate and reduce to a minimum potential adverse impacts 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."*

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have *"a single objective noise-based measure...that is applicable to all sources of noise in all situations"*. It further advises that the sound level at which an adverse effect occurs is *"likely to be different for different noise sources, for different receptors and at different times"*.

In the absence of specific guidance for assessment of environmental noise within the NPPF and the NPSfE, it is considered appropriate to base assessment on current British Standards and national guidance. These are considered to be Local Authority guidance, BS 4142 (2), BS 8233 (3) and the World Health Organisations (4) (WHO) guidelines.

3.2 BS 4142: 2014 + A1: 2019 – Methods for rating & assessing industrial & commercial sound.

Current Government advice to Local Planning Authorities in both England and Wales makes reference to BS 4142 as being the appropriate guidance for assessing commercial operations and fixed building services plant noise. This British Standard provides an objective method for rating the likelihood of complaint from industrial and commercial operations. It also describes means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The assessment of impacts is based on the subtraction of the measured background noise level from the rating level determined. The rating level is the source noise level (either measured or predicted) corrected for tone or character (if necessary). The difference is compared to the following criteria to evaluate the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact.
- A difference of around +5 dB indicates is likely to be an indication of an adverse impact.
- Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact.

This method is only applicable for external noise levels.

3.3 BS 8233: 2014 – Guidance on sound insulation and noise reduction for buildings.

BS 8233: 2014 provides guidance for control of noise in and around buildings and suggests appropriate criteria and limits for different situations. The criteria and limits are primarily intended to guide the design of new or refurbished buildings undergoing a change of use.

Table 4 within BS 8233 provides desirable internal ambient noise levels for spaces in residential dwellings when they are unoccupied.

Activity	Location	Daytime (0700 to 2300)	Night-Time (2300 to 0700)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room / Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Table 1: Indoor ambient noise levels in spaces for dwellings.

Supplementary Note 2 and 4 to Table 4 within BS 8233 are copied below for reference:

'NOTE 2 – the levels shown in Table 4 are based on the existing guidelines issued by the WHO...'

'NOTE 4 – regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night.'

3.4 Local planning policy.

3.4.1 Manchester City Council Planning & Noise Technical Guidance June 2022

Manchester Council has recently reset priorities up to 2025, refocusing on the challenges – pitting equality, inclusion and sustainability centre stage, with a renewed focus on young people, out economy, health, housing, environment and infrastructure.

The guidance aims to provide help and advice in relation to noise in a planning context to encourage good acoustic design. It outlines what is expected in relation to current guidance and policy with the aspiration that new developments achieve the highest possible standards without compromising the health and wellbeing of people that live and work within the City of Manchester.

The Council has adopted the following noise limits for **residential properties**:

- Bedrooms (night time 23.00-07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB $L_{Amax,F}$ by more than 10 times).
- Living Rooms (daytime 07.00-23.00) 35 dB L_{Aeq} .
- Gardens and terraces (daytime) 55 dB L_{Aeq} .

In respect of assessing music noise impacting on the proposed development, the 63 Hz and 125 Hz octave band levels should be assessed. It is stated that; **Music noise levels in the 63Hz and 125Hz octave bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB ($L_{eq,15min}$) respectively.**

Reference is also made to industrial sources associated with the development. These would apply for proposed building services plant. The Council considers the following as applicable: **The development should be designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.**

Lastly, the guidance recommends an approach to acoustic assessments for new residential development that take due regard of the interdependence of provisions for acoustics, ventilation and overheating.

3.5 BCO: British Council for Offices Guidance

Criteria for internal noise levels are presented in BCO Specification Guidance documents. These are shown in Table 2.

Location	Indoor ambient noise level (NR)	Maximum noise level due to noise ingress (dB $L_{A,f,max}$)
Open plan office	NR 40 ($L_{eq,T}$)	35-45 dB $L_{Aeq,T}$
Speculative office	NR 38 ($L_{eq,T}$)	35-40 dB $L_{Aeq,T}$
Cellular office/meeting rooms	NR 35 ($L_{eq,T}$)	45-50 dB $L_{Aeq,T}$

Table 2: BCO indoor ambient noise levels for offices.

On the use of natural ventilation, the BCO guide states that “it may be appropriate to accept higher external noise intrusion levels than shown above in maximum ventilation mode, provided occupants have the choice to open or close windows or ventilation openings. For example, +5 dB relaxation of $L_{eq,T}$ levels and/or +5 to 10 dB relaxation of $L_{A,f,max}$ levels depending on frequency of occurrence and character of noise”.

3.6 Proposed Acoustic Standards.

On the basis of guidance contained within local planning policy, it is deemed appropriate to base the assessment on guidance provided within current British Standards. These are BS 4142: 2014 + A1: 2019 and BS 8233: 2014.

3.6.1 Building services – noise.

On the basis of guidance contained within BS 4142: 2014 + A1: 2019, noise emissions from building services plant shall be designed to achieve the following noise emission limits.

Noise source	Noise emission limit
Building services plant	$L_{A,r,Tr} = L_{A90,T} - 5dB$

Table 3: Noise emission limits for building services.

3.6.2 Environmental noise – internal noise levels (Residential)

On the basis of the requirements detailed within BS 8233: 2014, the residential development shall be designed to enable achievement of the internal noise levels stated within Table 4.

Location	Daytime (0700 to 2300)	Night-Time (2300 to 0700)
Residential dwellings		
Living room	35 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ & 45 dB $L_{Amax,T}^*$

Table 4: Proposed internal noise levels.

Note *: 45 dB L_{AFmax} to be exceeded no more than 10 times per night-time from sources other than emergency sirens.

3.6.3 Environmental noise – internal noise levels (Office)

Location	BCO	BS8233
	Indoor ambient noise level (NR)	Indoor ambient noise level (L_{Aeq})
Open plan office	NR 40 ($L_{eq,T}$)	45 – 50

	BCO	BS8233
Speculative office	NR 38 ($L_{eq,T}$)	45 – 50
Cellular office/meeting rooms	NR 35 ($L_{eq,T}$)	35 – 45

Table 5: BCO and BS8233 indoor ambient noise levels for offices.

3.6.4 Music noise intrusion

In accordance with Manchester Council policy on entertainment noise, the proposed development shall provide sufficient facade acoustic performance so not to exceed music noise levels, in habitable rooms, of 47dB and 41dB ($L_{eq,15min}$) in the 63Hz and 125Hz octave bands respectively.

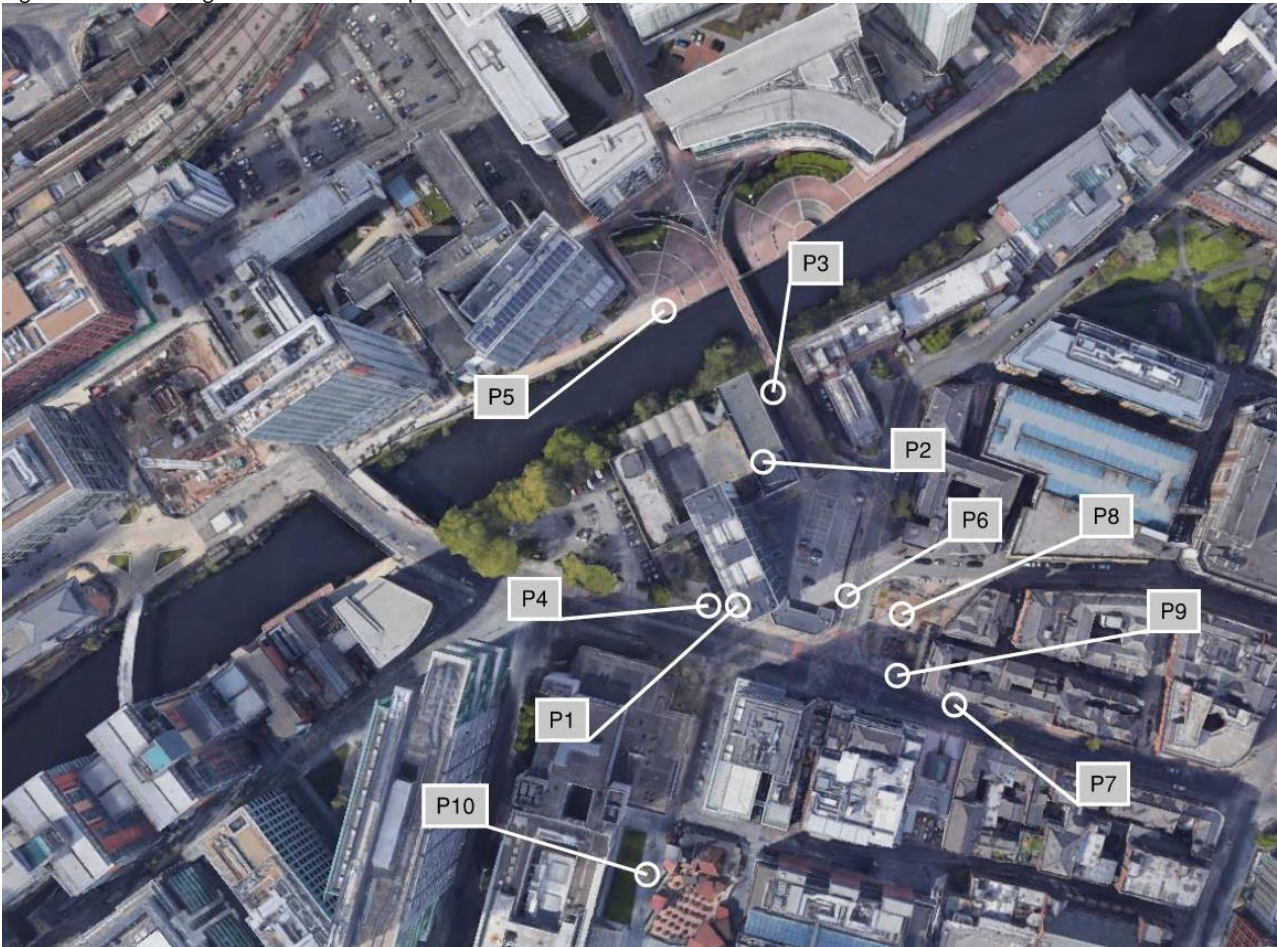
4. Environmental noise survey.

An acoustic survey has been carried out at the site to establish the prevailing environmental noise conditions local to the site.

4.1 Methodology.

Noise measurements on Site were acquired by use of automatic unattended logging sound level meters and hand-held sound level meters during attended measurements. Ten measurement positions were used as shown in Figure 2.

Figure 2: Plan showing noise measurement positions



The unattended measurement positions P1 and P2 were selected to be secure locations for leaving the equipment for the duration of the survey period.

The daytime attended measurement positions P3 to P6 inclusive were selected to widen the measurement area and to permit observation of differences by comparison to the unattended positions P1 and P2.

The night attended measurements positions P7 to P10 inclusive were selected to quantify the influence of late-night amplified music and entertainment noise located externally.

All noise measurements were taken at a height of approximately 1.2 m above local ground level under 'free-field' conditions, except positions P1 and P2 which were 1.2 m above the roof deck height and position P7 which was a 'façade' measurement. The acoustic measurement parameters obtained were $L_{Aeq,T}$ dB (ambient noise), $L_{Amax,T}$ dB (maximum event) and $L_{A90,T}$ dB (background).

Table 6 provides a summary description of the measurement periods at each position.

Table 6: Noise measurement positions

Position Reference	Approximate Measurement Height m	Measurement Conditions	Start Date and Time	End Date and Time
P1	65.2	Unattended 'Free-field'	10:45 hours Wednesday 2 nd March 2022	11:45 hours Wednesday 9 th March 2022
P2	23.2	Unattended 'Free-field'	10:15 hours Wednesday 2 nd March 2022	11:45 hours Wednesday 9 th March 2022
P3	1.2	Attended 'Free-field'	10:37 hours to 11:17 hours on Wednesday 2 nd March 2022*	09:31 hours to 09:46 hours on Wednesday 9 th March 2022*
P4	1.2	Attended 'Free-field'	11:19 hours to 11:49 hours on Wednesday 2 nd March 2022*	10:33 hours to 10:48 hours on Wednesday 9 th March 2022*
P5	1.2	Attended 'Free-field'	09:48 hours Wednesday 9 th March 2022	10:19 hours Wednesday 9 th March 2022
P6	1.2	Attended 'Free-field'	10:50 hours Wednesday 9 th March 2022	11:30 hours Wednesday 9 th March 2022
P7	1.2	Attended 'Façade'	23:06 hours Friday 26 th August 2022	23:14 hours Friday 26 th August 2022
P8	1.2	Attended 'Free-field'	23:08 hours Friday 26 th August 2022	23:09 hours Friday 26 th August 2022
P9	1.2	Attended 'Free-field'	23:09 hours Friday 26 th August 2022	23:11 hours Friday 26 th August 2022
P10	1.2	Attended 'Free-field'	23:16 hours Friday 26 th August 2022	23:20 hours Friday 26 th August 2022

Note * indicates a start time and end time on the same day, for measurements undertaken on two separate visits.

Record images of noise measurement positions P1 to P6 used are provided in Figure 3 below.

Figure 3: Photos of measurement positions



P1 Unattended Measurement Location



P2 Unattended Measurement Location



P3 Attended Measurement Location



P4 Attended Measurement Location



P5 Attended Measurement Location



P6 Attended Measurement Location

4.2 Environmental Noise Measurement Equipment

Three sets of sound measurement equipment were used on Site for which the details are provided below.

Measurement position P1:

- Rion - Sound Level Meter: NL-52 SN: 01143558
- Rion - Pre-amplifier: NH-25 SN: 43575
- Rion - Microphone: UC-59 SN: 07367
- External calibration date 10/01/2022
- External calibration certificate reference UCRT22/1036

Measurement position P2:

- Rion - Sound Level Meter: NL-52 SN: 00510142
- Rion - Pre-amplifier: NH-25 SN: 31928
- Rion - Microphone: UC-59 SN: 02847
- External calibration date 15/02/2022
- External calibration certificate reference UCRT22/1234

Measurement positions P3 to P6 P10:

- Brüel and Kjær - Sound Level Meter: 2250 SN: 3003815
- Brüel and Kjær - Pre-amplifier: ZC-0032 SN: 29116
- Brüel and Kjær - Microphone: 4189 SN: 2887159
- External calibration date 16/11/2021
- External calibration certificate reference UCRT21/2413

Local calibration was undertaken before and after each set of measurements. No significant drift in calibration level was observed. The hand-held calibrator details are as below.

Measurement positions P1 and P2:

- Rion – Calibrator: NC-74 SN: 34536109

Measurement position P3 to P6 P10:

- Brüel & Kjær – Calibrator: 4231 SN: 2545611
- External calibration date 09/08/2021
- External calibration certificate reference UCRT21/1973

4.3 Weather conditions

Table 7 provides the basic weather conditions encountered during the survey period. The historic recorded data has been taken from observations made at Manchester Airport weather station.

Table 7: Weather conditions

Date	Wind Direction	Mean Wind Speed m/s	Mean Daytime Temperature Degrees Celsius	Precipitation mm
Wednesday 2nd March 2022	East	3.0	6.8	0
Thursday 3rd March 2022	North	1.0	7.1	0
Friday 4th March 2022	Northwest	4.5	5.9	0
Saturday 5th March 2022	North	5.4	5.0	0
Sunday 6th March 2022	North	3.6	4.5	0

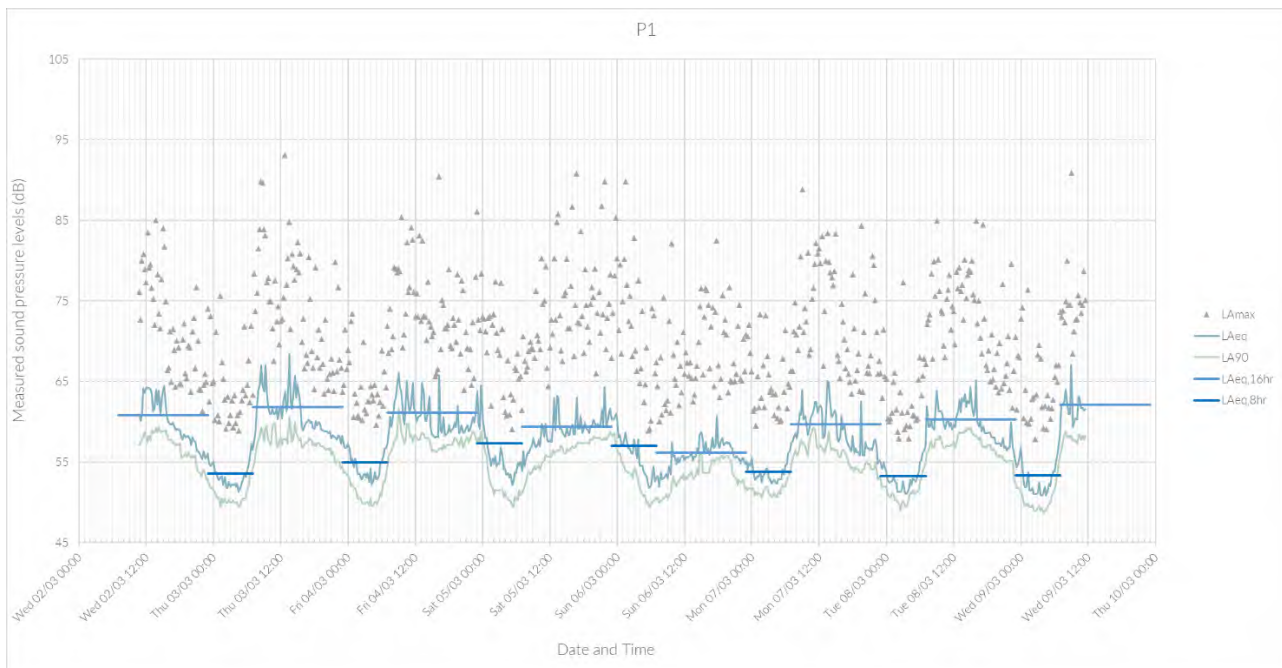
Date	Wind Direction	Mean Wind Speed m/s	Mean Daytime Temperature Degrees Celsius	Precipitation mm
Monday 7th March 2022	East	2.7	3.6	0
Tuesday 8th March 2022	East turning South	3.6	6.4	0
Wednesday 9th March 2022	South	4.0	9.5	0
Friday 26 th August 2022	North east	6.4	16.3	0

4.4 Summary of Measured Noise Levels

4.4.1 Position P1

Figure 4 provides a noise level time history at position P1 for three measured parameters, the ambient noise $L_{Aeq,15 \text{ min}}$ dB, the maximum noise events $L_{AFmax,15 \text{ min}}$ dB and the $L_{A90,15 \text{ min}}$ dB used to describe the underlying background noise.

Figure 4: Noise level time history at position P1



The ambient noise levels have been logarithmically averaged to determine hourly values $L_{Aeq,1 \text{ hr}}$ dB. These are presented in Table 8. In addition, the daytime (07:00 hours to 23:00 hours) $L_{Aeq,16 \text{ hr}}$ dB and night (23:00 hours to 07:00 hours) $L_{Aeq,8 \text{ hr}}$ dB are also provided (see Table 3 and Figure 3). For the overall measurement period, the highest complete daytime level was 62 dB $L_{Aeq,16 \text{ hr}}$ and at night 57 dB $L_{Aeq,8 \text{ hr}}$ (rounded to the nearest dB).

Table 8: Ambient noise levels at position P1

Start of Hourly Time Period	Wed. 02/03/22 L _{Aeq,1 hr} dB	Thurs. 03/03/22 L _{Aeq,1 hr} dB	Fri. 04/03/22 L _{Aeq,1 hr} dB	Sat. 05/03/22 L _{Aeq,1 hr} dB	Sun. 06/03/22 L _{Aeq,1 hr} dB	Mon. 07/03/22 L _{Aeq,1 hr} dB	Tues. 08/03/22 L _{Aeq,1 hr} dB	Wed. 09/03/22 L _{Aeq,1 hr} dB
00:00	-	53.9	56.2	58.9	58.5	53.9	52.9	54.2
01:00	-	52.8	54.6	55.5	57.7	53.2	52.7	52.2
02:00	-	52.3	53.2	55.0	56.3	53.8	51.3	51.2
03:00	-	52.1	53.2	55.5	57.1	52.7	51.6	51.4
04:00	-	51.8	53.3	53.6	54.3	52.6	52.4	51.3
05:00	-	52.9	53.5	53.0	52.7	53.3	53.1	52.9
06:00	-	55.5	56.0	54.5	53.2	55.5	55.7	55.7
07:00	-	59.3	59.1	55.1	53.0	57.9	59.8	61.6
08:00	-	65.2	62.8	56.5	53.1	59.9	60.2	62.2
09:00	-	64.6	64.1	57.3	54.9	61.5	62.1	63.0
10:00	60.9*	61.1	62.5	58.5	55.4	59.8	59.9	62.1
11:00	62.5	61.2	62.7	58.3	55.5	61.8	59.6	61.5*
12:00	64.2	62.3	60.7	60.0	55.5	61.1	60.3	-
13:00	62.7	64.6	62.7	61.5	55.7	63.1	62.4	-
14:00	62.5	63.6	61.3	58.6	56.8	61.2	62.6	-
15:00	62.9	62.6	58.2	58.8	57.6	58.9	62.4	-
16:00	59.8	59.6	61.7	60.3	56.4	59.4	61.9	-
17:00	59.1	59.8	59.0	59.5	58.4	56.9	58.8	-
18:00	58.3	59.7	59.1	59.2	57.4	56.9	58.5	-
19:00	58.1	59.1	60.1	59.4	57.3	58.7	57.6	-
20:00	57.6	58.7	58.9	59.6	56.7	56.7	57.3	-
21:00	56.1	58.1	59.1	61.7	55.5	56.8	56.7	-
22:00	55.7	57.9	60.2	60.5	55.1	56.4	57.7	-
23:00	55.0	57.2	62.4	60.5	54.6	54.5	55.0	-
L _{Aeq,16 hr} dB	60.8 [#]	61.7	61.1	59.3	56.1	59.7	60.3	62.1 [#]
L _{Aeq,8 hr} dB	53.5	54.9	57.2	57	53.8	53.2	53.3	-
Note * indicates an incomplete hour measurement Note # indicates a partial period result								

Figures 5 and 6 below provide histogram representations of the measured L_{AFmax,15 min} dB maximum event noise levels for the daytime (07:00 to 23:00 hours) and night (23:00 to 07:00 hours) periods respectively. The 90th percentile levels from the overall measurement period were 80 dB L_{AFmax,15 min} during the daytime and 73 dB L_{AFmax,15 min} at night (rounded to the nearest dB).

Figure 5: Daytime maximum noise event levels at position P1

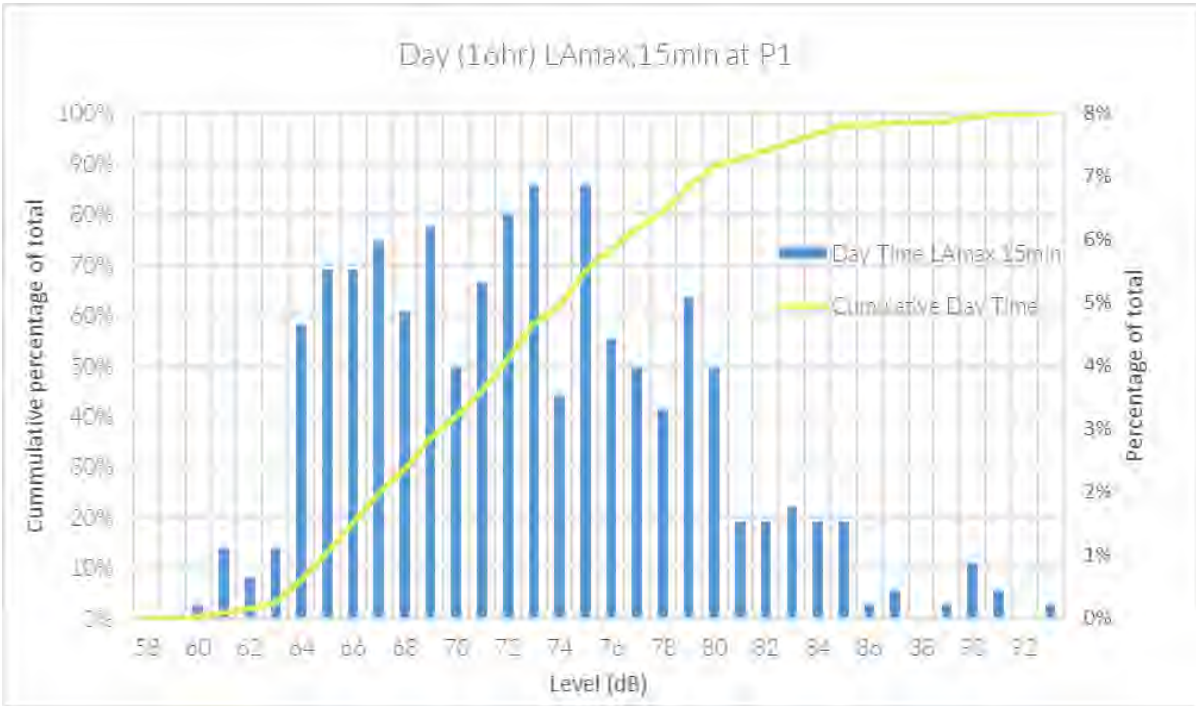
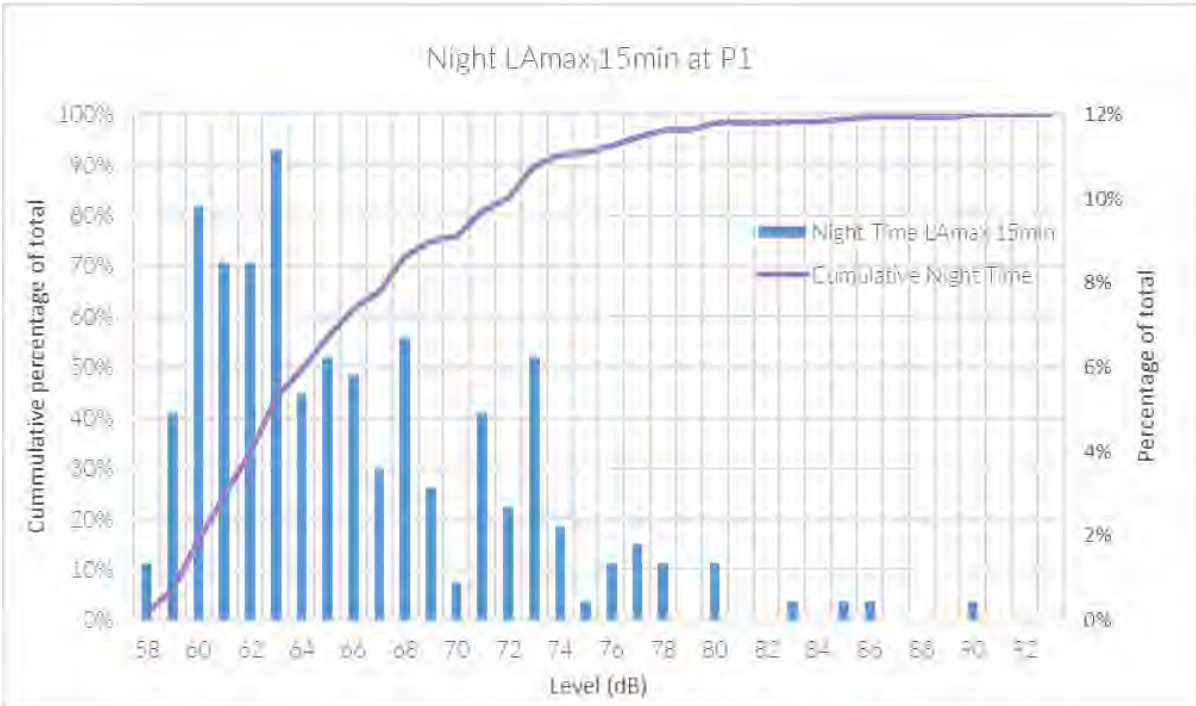


Figure 6: Night maximum noise event levels at position P1



Background noise measurements are presented following the statistical analysis approach of 'BS 4142 Methods for rating and assessing industrial and commercial sound:2014'(BS4142). The full measurement period has been processed as daytime (07:00 to 23:00 hours) and night (23:00 to 07:00 hours) histograms shown in Figure 7 and Figure 8 respectively. The lowest consistent daytime level, approximately the 10th percentile value is 53 dB $L_{A90,15\text{ min}}$ and at night is 49 dB $L_{A90,15\text{ min}}$.

Figure 7: Daytime background noise levels at position P1

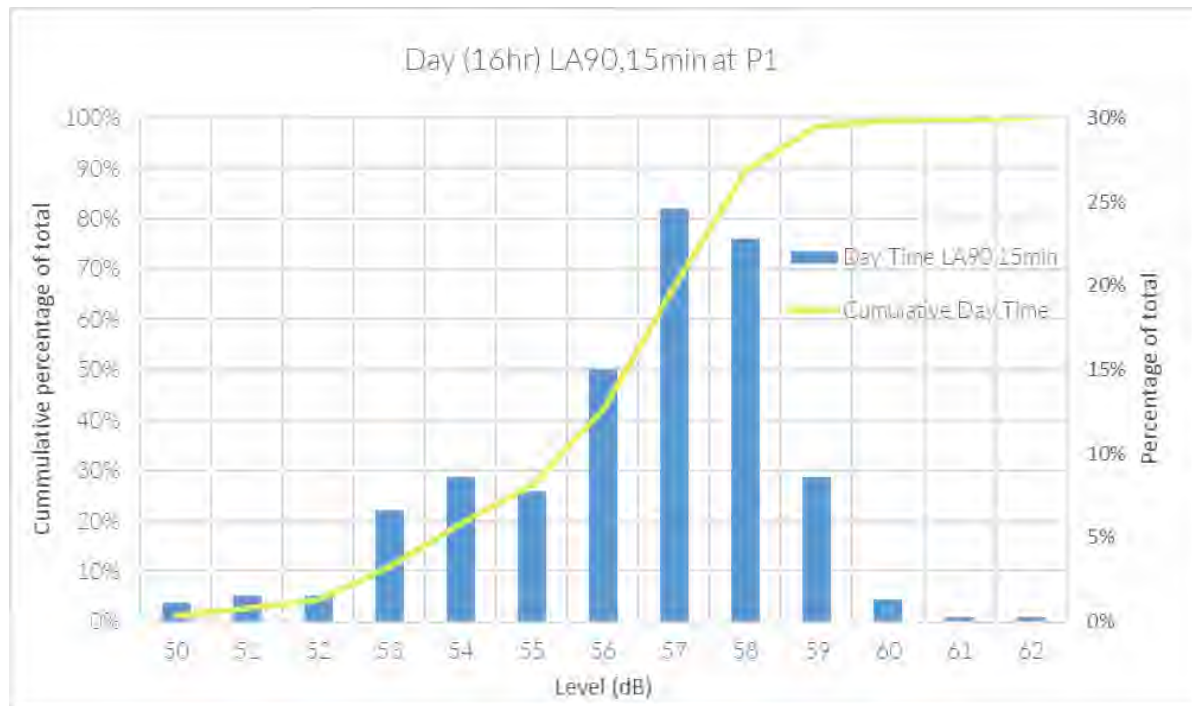
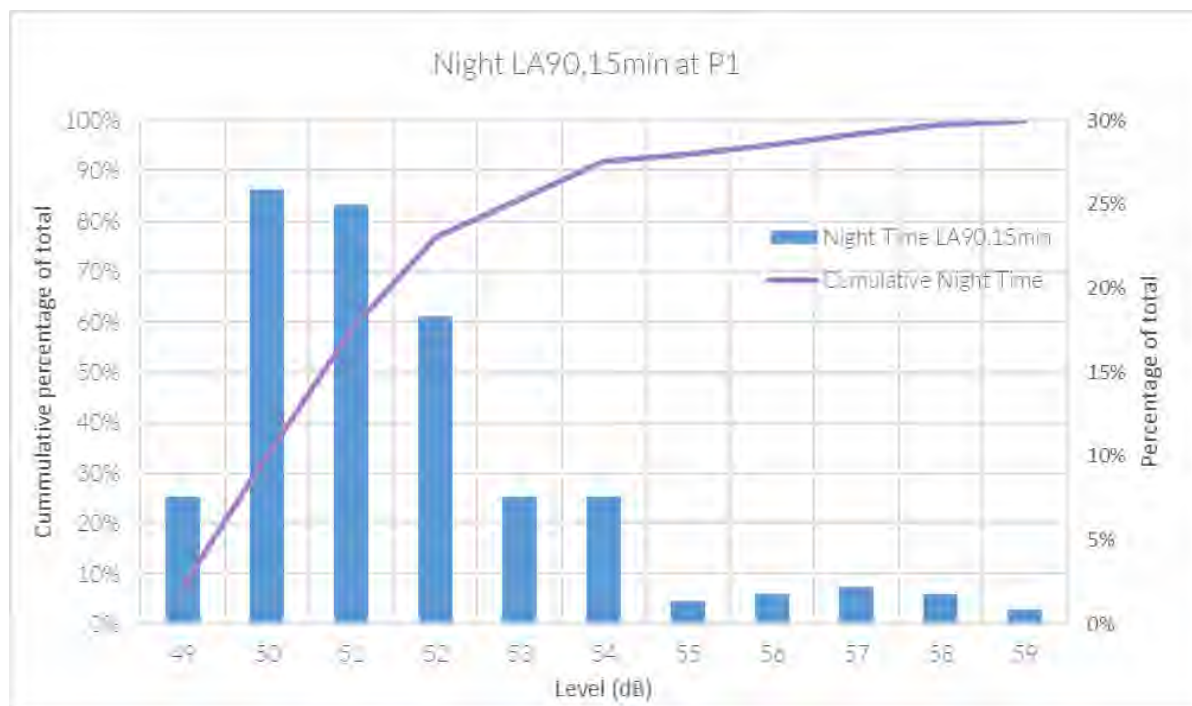


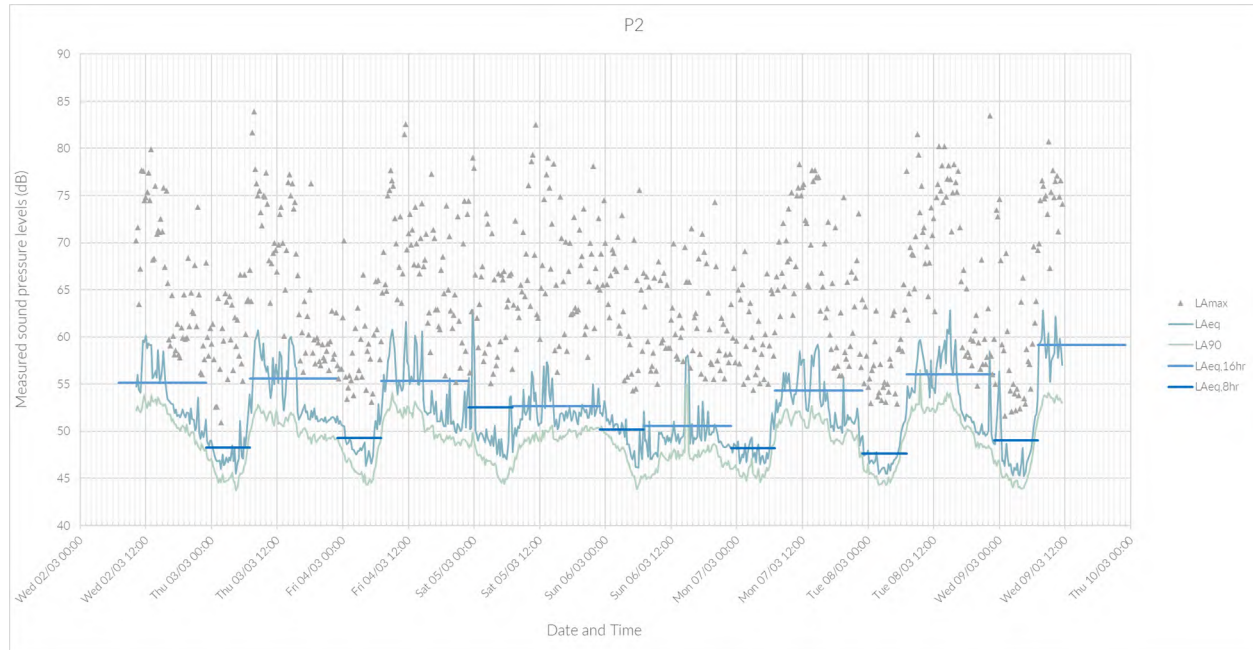
Figure 8: Night background noise levels at position P1



4.4.2 Position P2

Figure 9 provides a noise level time history at position P2 for three measured parameters, the ambient noise $L_{Aeq,15\text{ min}}$ dB, the maximum noise events $L_{AFmax,15\text{ min}}$ dB and the $L_{A90,15\text{ min}}$ dB used to describe the underlying background noise.

Figure 9: Noise level time history at position P2



The ambient noise levels have been logarithmically averaged to determine hourly values $L_{Aeq,1\text{ hr}}$ dB. These are presented in Table 9. In addition, the daytime (07:00 hours to 23:00 hours) $L_{Aeq,16\text{ hr}}$ dB and night (23:00 hours to 07:00 hours) $L_{Aeq,8\text{ hr}}$ dB are also provided (see Table 3 and Figure 3). For the overall measurement period, the highest complete daytime level was 56 dB $L_{Aeq,16\text{ hr}}$ and at night 53 dB $L_{Aeq,8\text{ hr}}$ (rounded to the nearest dB).

Table 9: Ambient noise levels at position P2

Start of Hourly Time Period	Wed. 02/03/22 $L_{Aeq,1\text{ hr}}$ dB	Thurs. 03/03/22 $L_{Aeq,1\text{ hr}}$ dB	Fri. 04/03/22 $L_{Aeq,1\text{ hr}}$ dB	Sat. 05/03/22 $L_{Aeq,1\text{ hr}}$ dB	Sun. 06/03/22 $L_{Aeq,1\text{ hr}}$ dB	Mon. 07/03/22 $L_{Aeq,1\text{ hr}}$ dB	Tues. 08/03/22 $L_{Aeq,1\text{ hr}}$ dB	Wed. 09/03/22 $L_{Aeq,1\text{ hr}}$ dB
00:00	-	48.0	49.8	54.1	51.4	47.8	47.1	52.0
01:00	-	46.6	48.8	49.6	51.0	47.6	47.0	47.2
02:00	-	47.0	47.8	49.3	50.3	48.6	45.9	45.9
03:00	-	47.4	48.2	49.3	50.6	47.5	45.9	45.8
04:00	-	46.9	47.7	48.3	48.1	47.5	46.5	46.6
05:00	-	48.5	48.0	47.9	46.9	47.1	47.7	47.3
06:00	-	50.4	51.4	51.7	48.0	50.4	50.5	50.8
07:00	-	55.0	54.1	49.4	49.7	52.6	53.7	58.6
08:00	-	60.0	58.0	50.9	48.5	54.4	54.9	60.1
09:00	-	58.0	59.0	52.7	48.3	55.5	59.0	58.1

Start of Hourly Time Period	Wed. 02/03/22 L _{Aeq,1 hr} dB	Thurs. 03/03/22 L _{Aeq,1 hr} dB	Fri. 04/03/22 L _{Aeq,1 hr} dB	Sat. 05/03/22 L _{Aeq,1 hr} dB	Sun. 06/03/22 L _{Aeq,1 hr} dB	Mon. 07/03/22 L _{Aeq,1 hr} dB	Tues. 08/03/22 L _{Aeq,1 hr} dB	Wed. 09/03/22 L _{Aeq,1 hr} dB
10:00	55.1*	55.8	54.7	54.6	49.6	53.6	57.1	59.9
11:00	58.0	56.3	58.6	52.6	49.1	56.9	55.6	58.7*
12:00	59.4	57.1	55.8	53.9	49.9	56.0	56.1	-
13:00	57.0	54.4	58.0	55.6	49.1	55.2	58.3	-
14:00	56.5	59.0	57.3	53.4	53.5	58.3	59.7	-
15:00	56.5	56.8	51.9	51.0	55.1	55.1	59.4	-
16:00	53.1	51.8	52.8	51.7	49.1	53.9	56.6	-
17:00	52.2	52.1	51.6	51.8	51.5	50.7	51.7	-
18:00	51.8	51.9	51.1	51.7	50.8	50.9	51.6	-
19:00	51.8	51.3	53.3	51.8	49.8	52.3	50.6	-
20:00	51.5	51.3	50.5	52.0	49.9	51.3	50.1	-
21:00	51.3	51.1	50.4	53.0	48.6	51.0	49.7	-
22:00	49.7	51.3	52.6	52.8	48.4	50.7	53.9	-
23:00	49.5	51.1	58.0	52.2	48.3	48.1	51.0	-
L _{Aeq,16hr} dB	55.1 [#]	55.6	55.4	52.7	50.5	54.3	56	59.1 [#]
L _{Aeq,8hr} dB	48.2	49.3	52.5	50.2	48.2	47.6	49	-
Note * indicates an incomplete hour measurement Note # indicates a partial period result								

Figures 10 and 11 below provide histogram representations of the measured L_{AFmax,15 min} dB maximum event noise levels for the daytime (07:00 to 23:00 hours) and night (23:00 to 07:00 hours) periods respectively. The 90th percentile levels from the overall measurement period were 77 dB L_{AFmax,15 min} during the daytime and 71 dB L_{AFmax,15 min} at night (rounded to the nearest dB).

Figure 10: Daytime maximum noise event levels at position P2

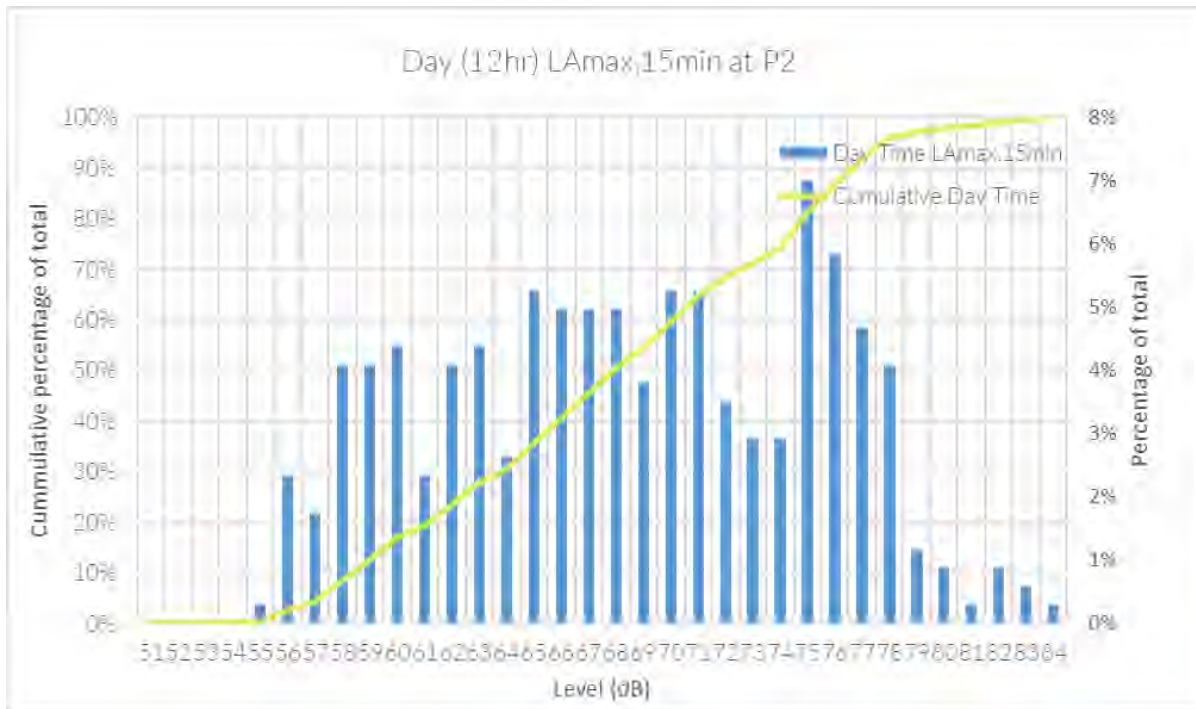
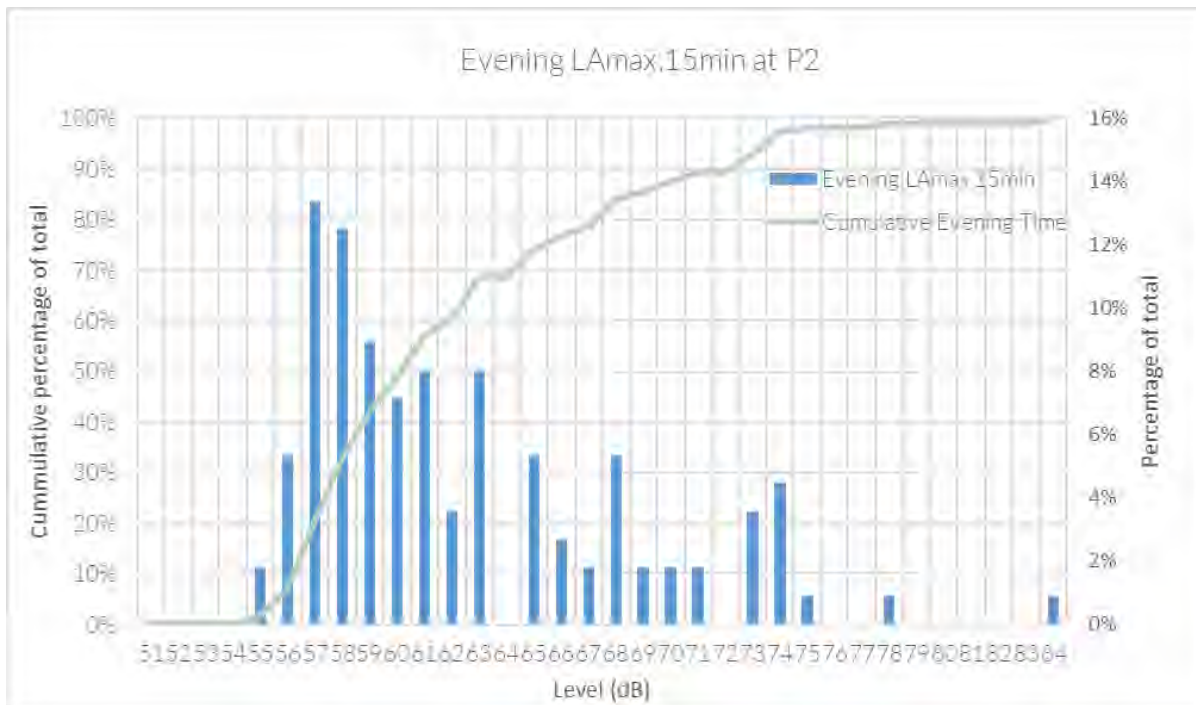


Figure 11: Night maximum noise event levels at position P2



Background noise measurements are presented following the statistical analysis approach of 'BS 4142 Methods for rating and assessing industrial and commercial sound:2014'(BS4142). The full measurement period has

been processed as daytime (07:00 to 23:00 hours) and night (23:00 to 07:00 hours) histograms shown in Figure 12 and Figure 13 respectively. The lowest consistent daytime level, approximately the 10th percentile value is 47 dB $L_{A90,15\text{ min}}$ and at night is 44 dB $L_{A90,15\text{ min}}$.

Figure 12: Daytime background noise levels at position P2

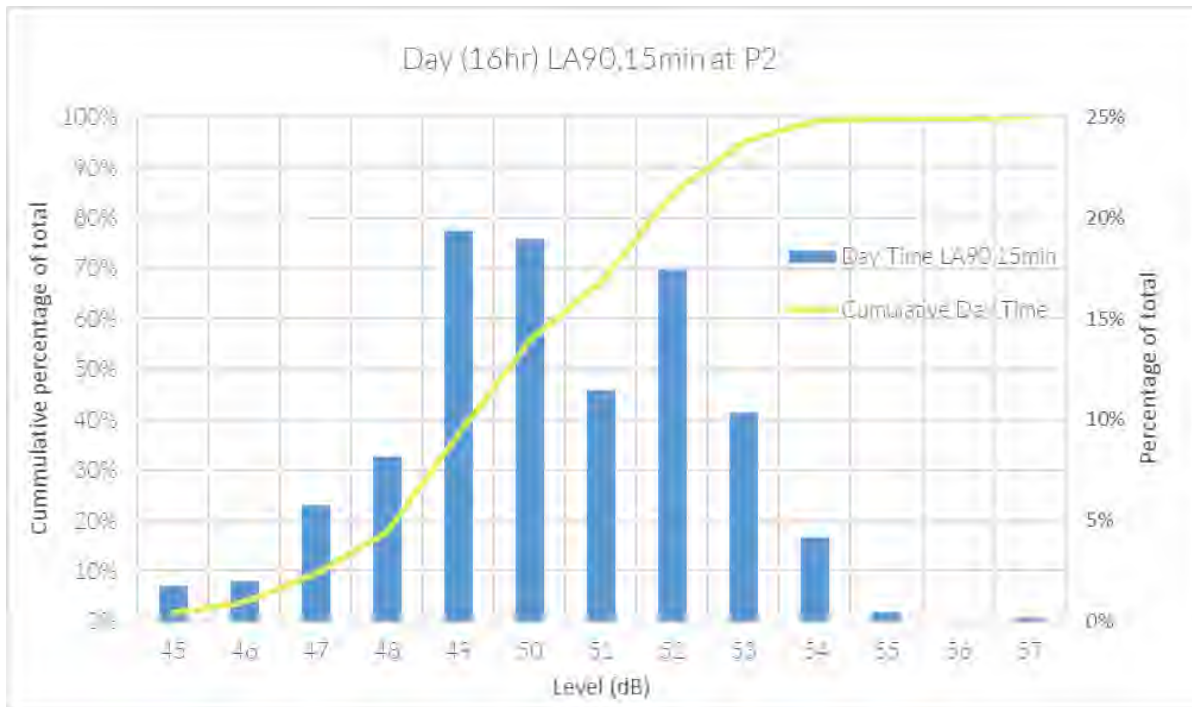
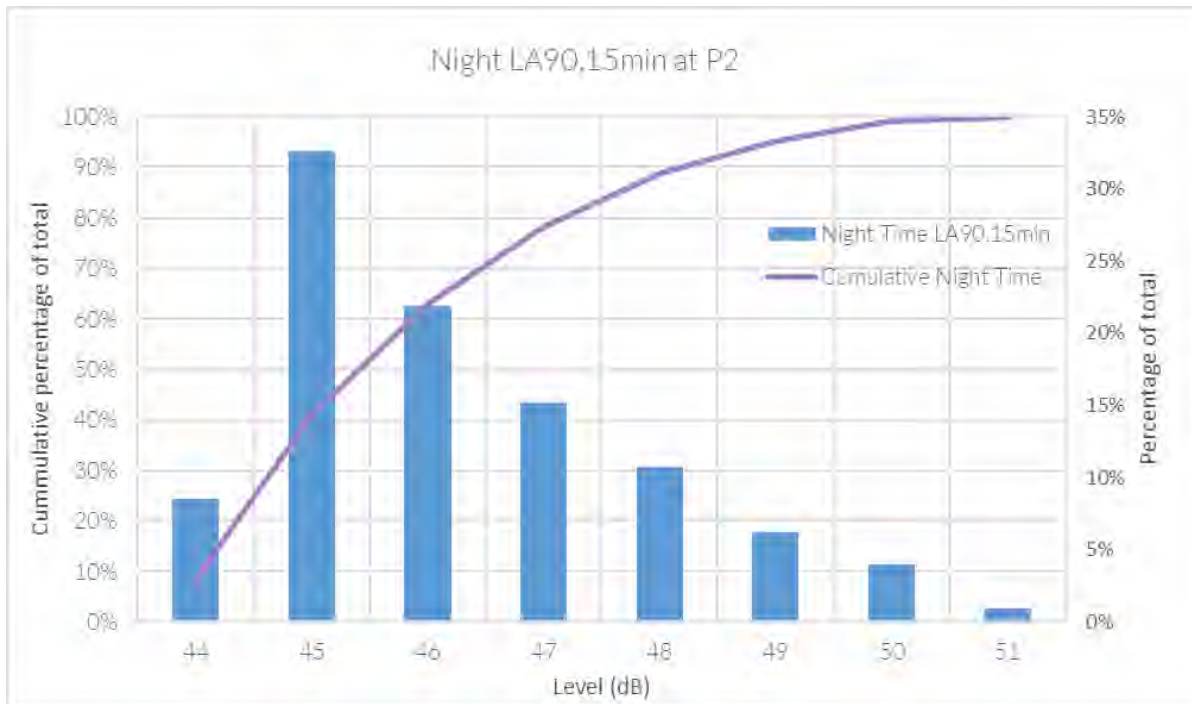


Figure 13: Night background noise levels at position P2



4.4.3 Position P3

Table 10 below provides the attended measured noise levels, the ambient noise $L_{Aeq,15\text{ min}}$ dB, the maximum noise events $L_{AFmax,15\text{ min}}$ dB and the $L_{A90,15\text{ min}}$ dB used to describe the underlying background noise.

Table 10: Attended measured noise levels at position P3

Measurement Start Time and Date	Duration Minutes:Seconds	$L_{Aeq,15\text{ min}}$ dB	$L_{AFmax,15\text{ min}}$ dB	$L_{A90,15\text{ min}}$ dB
10:37 on 02/03/22	07:56	56	71	54
10:46 on 02/03/22	15:00	58	73	53
11:02 on 02/03/22	15:00	56	67	52
09:31 on 09/03/22	15:00	55	72	52

4.4.4 Position P4

Table 11 below provides the attended measured noise levels, the ambient noise $L_{Aeq,15\text{ min}}$ dB, the maximum noise events $L_{AFmax,15\text{ min}}$ dB and the $L_{A90,15\text{ min}}$ dB used to describe the underlying background noise.

Table 11: Attended measured noise levels at position P4

Measurement Start Time	Duration Minutes:Seconds	$L_{Aeq,15\text{ min}}$ dB	$L_{AFmax,15\text{ min}}$ dB	$L_{A90,15\text{ min}}$ dB
11:19 on 02/03/22	15:00	68	79	59
11:34 on 02/03/22	15:00	68	79	61
10:33 on 09/03/22	15:00	65	78	58

4.4.5 Position P5

Table 12 below provides the attended measured noise levels, the ambient noise $L_{Aeq,15\text{ min}}$ dB, the maximum noise events $L_{AFmax,15\text{ min}}$ dB and the $L_{A90,15\text{ min}}$ dB used to describe the underlying background noise.

Table 12: Attended measured noise levels at position P5

Measurement Start Time	Duration Minutes:Seconds	$L_{Aeq,15\text{ min}}$ dB	$L_{AFmax,15\text{ min}}$ dB	$L_{A90,15\text{ min}}$ dB
09:48 on 09/03/22	15:00	56	72	51
10:04 on 09/03/22	15:00	55	64	51

4.4.6 Position P6

Table 13 below provides the attended measured noise levels, the ambient noise $L_{Aeq,15\text{ min}}$ dB, the maximum noise events $L_{AFmax,15\text{ min}}$ dB and the $L_{A90,15\text{ min}}$ dB used to describe the underlying background noise.

Table 13: Attended measured noise levels at position P6

Measurement Start Time	Duration Minutes:Seconds	$L_{Aeq,15\text{ min}}$ dB	$L_{AFmax,15\text{ min}}$ dB	$L_{A90,15\text{ min}}$ dB
10:50 on 09/03/22	15:00	64	80	55
11:06 on 09/03/22	09:28	64	91	56

Measurement Start Time	Duration Minutes:Seconds	L _{Aeq,15 min} dB	L _{AFmax,15 min} dB	L _{A90,15 min} dB
11:15 on 09/03/22	15:00	63	78	54

4.4.7 Position P7

Table 14 below provides the attended measured short duration ambient entertainment noise levels. Position P7 was a façade measurement location and hence the noise levels of Table 10 below have been adjusted down by 3dB to convert to an equivalent free-field noise level. Position P7 was approximately 11m from the nearest boundary of the Carnival Street Food entertainment venue on Bridge Street. At the time of measurement there were many patrons occupying the outdoor seating and a DJ was playing a music set through an amplified music system.

Table 14: Attended measured noise levels at position P7 (free-field)

Start Time	Duration s	L _{Aeq,T} dB	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
23:06:04	10	79	89	78	72	72	77	69	62
23:06:14	10	78	90	74	74	72	76	68	62
23:06:24	10	78	88	74	79	74	74	68	63
23:06:43	10	78	90	80	71	73	74	70	64
23:06:53	7	76	90	81	72	70	74	65	62
23:12:58	8	76	87	78	74	72	73	66	63
23:13:06	10	76	87	79	77	71	73	67	63
23:13:16	10	75	86	79	79	69	70	64	58
23:13:26	10	74	85	80	79	68	69	63	57
23:13:36	10	75	86	79	78	70	71	66	58
23:13:46	10	76	85	79	81	70	73	65	58
23:14:08	10	75	84	74	78	71	70	62	57
23:14:18	10	76	86	76	81	72	69	63	58
23:14:28	10	76	85	75	83	71	69	65	59
23:14:38	10	77	87	75	82	72	72	65	59
Maximum	-	79	90	81	83	74	77	70	64

4.4.8 Position P8

Table 15 below provides the attended measured short duration ambient entertainment noise levels. Position P8 was approximately 15m from the nearest boundary of Crazy Pedros / MOJO / Liars Club entertainment venues. Although music was audible from Crazy Pedros / MOJO / Liars Club, the more dominant sources of noise were road traffic on Bridge Street and spill-out from Carnival Street Food on Bridge Street.

Table 15: Attended measured noise levels at position P8

Start Time	Duration s	L _{Aeq,T} dB	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
23:08:05	10	68	75	71	67	63	64	60	53
23:08:15	10	69	74	70	67	65	64	61	56
23:08:46	10	73	72	69	73	70	69	65	59
Maximum	-	73	75	71	73	70	69	65	59

4.4.9 Position P9

Table 16 below provides the attended measured short duration ambient entertainment noise levels. Position P9 was approximately 8m from the nearest boundary of Crazy Pedros / MOJO / Liars Club entertainment venues, approximately 25m from Carnival Street Food and 15m from the entrance of Manchester Hall, which had a function. Although music was audible from Crazy Pedros / MOJO / Liars Club, the more dominant sources of noise were road traffic on Bridge Street and spill-out from Carnival Street Food adjacent to Manchester Hall on Bridge Street.

Table 16: Attended measured noise levels at position P9

Start Time	Duration s	L _{Aeq,T} dB	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
23:09:06	10	72	74	71	72	71	67	63	58
23:09:16	10	71	73	73	75	70	66	61	56
23:09:26	10	71	75	77	76	69	65	60	54
23:09:36	10	71	74	77	74	68	65	60	54
23:10:00	10	72	66	67	71	71	66	60	58
23:10:10	10	71	75	70	72	70	65	60	57
23:10:20	10	71	77	73	70	67	67	60	57
23:10:30	10	72	73	72	71	71	68	61	55
23:11:25	10	73	78	75	76	72	67	58	54
23:11:35	10	72	76	76	72	71	66	61	54
Maximum	-	73	78	77	76	72	68	63	58

4.4.10 Position P10

Table 17 below provides the attended measured short duration ambient entertainment noise levels. Position P8 was approximately 15m from the nearest boundary of Crazy Pedros / MOJO / Liars Club entertainment venues. Although music was audible from Crazy Pedros / MOJO / Liars Club, the more dominant sources of noise were road traffic on Bridge Street and spill-out from Carnival Street Food on Bridge Street.

Table 17: Attended measured noise levels at position P10

Start Time	Duration s	L _{Aeq,T} dB	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
23:16:52	10	77	90	82	74	73	71	68	68

Start Time	Duration s	L _{Aeq,T} dB	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
23:17:10	10	80	95	84	77	78	74	70	69
23:17:57	10	83	93	87	84	81	78	73	70
23:18:07	7	82	93	84	82	80	77	73	70
23:18:23	7	81	94	83	82	77	76	71	65
23:19:13	10	75	89	81	75	69	68	66	65
23:19:23	10	76	87	81	76	71	70	66	64
23:19:33	10	76	91	82	76	72	71	66	65
23:19:43	10	77	90	83	76	74	72	67	66
23:19:53	10	78	89	82	76	74	73	67	67
23:13:46	9	78	89	83	75	74	74	67	68
23:14:08	10	80	96	88	81	73	73	68	69
Maximum	-	83	96	88	84	81	78	73	70

5. Vibration measurements

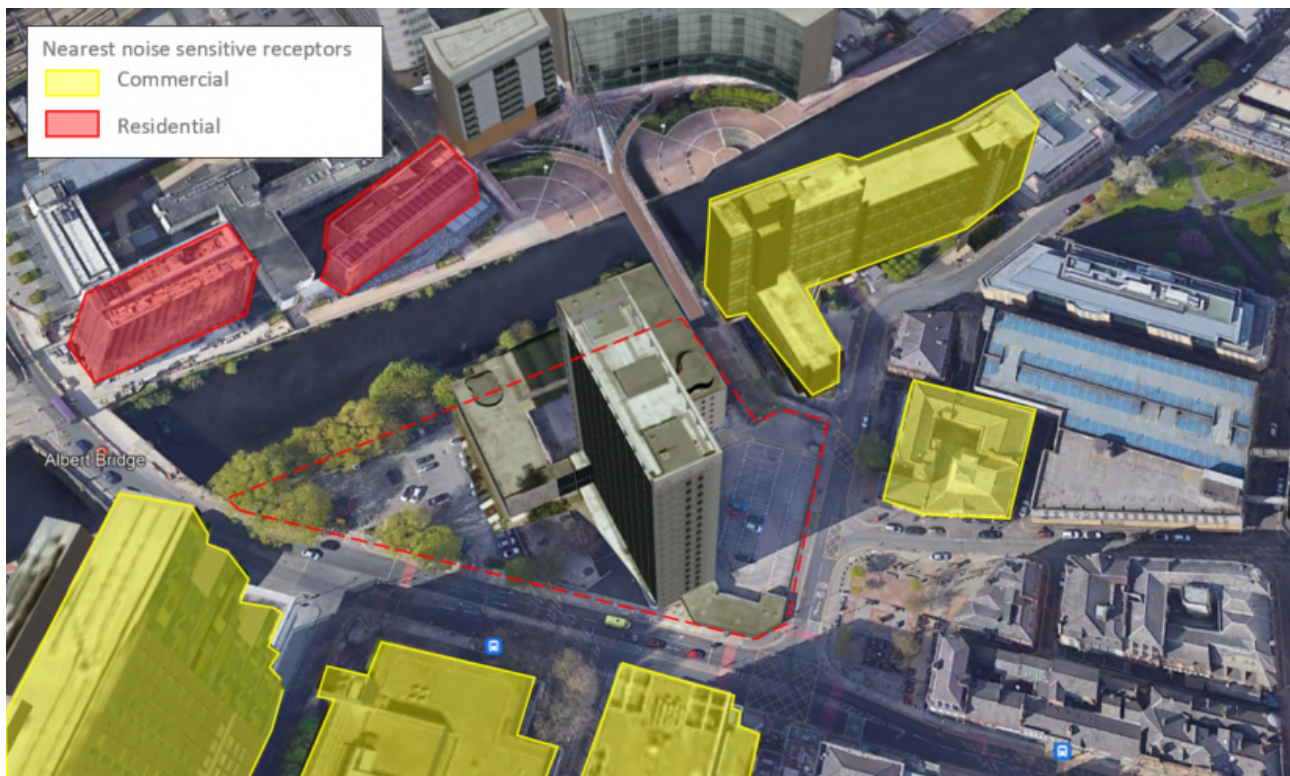
No direct measurement of vibration was deemed necessary following subjective observations during the set up and dismantling of the noise measurement equipment. Subjectively, no perceivable ground vibration existed on Site leading to the measurement positions P1 to P6. In addition, observations did not indicate any significant areas of vibration concern.

6. Noise sensitive receptors

A noise sensitive area is defined as landscapes or buildings where the occupiers are likely to be sensitive to noise generated by the proposed development including proposed building services plant.

The nearest noise sensitive area is identified as **the proposed development**. The following Figure shows other nearby receptors classified as residential or commercial in use. Residential properties would be considered more sensitivity to noise than commercial.

Figure 14: Nearest noise sensitive receptors (red line boundary indicative only) © Google Earth.



7. Noise emission criteria for fixed plant.

Noise levels due to building services serving the proposed development are advised to meet the following noise level criteria shown below in Table 18 one metre from the nearest noise sensitive receptor including the proposed development. Due to proximity of the proposed development to proposed building services, we fully expect the proposed development will determine the noise control strategy for plant.

Table 18: Building services noise emission limits.

Period	Typical background noise level $L_{A90,T}$ dB	Noise emission limit $L_{A,r,Tr}$ dB
Daytime (0700 to 2300)	50	45
Night-Time (2300 to 0700)	44	39

It should be noted that each of the limits stated above are the combined operational noise levels of plant at the nearest noise sensitive façade. As such, the combined operational noise levels of all plant are required to achieve the noise limits defined above.

For plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 18 above need to include a character correction in accordance with BS 4142.

At this stage of the project initial plant selections have been undertaken for the ASHP (Air Source Heat Pumps) located on the roof of the residential building and at the highest floor levels on the office building. There will be 2 ASHP's on each roof level of the residential building (4 ASHP's in total) and 4 located at the top two plant rooms of the office building. Typical plant shown below:

Figure 15: Typical ASHP, with and without acoustic package



Further detailed work is required although provision has been made to include for full acoustic packs such that the maximum 'A' weighted sound power level does not exceed 70 $L_w(A)$. Additional to this are plant screens to limit noise levels at facades of the proposed development and nearby properties, acoustic louvres where airflow requirements have been identified. Compliance with the proposed noise limits is expected with appropriate acoustic measures.

For guidance, a source generating an 'A' weighted sound power level of 70 $L_w(A)$ will result in a sound pressure level of 34 dB(A) at 25 metres. Appropriate operational controls shall also be incorporated to limit noise emission further at night, when operating loads are much lower.

8. Noise prediction model.

In order to predict the external noise level present at each façade of the proposed development and to determine a suitable ventilation strategy, a noise map has been created using Cadna A environmental noise prediction and mapping software. Cadna A is the leading software for the calculation, assessment and prediction of environmental noise.

A baseline noise map was generated of the existing site using the results of the environmental noise survey and calibrated for daytime equivalent noise levels ($L_{Aeq,16hr}$), night-time equivalent noise levels ($L_{Aeq,8hr}$) and the maximum ninetieth percentile night-time $L_{Amax,T}$.

A noise map was then generated of the site with the proposed development in-situ. The following Figures show a three-dimensional representation of the noise map prediction for each of the proposed development façades. It should be noted that the noise mapping exercise takes into consideration all noise reflections that may occur off the proposed development and adjacent buildings.

Figure 16: Predicted daytime (07.00-23.00) noise levels ($L_{Aeq,16\text{ hours}}$) at proposed building facade

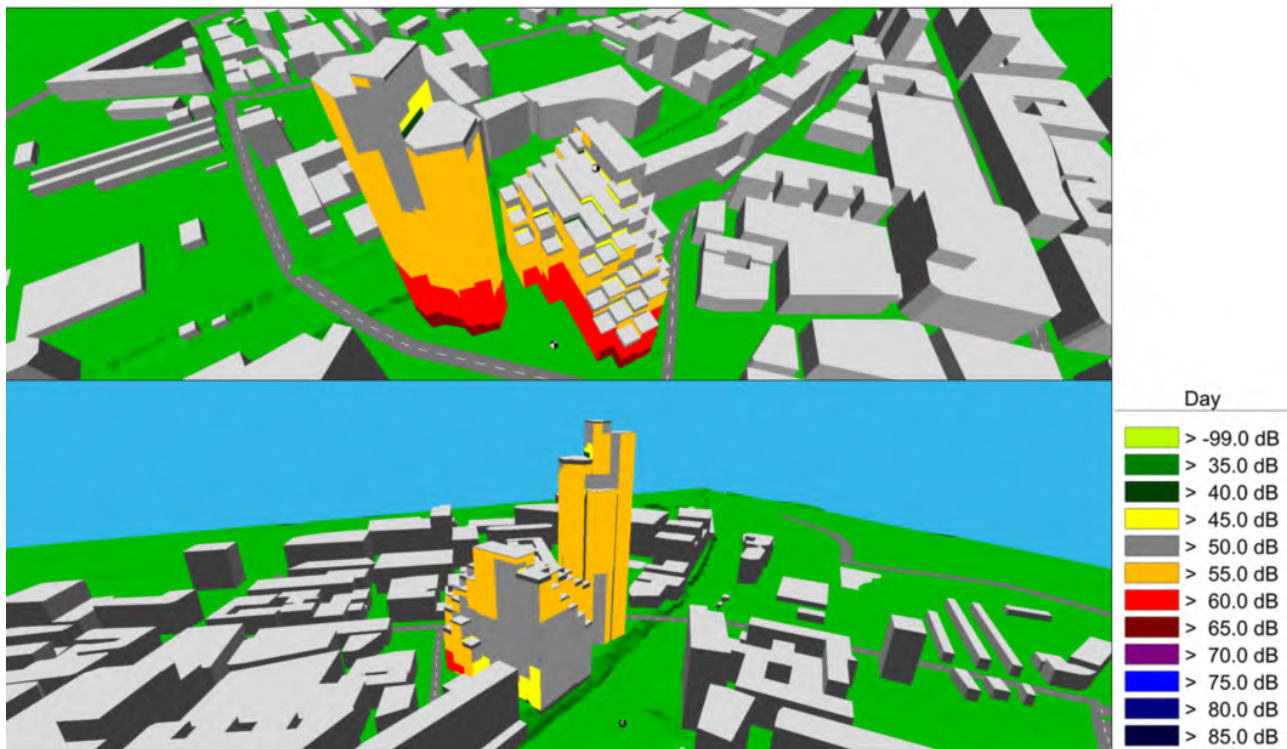


Table 19: Predicted external daytime (07.00-23.00) noise levels – Residential building

Location	Ground – 5 th floor	6 th – 20 th floor	21 st – 45 th floor
South / Southeast	65–67 dB $L_{Aeq, 16\text{ hour}}$	60–64 dB $L_{Aeq, 16\text{ hour}}$	57–59 dB $L_{Aeq, 16\text{ hour}}$
North / Northwest	55–58 dB $L_{Aeq, 16\text{ hour}}$	57–58 dB $L_{Aeq, 16\text{ hour}}$	57–58 dB $L_{Aeq, 16\text{ hour}}$

Figure 17: Predicted night-time (23.00-07.00) noise levels ($L_{Aeq,8hrs}$) at proposed building façade

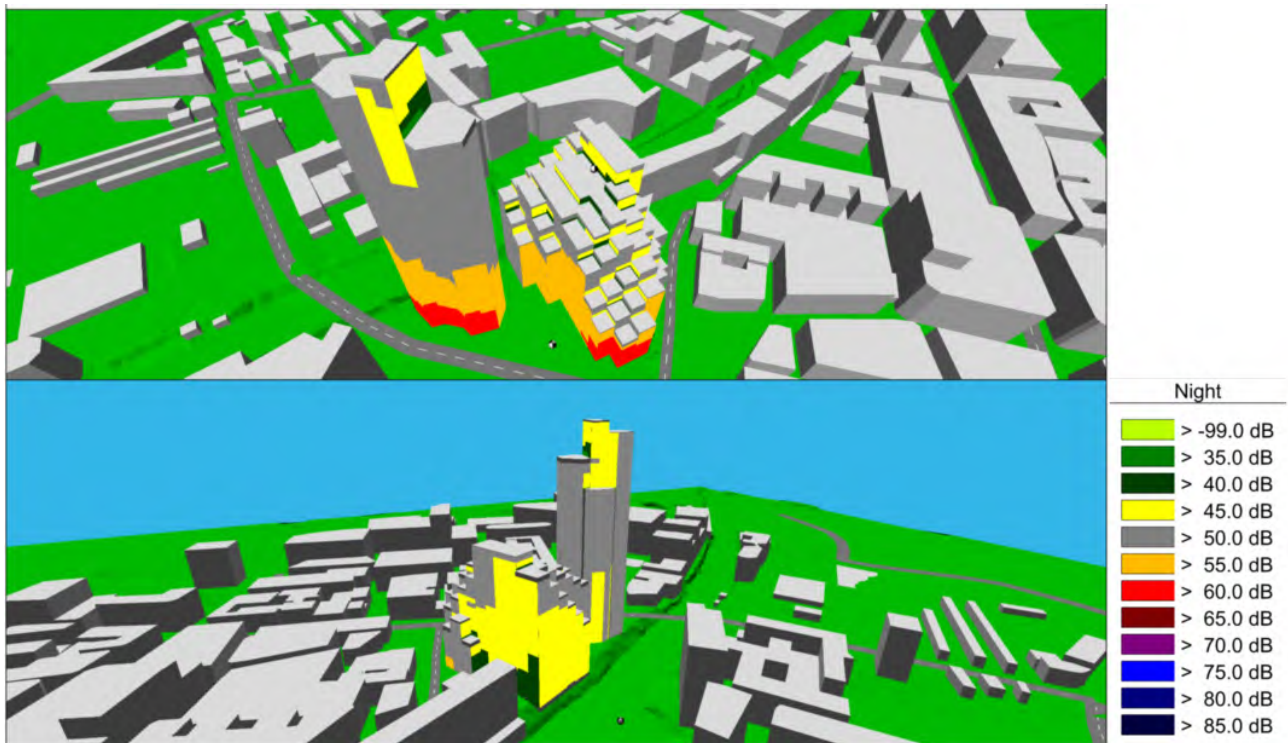


Table 20: Predicted external night-time (23.00-07.00) noise levels – Residential building

Location	1 st – 5 th floor	6 th – 20 th floor	21 st – 45 th floor
South / Southeast	61–63 dB $L_{Aeq, 8 \text{ hour}}$	56–60 dB $L_{Aeq, 8 \text{ hour}}$	52–54 dB $L_{Aeq, 8 \text{ hour}}$
North / Northwest	52–55 dB $L_{Aeq, 8 \text{ hour}}$	52–54 dB $L_{Aeq, 8 \text{ hour}}$	52–54 dB $L_{Aeq, 8 \text{ hour}}$

8.1 Prediction of music noise at proposed residential facades

In accordance with Manchester Council policy on entertainment noise, the proposed development shall provide sufficient facade acoustic performance so not to exceed music noise levels, in habitable rooms, of 47dB and 41dB ($L_{eq,15min}$) in the 63Hz and 125Hz octave bands respectively.

The predicted external noise levels at the proposed residential development from the witnessed externally located amplified music at Oast House and Carnival Street Food, indicates noise levels are no higher than 69 dB at 63 Hz and 63 dB at 125Hz.

To enable achievement of the internal noise criteria for music noise requires glazed facades of the residential development to provide a minimum noise reduction of 22 dB at 63 Hz and 125Hz. This should be achievable using glazing systems rated at 32 dB $R_w + C_{tr}$. This will require further review during the detailed design stage. The solid façade element should achieve at least 30 dB reduction at 63Hz and 125Hz.

Noise level breakout associated with Crazy Pedros / MOJO / Liars Club were not evident during the various site visits and are not considered to be the dominant source of noise compared with road traffic on Bridge Street.

8.2 Office building facade noise levels

Internal ambient sound levels within offices are advised not to exceed those set out in Table 5. These are established industry standards based on guidance provided in BS 8233:2014 Guidance on sound insulation and noise reduction for buildings and the British Council for Offices Guide to specification (BCO 2019).

It should be noted that BCO refers to the target levels in terms of a noise rating (NR) which essentially fall within the L_{Aeq} range stated in BS 8233. In addition to this, BCO recommends a limit of 55 dB(A) $LA_{01,1hr}$ and 50 dB(A) $LA_{01,1hr}$ within open-plan and cellular offices, respectively for noisier events occurring over short periods of time.

It is also noted that BCO allows for a +5 dB relaxation in the case of naturally ventilated buildings or where the occupants have the option of opening windows for occasional periods.

The predicted noise levels just outside the office building are in the range 55–67 dB L_{Aeq} during the daytime period. The highest noise levels predicted on the South and Southeast elevations.

To achieve compliance with the internal noise levels would require a façade capable of providing an acoustic performance up to 27 dB $R_w + C_{tr}$. This is readily achievable from a secondary glazing system.

9. Building envelope & ventilation strategy.

The sound insulation properties of the building envelope depend upon the external noise levels present at the façade and the proposed design criteria for the internal noise levels of specific rooms. Figure 18 shows a façade mark-up and Table 21 the initial minimum acoustic performance requirement at different floor levels. This applies to all external noise sources (predominantly road traffic). Façade performance requirement for music noise is shown in Figure 19 and Table 22.

Figure 18: Predicted façade acoustic performance

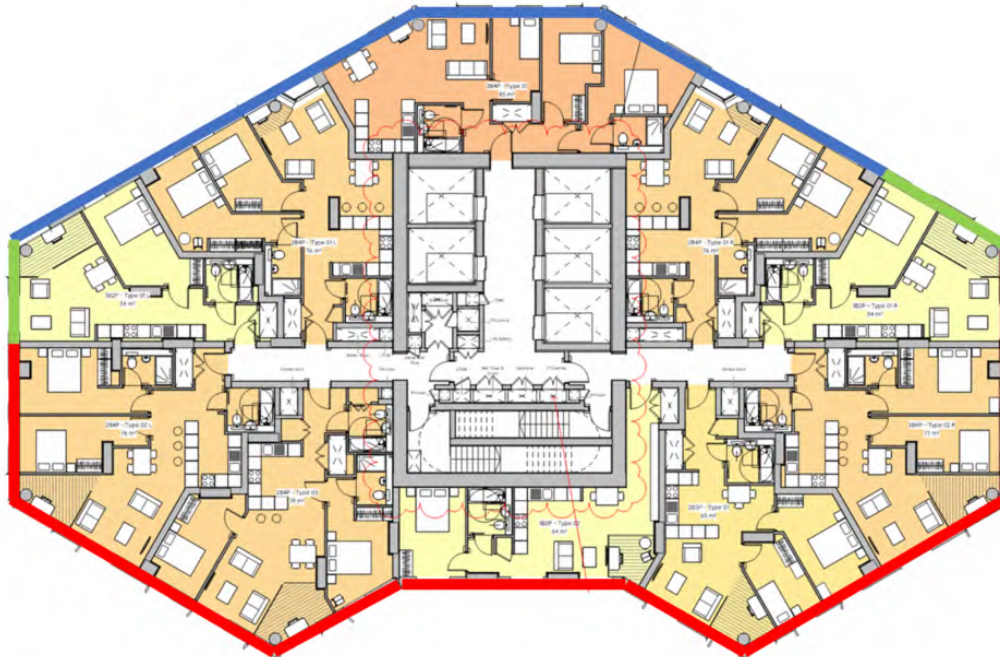


Table 21: Notional sound insulation values of proposed façade construction.

Façade	Room use	Residential building minimum acoustic performance $R_w + C_{tr}$			
		Glazed façade element			Solid façade element
		1-5	6-20	21-45	
Zone 1	Living room ¹	32	29	24	45
	Bedroom ¹	33	30	25	
	Bedroom (L_{Amax}) ²	37	34	29	
Zone 2	Living room ¹	30	27	25	45
	Bedroom ¹	30	28	25	
	Bedroom (L_{Amax}) ²	35	32	27	
Zone 3	Living room ¹	25	25	25	40
	Bedroom ¹	25	24	24	
	Bedroom (L_{Amax}) ²	30	28	28	

Note 1: Living room (day) $L_{Aeq,16hr}$ (0700 to 2300) and bedroom (night) $L_{Aeq,8hr}$ (2300 to 0700).

Note 2: Bedroom $L_{Amax,T}$ (2300 to 0700).

At this stage the non-glazed element on all facades will need to be capable of achieving an acoustic performance of of 40-45 dB $R_w + C_{tr}$.

At this stage the required glazing sound insulation values have been based on $R_w + C_{tr}$ only. Detailed calculations will be undertaken to determine refined glazing requirements in octave bands during the design development stage.

Examples of primary glazing configurations capable of achieving the minimum required $R_w + C_{tr}$ detailed previously are:

- $R_w + C_{tr}$ 29 dB – 10mm glass, 16mm air gap, 4mm glass.
- $R_w + C_{tr}$ 32 dB – 10mm glass, 16mm air gap, 6.4mm acoustic glass.
- $R_w + C_{tr}$ 38 dB – 8.8mm acoustic glass, 16mm air gap, 12.8mm acoustic glass.

Please note the window / door is required to meet this performance and not only the glass.

Please note that where enhanced façade performance is required to mitigate external music noise, this is also required and not simply compliance with the above.

9.1 Predicted façade acoustic performance from external music noise

The minimum requirement for the façade noise reduction to limit external music noise intrusion to the levels set out earlier in this document is shown in Figure 19 and Table 22.

Figure 19: Predicted façade acoustic performance to limit external music noise intrusion

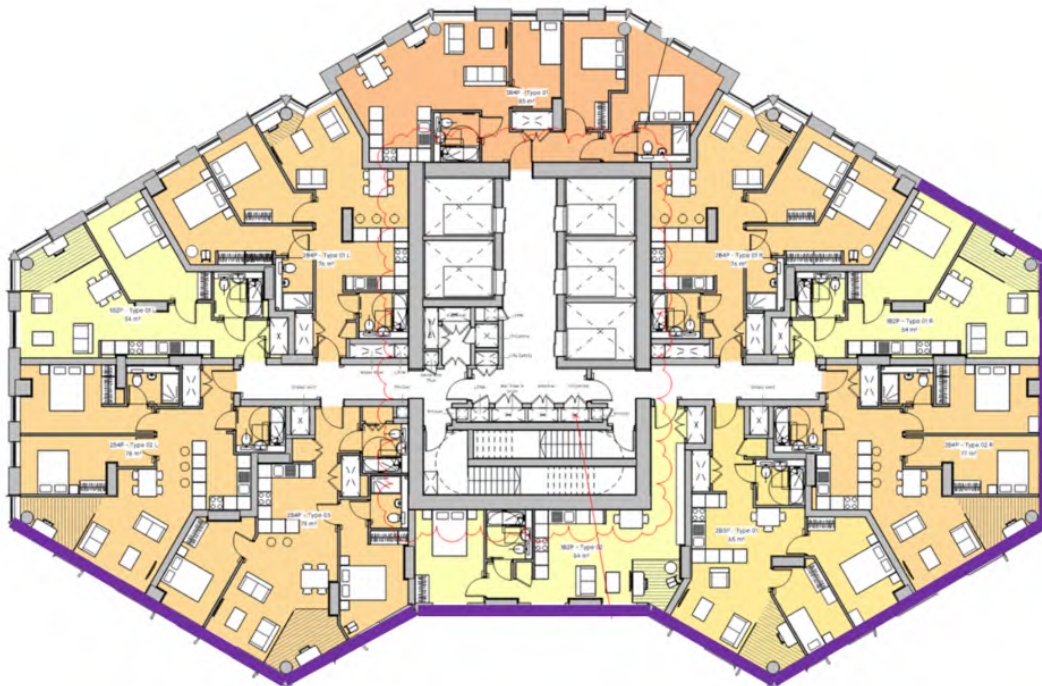


Table 22: Minimum facade acoustic performance to limit external music noise intrusion

Facade	Room use	Residential building minimum acoustic performance R'		
		Glazed facade element		Solid facade element
		63 Hz	125 Hz	63 Hz and 125 Hz
Zone 1	Habitable Room	22	22	30

The proposed acoustic performance requirements to limit music noise intrusion are not particularly onerous but do need compliance. An example of primary glazing configurations capable of achieving the minimum required R' at 63Hz and 125Hz is 10mm glass, 16mm air gap, 6.4mm acoustic glass. Please note the window / door is required to meet this performance and not only the glass.

Please note that where the above is required, that the previous discussion regarding other ambient noise mitigation is also provided, thus the final façade system must comply with all external noise sources, road traffic and music noise.

9.2 Compliance.

In order to confirm the suitability of the proposed glazed and non-glazed elements, evidence of the laboratory sound insulation performance will be required for the entire unit as it will be installed (including glass, frame, seals, mullions and transoms). All acoustic testing shall be undertaken in controlled laboratory conditions in accordance with ISO 10140-2:2021 *"Acoustics – Laboratory Measurement of Sound Insulation of Building Elements"*(5).

9.3 Ventilation and overheating – residential building

An assessment of internal noise levels based on the predicted external noise intrusion has been undertaken with windows open. The starting point is whether the external noise levels are sufficiently high enough to exceed what would be considered a suitable internal noise level.

A review of the Council's policy on this subject suggests there is some room for increasing internal noise levels where windows could be opened to provide mitigation of overheating in lieu of enhanced or additional mechanical ventilation. It is considered that an uplift from the values stated in BS 8233 of 5 dB would be reasonable and acceptable for the duration when mitigating overheating.

This uplift also falls within the assessment methodology following AVOG (Acoustics, Ventilation and Overheating Guidance). Increases of 5 dB would not be expected to give rise to significant changes in behaviour or be detrimental to the wellbeing of future residents.

The use of a fully opened door or window to provide natural ventilation can achieve a noise reduction of between 7-10 dB depending on the amount of opening. Partially open doors or windows would be expected to provide slightly higher noise reduction and up to 10-15 dB but, may not provide sufficient open area to mitigate overheating. The acoustic performance requirements for the glazed elements exceed what would be required to allow for mitigation of overheating via a fully opened door or window.

Provision for alternative forms of ventilation will be made such that windows are not required to be opened for ventilation purposes. It should be noted that windows may be openable for short term rapid ventilation within all apartments and residents will have the option to open windows for longer periods should they wish. An assessment using AVOG has been undertaken to illustrate the proposed outcome and this is shown in 9.4.

For the purposes of a Level 2 assessment, it is assumed that a partially open window will provide an outside-to-inside level difference of 13dB. This level difference is considered representative of typical domestic rooms with simple facade openings although would not apply to fully opened windows, which are likely to achieve lower levels of noise reduction.

Table 24: Guidance for Level 2 assessment of noise from transport noise sources relating to 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]	$L_{Aeq,8h}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 [Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{AF,max}$	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 $L_{AF,max}$ 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.

Following the estimated external noise levels outside the residential facade shown in Tables 19 and 20, a Level 2 assessment provides the following estimated internal noise levels using a 13dB noise reduction for a partially opened window.

Table 25: Predicted internal daytime (07.00-23.00) noise levels with partially opened windows – Residential building

Location	Ground – 5 th floor	6 th – 20 th floor	21 st – 45 th floor
South / Southeast	52–54 dB $L_{Aeq, 16 \text{ hour}}$	47–51 dB $L_{Aeq, 16 \text{ hour}}$	44–46 dB $L_{Aeq, 16 \text{ hour}}$
North / Northwest	42–45 dB $L_{Aeq, 16 \text{ hour}}$	44–45 dB $L_{Aeq, 16 \text{ hour}}$	44–45 dB $L_{Aeq, 16 \text{ hour}}$

Table 26: Predicted internal night-time (23.00-07.00) noise levels with partially opened windows – Residential building

Location	1 st – 5 th floor	6 th – 20 th floor	21 st – 45 th floor
South / Southeast	48–50 dB $L_{Aeq, 8 \text{ hour}}$	43–47 dB $L_{Aeq, 8 \text{ hour}}$	39–41 dB $L_{Aeq, 8 \text{ hour}}$
North / Northwest	39–42 dB $L_{Aeq, 8 \text{ hour}}$	39–41 dB $L_{Aeq, 8 \text{ hour}}$	39–41 dB $L_{Aeq, 8 \text{ hour}}$

During the daytime (07:00-23:00) all predicted noise levels exceed the proposed internal noise level of 40 dB $L_{Aeq, 16 \text{ hour}}$. The night-time situation is worse when compared with the proposed internal noise level of 35 dB $L_{Aeq, 8 \text{ hour}}$.

If MCC accepted a relaxation of their criteria to 45 dB $L_{Aeq, 16 \text{ hour}}$ during the daytime period it would be possible to have mitigation of overheating via an open window on the North and Northwest elevations without the need for enhanced mechanical ventilation. The night-time noise climate requires an alternative means of mitigating overheating for the average noise levels ($L_{Aeq,T}$) and also the maximum noise events (L_{Amax}).

9.5 Ventilation and overheating – office building

A mixed-mode ventilation strategy is being considered as an option for the design. This could at times involve opening windows, and so consideration has been given to the level of noise that would arise and how acceptable this would be to future occupants.

Based on the data obtained from the acoustic survey, predicted internal noise levels in the office spaces with windows opened has been undertaken.

Table 27: Predicted internal noise levels within office when windows are partially opened

Location (office South / Southeast facade)	Internal noise level, dB (L_{Aeq})
Ground floor	52–57 dB $L_{Aeq, 16 \text{ hour}}$
Mid-level floor	48–53 dB $L_{Aeq, 16 \text{ hour}}$
Top floor	45–50 dB $L_{Aeq, 16 \text{ hour}}$

Based on the above predictions, it should be possible to provide a mixed mode of ventilation allowing windows / attenuated openings from 3rd floor and above. Further work is required to develop the mixed mode ventilation solution.

10. Noise breakout from proposed commercial

There are retail, F&B and restaurant uses within the proposed development. They are situated at ground and first floor within the office building and ground floor within the residential building. Figure 20 shows the current positioning of these at ground floor level.

Figure 20: Ground floor plan showing retail, F&B and restaurant spaces (in green)



Noise breakout from these spaces has been considered and an assessment undertaken to reflect the criteria set out in MMC guidance for development document. On the basis that the nearest noise sensitive residential property is approximately 20 metres from the proposed restaurant (the proposed residential development) the noise generated within the restaurant minus the façade noise reduction shall be sufficient to meet the MMC guidance, with particularly reference to the 63Hz and 125Hz octave bands.

Currently the assessment concludes that glazing shall need to achieve at least 35 dB R_w with a 20 dB reduction at 63Hz and 25 dB reduction at 125Hz to enable restaurant noise levels to be in the region of 90 dB $L_{eq,T}$ in those octave bands. Noise levels at other octave bands could be higher although not expected to be so.

A similar scenario applies to other retail and F&B spaces proposed although not expecting retail to generate anywhere near the noise levels used for the restaurant example.

11. Summary & conclusions.

Hoare Lea has conducted an environmental noise survey for the proposed development known as Albert Bridge House, Manchester.

The following summarises the assessment procedure and findings contained within this report:

- Environmental noise monitoring was undertaken at the proposed development site across a seven-day period between Wednesday 2nd March 2022 and Wednesday 9th March 2022.
- Noise emission levels associated whilst nearby externally located amplified music events were happening was undertaken on 26 August 2022.
- Background noise levels typical of the daytime and night-time have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptors.
- The nearest receptors have been identified as the proposed development itself. Other commercial and residential properties adjacent to the development have also been identified.
- During the daytime and night-time, the combined building services plant noise emission contribution limit advised is 45 dB(A) and 39 dB(A) respectively, one metre from the nearest residential façade.
- An assessment of the building envelope acoustic performance is provided and indicates the ventilation strategy should allow for future residents to close windows if they choose to do so. This is because external noise levels are sufficiently high that would mean internal noise levels would exceed criteria considered reasonable when windows / doors are open for long periods. This means a suitable mechanical ventilation system is required to mitigate summertime overheating with relying on an open door / window. Short periods of opening a door or window would be acceptable, such as required for rapid ventilation.
- The proposed office building is exposed to noise levels where a mixed mode of ventilation could be possible. Further details of the ventilation strategy will be development but in essence, the use of attenuated openings in the facades should be possible to help ventilate the building whilst maintaining a suitable internal noise climate.
- On the basis of the guidance contained within this report, it is concluded that the Site is suitable for the proposed development.

12. References.

1. *National Planning Policy Framework, Department for Communities and Local Government, July 2021.*
2. *BS 4142: 2014 + A1: 2019: 'Method for rating and assessing industrial and commercial sound'.*
3. *BS 8233: 2014, "Guidance on Sound Insulation and Noise Reduction for Buildings", BSI.*
4. *World Health Organisation (WHO) - Environmental Noise Guidelines for the European Region, 2018.*
5. *ISO 10140-2: 2021, "Acoustics - Laboratory Measurement of Sound Insulation of Building Elements. Part 2: Measurement of Airborne Sound Insulation."*
6. *BS EN ISO 10848-2: 2006: 'Application to Light Elements when the Junction has a Small Influence'.*
7. *BS EN ISO 717-1: 2013. "Acoustics - Rating of Sound Insulation in Buildings and of Building Elements. Part 1: Airborne Sound Insulation."*

Appendix A – Acoustic terminology.

Sound

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

The Sound Pressure

The Sound Pressure is the force (N) of sound on a surface area (m²) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm⁻² or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure – p. The power is proportional to the square of the sound pressure.

The Sound Pressure Level

The human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately 2×10^{-5} Pa (2 ten billionths of an atmosphere) and the highest is approximately 100 Pa.

It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound, where:

$$L_p = 10 \log \left(\frac{p^2}{p_{ref}^2} \right) = 10 \log \left(\frac{p}{p_{ref}} \right)^2 = 20 \log \left(\frac{p}{p_{ref}} \right)$$

Where:

L_p = sound pressure level (dB)

p = sound pressure (Pa)

p_{ref} = 2×10^{-5} – reference sound pressure (Pa)

In accordance with the logarithmic scale, doubling the sound pressure level gives an increase of 6 dB.

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels.

In accordance with the logarithmic scale, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

Sound Pressure Level of Some Common Sources

An indication of the range of sound levels commonly found in the environment is given in the following Table.

Source	Sound Pressure Level dB
Threshold of Hearing	0
Rustling Leaves	20
Quiet Whisper	30
Home	40
Quiet Street	50
Conversation	60
Inside a Car	70
Loud Singing	80
Motorcycle (10m)	90
Lawn Mower (1m)	100
Diesel Truck (1m)	110
Amplified Music (1m)	120
Jet Plane (1m)	130

Frequency

The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.

Octave and Third Octave Bands

An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz.

Third octave bands provided a fine resolution by dividing each octave band into three bands. For examples, third octave bands would be 160 Hz, 250 Hz and 315 Hz for the same 250 Hz octave band.

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequency than to low frequencies within the range. This is the basis of the A-weighting.

A-Weighting

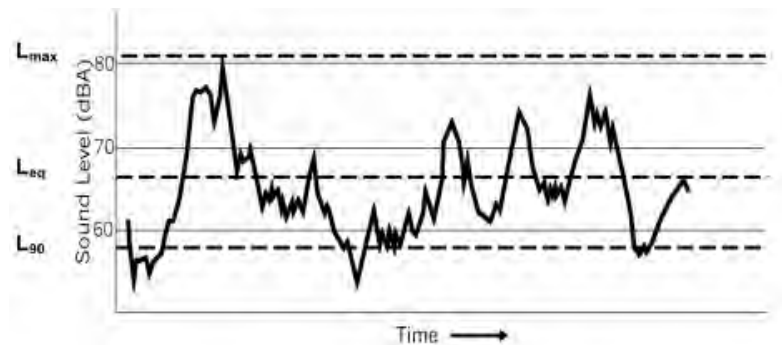
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

An A weighted value would be written as dB(A) or including A within the parameter term.

Noise Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as five minutes, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



$L_{eq,T}$

The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level over a defined time period 'T'. It is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal.

The $L_{eq,T}$ can be thought of as an 'average' sound pressure level over a given time period (although it is not an arithmetic average). Typically, the $L_{eq,T}$ will be an A-weighted noise level in dB(A) and is commonly used to describe all types of environmental noise sources.

$L_{01,T}$

The $L_{01,T}$ is a parameter defined as the sound pressure level exceeded for 1% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameters.

$L_{10,T}$

The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe road traffic noise.

$L_{90,T}$

The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe the prevailing background noise level.

$L_{max,T}$

The $L_{max,T}$ is a parameter defined as the maximum noise level measured during the specified period 'T'.

Specific Noise Level, $L_{Aeq,T,r}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Free Field

A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade

A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

R_w

A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1: 1997.

Appendix B – List of measurement equipment.

Environmental Noise Survey

Three sets of sound measurement equipment were used on Site for which the details are provided below.

Measurement position P1:

- Rion - Sound Level Meter: NL-52 SN: 01143558
- Rion - Pre-amplifier: NH-25 SN: 43575
- Rion - Microphone: UC-59 SN: 07367
- External calibration date 10/01/2022
- External calibration certificate reference UCRT22/1036

Measurement position P2:

- Rion - Sound Level Meter: NL-52 SN: 00510142
- Rion - Pre-amplifier: NH-25 SN: 31928
- Rion - Microphone: UC-59 SN: 02847
- External calibration date 15/02/2022
- External calibration certificate reference UCRT22/1234

Measurement positions P3 to P6 P10:

- Brüel and Kjær - Sound Level Meter: 2250 SN: 3003815
- Brüel and Kjær - Pre-amplifier: ZC-0032 SN: 29116
- Brüel and Kjær - Microphone: 4189 SN: 2887159
- External calibration date 16/11/2021
- External calibration certificate reference UCRT21/2413

Local calibration was undertaken before and after each set of measurements. No significant drift in calibration level was observed. The hand-held calibrator details are as below.

Measurement positions P1 and P2:

- Rion – Calibrator: NC-74 SN: 34536109

Measurement position P3 to P6 P10:

- Brüel & Kjær – Calibrator: 4231 SN: 2545611
- External calibration date 09/08/2021
- External calibration certificate reference UCRT21/1973



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