

100 BARBIROLI SQUARE

Rooftop Plant Noise Assessment



Document History

Project Document reference:

Rev	Date	Comment	Author	Checked
P00	8 April 2021	For client review	CT	GH

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1. INTRODUCTION

MZA Acoustics has been appointed by Savills on behalf of AEW to undertake an assessment of noise impact of the development at 100 Barbirolli Square upon nearby noise sensitive receptors. The assessment is necessary to discharge a planning condition relating to noise emissions from fixed plant serving the development.

This report is a follow on from previous MZA Acoustics report ref: 1700114 RPAC001 rev1 dated July 2019. The previous report demonstrated an environmental noise survey undertaken to determine the prevailing background noise levels at the nearest noise sensitive receptors. The report also presented an accurate CadnaA noise model of the site.

This report details the post completion acoustic testing undertaken on 24th March 2021 required to fully discharge the already partially discharged planning condition 8 ref: CDN/19/0485. This report also provides the findings of an on-site inspection undertaken on 24th March 2021 to ensure noise mitigation items have been properly installed.

This report occasionally employs technical terminology. In order to assist the reader, a glossary of terms is presented in Appendix A.

2. SITE DESCRIPTION

The site is located in Manchester city centre, at 100 Barbirolli Square, M2 3AB. The development site is an existing 9 storey office block bound by Chepstow Street to the east, Chepstow House residential properties to the south, Barbirolli Square to the west and a cluster of office buildings on Oxford Court to the north.

The nearest residential property is Chepstow House which is located immediately to the south of 100 Barbirolli Square. A Premier Inn hotel is located approximately 60m to the north on Lower Mosley Street. Figure 1 presents the site in the context of its surroundings.



Figure 1 – 100 Barbirolli Square (courtesy of Google Maps)

The sound climate across the site is generally dominated by road traffic, which is constant during the day, with particularly busy periods during morning and evening rush hours. There is a neighbouring tram line that runs along Lower Mosley Street which sees steady traffic throughout the day and into the night. Oxford Road railway station is located approximately 500m to the south.

The development proposals involve the refurbishment of all floors throughout the building. The 9th storey is being expanded to increase floor space at this level, which will require alterations to the roof plant area. Further to this, new plant items are to be included to provide additional heating, cooling and ventilation to the building. These items have the potential to impact neighbouring noise receptors and as such are assessed in this report.

3. **GUIDANCE AND CRITERIA**

3.1 **BS 7445-2:1991 'Description and Measurement of Environmental Noise**

BS 7445-2:1991 'Description and Measurement of Environmental Noise - Part 2: Guide to the acquisition of data pertinent to land use' defines parameters, procedures and instrumentation required for noise measurement and analysis. Accordingly, together with associated guidance within the documents below, this Standard has been used to ensure the survey and data are fit for purpose.

3.2 **BS 4142:2014 'Method for Rating and Assessing Industrial & Commercial Sound'**

BS 4142 is the generally adopted method for assessing plant noise emissions affecting residential areas, and is specifically referenced as the assessment methodology in POL05 of BREEAM 2011 and is also specified by the majority of local authorities for such instances commercial & industrial sound affecting residential properties.

The BS 4142 Standard describes methods for rating and assessing the following:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train movements on or around an industrial and/or commercial site.

The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

If appropriate, the specific sound level of the source ($L_{Aeq,T}$) is corrected, by the application of one or more corrections for acoustic features such as tonal qualities and/or distinct impulses, to give a 'rating' level ($L_{Ar,Tr}$). The Standard effectively compares and rates the difference between the rating level of the specific sound and the typical background sound level ($L_{A90,T}$) in the absence of the specific sound.

The Standard advises that the time interval ('T') of the background sound measurement should be sufficient to obtain a representative or typical value of the background sound level at the time(s) the source in question operates or is proposed to operate in the future.

Comparing the rating level with the background sound level, BS 4142 states:

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

- A difference of around +5 dB 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."

3.3 **Manchester City Council Planning Condition**

A decision notice has been granted for the development (decision notice 121887/FO/2018), based on a number of planning conditions. One of these (Condition 8) relates to noise emissions from site, with particular focus on fixed plant. Note that the condition has a design element, which is addressed in this report, and an element to be addressed upon completion of the scheme. The condition is as follows:

"8) Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location. The scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site. The approved scheme shall be completed before the premises is occupied.

Upon completion of the development a verification report will be required to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic consultant's report. The report shall also undertake post completion testing to confirm that the noise criteria has been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria. Reason - To minimise the impact of the development and to prevent a general increase in pre-existing background noise levels around the site, pursuant to policies SP1 and DM1 of the Core Strategy."

4. ENVIRONMENTAL SOUND SURVEY

4.1 Previous Background Survey Summary

This section of the report details a noise survey previously undertaken by MZA Acoustics. The background sound levels measured in this survey are used to inform the post completion assessment.

Baseline environmental sound monitoring was undertaken at the site on Wednesday Monday 9th to Tuesday 10th July 2018 in order to quantify the existing prevailing background sound levels close to the existing noise sensitive receptors to the proposed development site. The survey commenced at approximately 14:00 hours on the 9th July and concluded at approximately 12:30 on the 10th July.

This survey consisted of two unattended measurement locations during critical daytime and night time periods.

Based on the results of the previously undertaken environmental noise monitoring surveys, and considering the requirements of Local Authority, the following noise emission limits were recommended at the location of the existing noise sensitive properties. These are the noise emission limits used for the post completion assessment in this report:

Noise Sensitive Receptor	Representative Background Sound Level (LA90, dB)		Local Authority Criterion	Noise Emission Limit (LA _{Tr} , dB) ²	
	Daytime (07:00 – 23:00)	Night-time (23:00- 07:00)		Daytime (07:00 – 23:00)	Night-time (23:00- 07:00)
Chepstow House	58	43	Rating Level = Background Level -5dB	53	38
Premier Inn ¹	55	49	Rating Level = Background Level -5dB	50	44

¹ Note that limits at the Premier Inn are based on results from measurements position LT1, which overlooks Chepstow Street. This is considered representative due to the proximity to similar noise sources.

² Note that this is given as a BS4142 rating level (LA_{Tr}) and as such accounts for acoustic penalties, where applicable

Table 1 – Noise Emission Limits

4.2 Post Completion Survey Description

MZA Acoustics returned to site on 24th March 2021 to measure the level of noise attributed to the rooftop plant post installation. A sound level meter was set up in a free field position on the rooftop of 100 Barbirolli. The microphone was positioned approximately 7 meters away from the external facing side of the installed noise barrier, which has a height of 2m. An image of the installed monitoring equipment is shown below in Figure 2.



Figure 2 – Post completion assessment noise measurement location

The rooftop layout, with the measurement position highlighted is shown below in Figure 3. The position of the noise barrier is also shown.

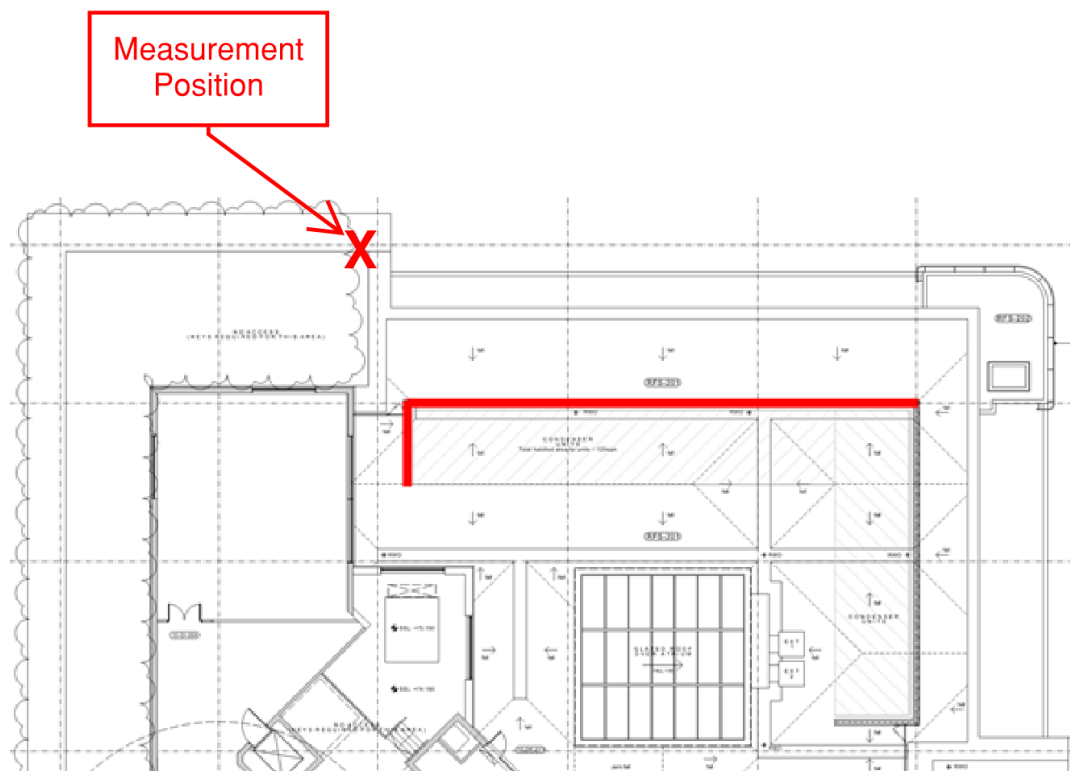


Figure 3 – Measurement location and barrier position

The monitor ran between 15:00 on 24th March to 09:00 on the 25th of March 2021. A full time history is presented in Appendix B.

Table 2 details the equipment used during the survey. The sound level meter was field-calibrated before and after measurements using the acoustic calibrator shown. No significant drift in calibration level was recorded (<0.1 dB). The calibrator and sound level meters have been calibrated by a UKAS accredited calibration laboratory within the past year and in the past two years respectively.

Equipment	Model Type	Serial Number	Calibration Due Date
Sound Level Meter	01dB Metravib FUSION	11704	20/04/2022
Pre-amplifier	01dB Metravib PRE22	1707136	
Microphone	GRAS 40CD 1/22" Pre-polarised free-field	331728	
Calibrator	01dB Metravib CAL31	83395	17/04/2021

Table 2 – Equipment used for 24/03/21 Survey.

4.3 Post Completion Survey Results

Table 3 below presents the measured plant noise levels during the post completion survey. MZA Acoustics were assured by the M&E contractor that the rooftop plant ran consistently and at maximum duty. The levels presented are considered to be representative of the plant noise with installed mitigation as plant noise was the dominant source at the measurement location. The levels presented in Table 3 are the highest consistent noise levels measured (between the hours of 15:00 and 18:00) and are considered to be worst case. MZA Acoustics engineers were on site during this period. The night-time measured levels are also presented, it is assumed some items of plant were switched off or running at reduced duty during this period.

Measurement	L _{Aeq,T} dB	L _{A90,T} dB
Worst Case Measured Plant Noise (15:00-18:00)	58	56
Measured Night-time plant noise emission 23:00-07:00	54	49

Table 3 – Measured level of plant noise including barrier effect from acoustic screen.

A full time history is presented in Appendix B.

5. ASSESSMENT

5.1 Predicted levels at receptors

A prediction method has been used to assess the level of plant noise at the nearest noise sensitive receptors. Typically, measurement would be taken at the receptor, however in the case of this assessment it was not possible due to access restrictions at both Chepstow House and Premier Inn.

MZA Acoustics have therefore assessed using a 2-stage approach which involves on site measurement at a representative receptor point (as presented in Section 4.2) and comparison to a detailed noise model of the site and surrounding area.

The previously submitted MZA Report modelled the development site using DataKustik software CadnaA. An annotated image of the modelled site is presented below in Figure 4 for reference.

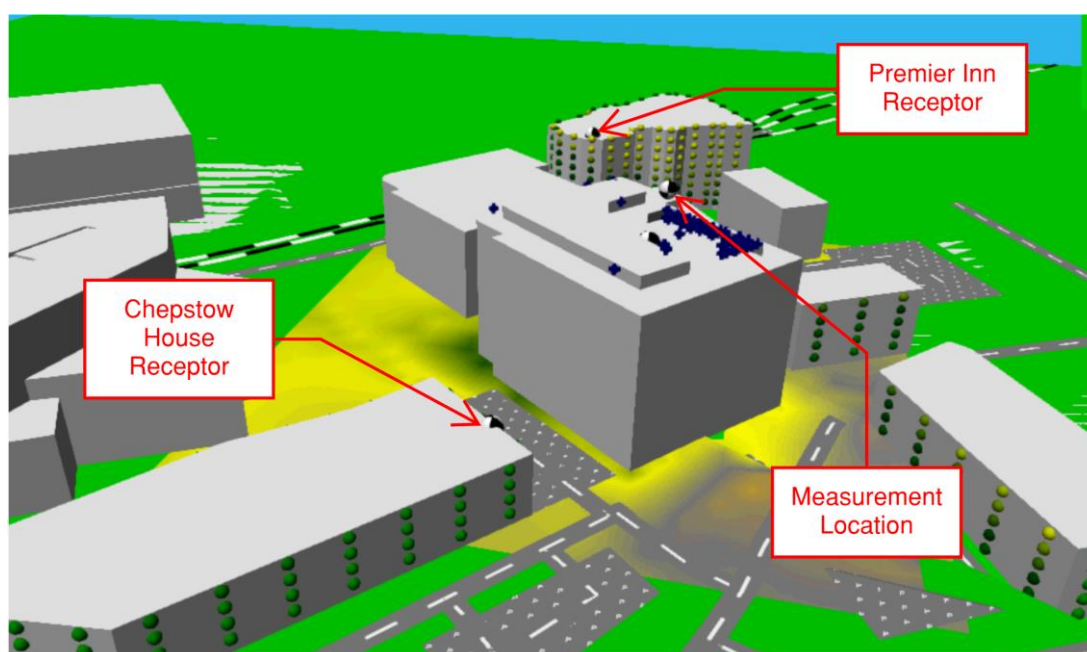


Figure 4 – Noise model.

The CadnaA noise model included all items of onsite plant in the correct position as per the building services drawings and schematics. A full list of the equipment in the noise model, as well as a checklist confirming its presence on site is presented in Appendix C.

With the attenuation provided by the acoustic screen and plant specific attenuators the noise model found the levels of plant noise at the nearest receptors to be the following presented in Table 4.

Noise Sensitive Receptor	Local Authority Criterion (L _{Aeq} dB)		CadnaA Predicted Noise Levels (L _{r,Tr,r} dB) ¹	
			With mitigation installed	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Chepstow House	53	38	38	38
Premier Inn	50	44	44	44

Table 4 – CadnaA noise model assessment (Original Assessment Submitted at Planning).

The levels presented in Table 4 comply with the Local Authority Criterion. When a receiver point is placed within the model at the same position as the on site microphone (as shown in Figure 3 and Figure 4) the sound level measured in CadnaA **61dBA**.

This is **3dBA** higher than the worst case measured on site level of **58dBA** as presented in Table 3 of this report.

Measurement Info	Noise Level
Noise model prediction at onsite measurement location	61dBA
Onsite Worst-Case Measurement	58 dBA
Difference	-3dBA

Table 5 –CadnaA predicted level compared to on site noise level.

The noise model has been calibrated using this 3dBA correction. With 3dB being subtracted from the noise levels presented in Table 4 to give an accurate final noise prediction using the data obtained from the measurements on site. Table 6 presents the final predicted levels against the Local Authority Criterion.

Noise Sensitive Receptor	Local Authority Criterion (L _{Aeq} dB)		Predicted Noise Levels (L _{r,Tr,r} dB) ¹		Excess of Predicted level over criterion	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)	Daytime (07:00-23:00)	Night-time (23:00-07:00)	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Chepstow House	53	38	35	35	-18	-3
Premier Inn	50	44	41	41	-9	-3

Table 5 –Final noise level assessment using CadnaA model calibrated to on site measurement levels..

It can be concluded that the level of plant noise is lower than the Local Authority Criterion and therefore demonstrates compliance with the Planning Condition.

5.2 Installed Mitigation

A secondary requirement of Planning Condition 8 is to demonstrate proof of the installed mitigation on site. Figure 5 below shows an image of the external face of the installed 2m high noise barrier on the rooftop of 100 Barbirolli.

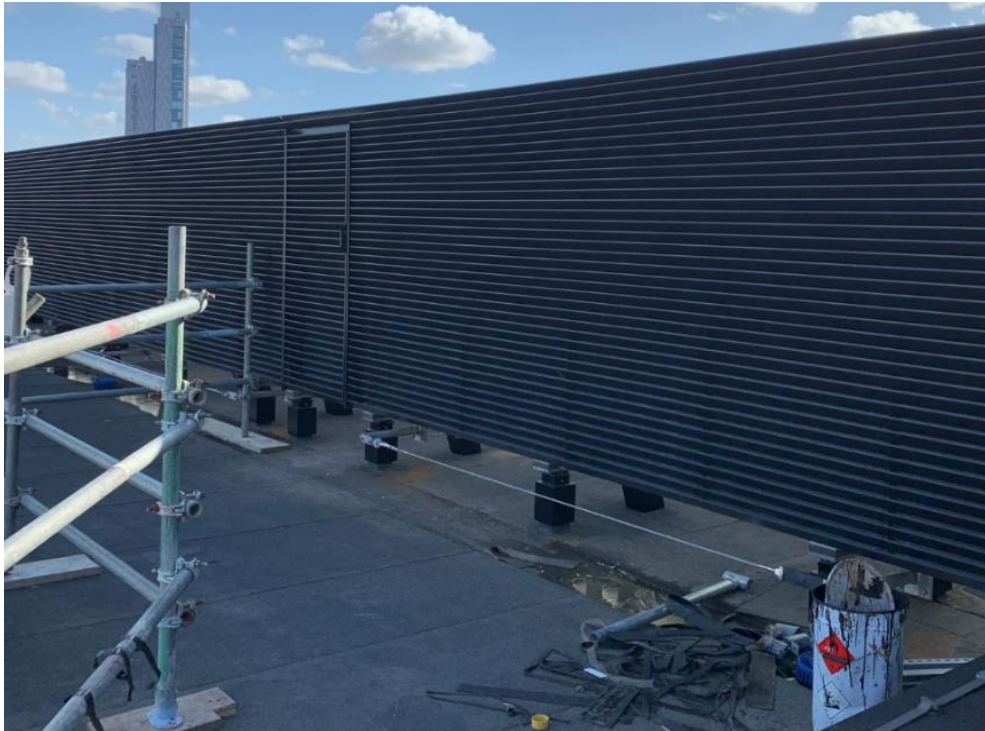


Figure 5 – Installed Barrier on rooftop.

.It is noted that there is a gap between the base of the barrier and the slab, but the effect of this was considered and predicted to have no effect as the plant is raised on a big-foot system, resulting in the noise source being well above the gap and the perimeter parapet wall of the building is also higher than the gap.

It is understood the gap was required to reduce potential wind loading on the barrier and aide air flow to the equipment.

6. CONCLUSION

MZA Acoustics has been appointed by Savills on behalf of AEW to undertake an assessment of noise impact of a development upon noise sensitive nearby receptors. The assessment is in place to discharge a planning condition relating to noise emissions from fixed plant serving the development, with the impacts measured at nearby residential premises.

An environmental noise survey was previously undertaken to determine prevailing background sound levels in the surrounding area which have been used to determine limits at the nearest receptors.

To determine the impacts at the receptors a secondary survey was undertaken post completion on 24th March 2021. The data collected from this survey was compared with predicted sound levels of a previous MZA Acoustics CadnaA noise model. The level on site was found to be **3dBA lower** than that of the CadnaA noise model in the same position, the results from the initial CadnaA model were calibrated to reflect this difference and compliance with the Local Authority Criterion is shown.

Noise emission limits are achieved at both receptors and as such the requirements of planning Condition 8 of decision notice 121887/FO/2018, issued by Manchester City Council, have been satisfied.

Appendices

Appendix A – Glossary of Acoustic Terminology

Acoustics is the branch of physics concerned with the properties of sound, including ultrasound, infrasound and vibration. A scientist or engineer who works in the field of acoustics is an acoustician or acoustic engineer.

Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response, and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive. Care has been taken in this document to use the most relevant of these terms (whereby 'sound' is used predominantly); however, in most reference documents, and, indeed, generally, 'sound' and 'noise' are used interchangeably.

Consequently, just because the term 'noise' is used doesn't necessarily mean a negative effect exists or will occur, and the context of the accompanying text should be taken into account.

Human hearing is able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble), and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain).

The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify sound in a manner that approximates the response of the human ear, a weighting mechanism is used, which reduces the importance of lower and higher frequencies in a similar manner to human hearing.

The weighting mechanism that best corresponds to the response of the human ear (though not necessarily perfectly) is the 'A'-weighting scale. This is widely used for environmental sound measurement, and the levels are denoted as dBA, dB(A) or LAeq, LA90 etc. according to the metric being measured or determined (see the Definitions over leaf).

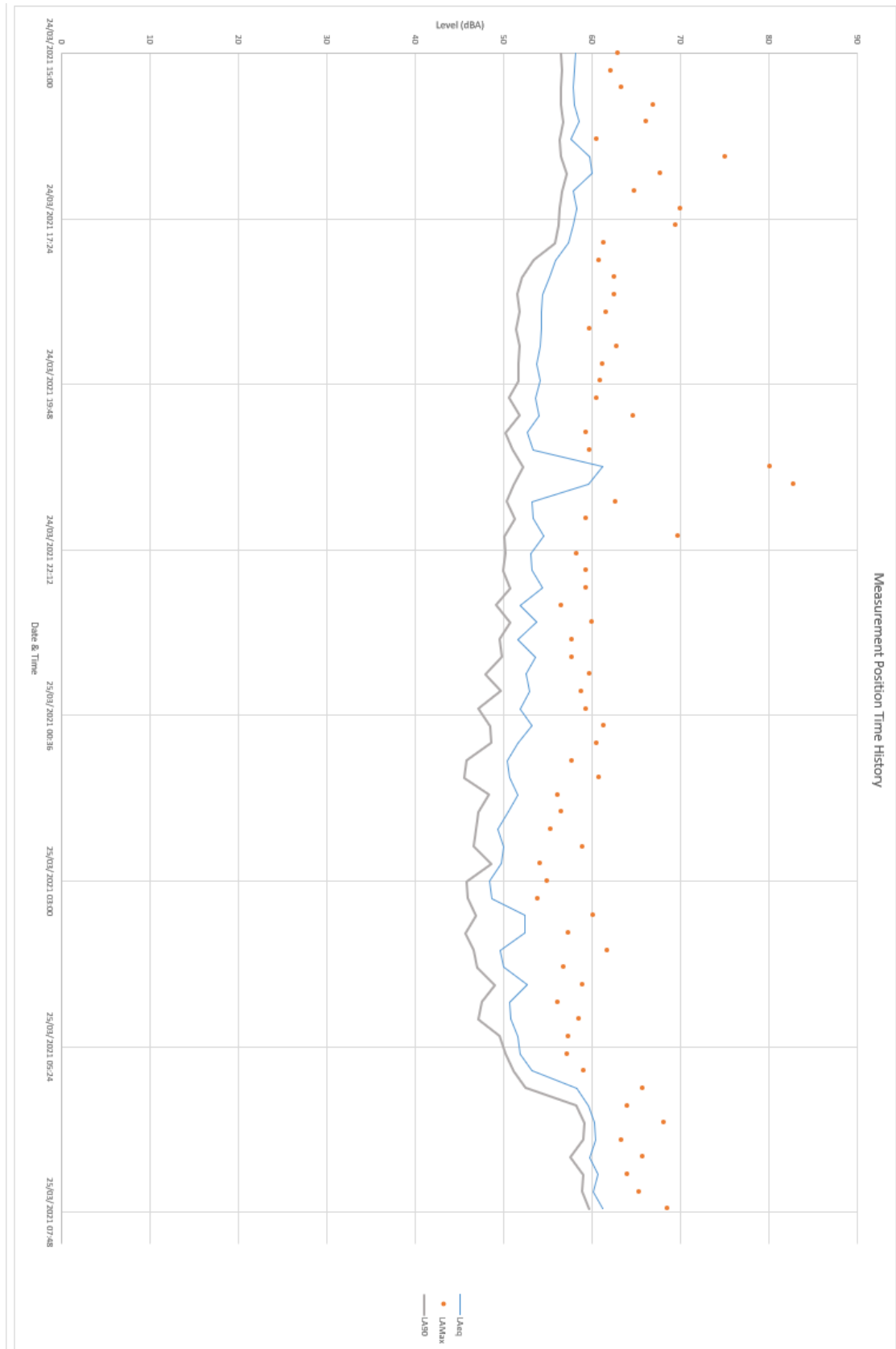
The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB is generally regarded as the minimum difference needed to perceive a change under normal listening conditions. Where other changes occur (associated with the change in sound level), such as additional vehicle movements on a road, which can be seen, then these may result in changes in sound level being more noticeable than they might otherwise be.

Further to such visual clues, and any other non-acoustical factors that affect people's response (such as personal characteristics, and social, residential or environmental factors), the subjective response to a sound is dependent not only upon the sound pressure level and component frequencies, but also its intermittency. Consequently, various metrics have been developed to try and correlate people's attitudes to different sounds with the sound level and its fluctuations. The metrics used in this document, as per the relevant guidance, are defined overleaf.

Airborne Sound	Sound that reaches the point of interest by propagation through air.
Ambient Sound:	Sound from all sources at any given time, from both near and far. Usually measured in terms of L_{Aeq} .
A-Weighting	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Background Sound Level	The A-weighted sound pressure level that can be considered the baseline in the absence of any noise from a specific source of sound under assessment. Measured in terms of $L_{A90, T}$.
Calibration	The measurement system/ chain should be periodically calibrated, within a laboratory, against traceable calibration instrumentation, to either National Standards or as UKAS-Accredited, as required. The calibration of the system should also be checked in the field using a portable calibrator before and after each short term measurements, and periodically for longer term monitoring.
Class 1	The Class of a sound level meter describes its accuracy as defined by the relevant international standards – Class 1 is more accurate than Class 2. The older standard IEC 60651 referred to the grade as "Type", whereas the new standard IEC 61672 refers to it as the "Class". The most accurate meters used in the field (as opposed to a laboratory) are Class 1. Class 2 meters can be used in some instances; however MZA Acoustics use Class 1 (or Type 1) meters by default, as required by BS 4142:2014, for example.
Decibel	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds (s_1 and s_2) is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 Pa.
Fast time Weighting (F)	Averaging time used in sound level meters. Defined in BS EN 61672-2:2013 Electroacoustics. Sound level meters. Pattern evaluation tests.
Free-field / Façade	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m away.
$L_{AF90, T}$	The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time fast time-weighting (F). Generally used to describe the 'background' sound conditions.
L_{AFmax}	The maximum A-weighted sound pressure level during a given time period. L_{max} is sometimes used for the assessment of occasional loud sounds, which may have little effect on the overall L_{eq} noise level, but could still affect the sound environment. Unless described otherwise, it is measured using the fast time-weighting (F).
$L_{eq, T}$	A sound level index called the equivalent continuous sound level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. Where the value is A-weighted, is

	will be presented 'LAeq,T' or 'dBA Leq,T', otherwise it should be an un-weighted (or linear) value.
L _p	See Sound Pressure Level.
Noise	Related to human response to sound. Unwanted sound, or sound that is considered undesirable or disruptive.
Octave Band	Frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.
Sound Absorption Coefficient	A measure of how effective a material is at absorbing sound incident to its surface. The index range is between 0 and 1, where 1 indicates a perfectly absorbent material and 0 indicates a perfectly reflective one.
Sound Power	In a specified frequency band, the rate at which acoustic energy is radiated from a source. In general, the rate of flow of sound energy, whether from a source, through an area, or into an absorber.
Sound Power Level	Of airborne sound, ten times the common logarithm of the ratio of the sound power under consideration of the standard reference power of 1 pW. Expressed in decibels.
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level	The sound level is the sound pressure relative to a standard reference pressure of 20 Pa (20x10 ⁻⁶ Pascals) on a decibel scale.
Weighted Sound Reduction Index (R _w)	A single-figure quantity which characterises the airborne sound insulating properties of a material or element over a range of frequencies.

Appendix B - Measurement Time History



Appendix C – Rooftop Plant Installation & Model Checklist

Item Of Plant	Type/REF	Variant	SWL dBA	Number on site	Included in noise model	Present on site
Condenser	Mitsubishi PURY R401A	P300	80	1	Yes	Yes
Condenser	Mitsubishi PURY R401A	P350	81	5	Yes	Yes
Condenser	Mitsubishi PURY R401A	P400	83	3	Yes	Yes
Condenser	Mitsubishi PURY R401A	P450	83	5	Yes	Yes
Condenser	Mitsubishi PURY R401A	P500	82	8	Yes	Yes
Condenser	Mitsubishi PURY R401A	P550	84	2	Yes	Yes
Condenser	Mitsubishi PURY R401A	P600	83	4	Yes	Yes
Condenser	Mitsubishi PURY R401A	P650	84	3	Yes	Yes
Condenser	Mitsubishi PURY R401A	P700	84	6	Yes	Yes
Condenser	Mitsubishi PURY R401A	P850	86	1	Yes	Yes
Condenser	Mitsubishi PURY R401A	P900	86	2	Yes	Yes
Air Handling Unit	AHU01	Outlet	87	1	Yes	Yes
Air Handling Unit	AHU01	Inlet	78	1	Yes	Yes
Air Handling Unit	AHU02	Outlet	88	1	Yes	Yes
Air Handling Unit	AHU02	Inlet	83	1	Yes	Yes
Air Handling Unit	AHU03	Outlet	79	1	Yes	Yes
Air Handling Unit	AHU03	Inlet	71	1	Yes	Yes
Air Handling Unit	AHU04	Outlet	83	1	Yes	Yes
Air Handling Unit	AHU04	Inlet	71	1	Yes	Yes
Toilet Extract Fan	TEF1-2	Outlet	72	2	Yes	Yes
Smoke Extract Fan	SEF2	Outlet	85	1	Yes	Yes
Extract Fan	EF1	Outlet	46	1	Yes	Yes
Extract Fan	EF2	Outlet	70	1	Yes	Yes
Extract Fan	EF3	Outlet	71	1	Yes	Yes
Extract Fan	EF4	Outlet	57	1	Yes	Yes

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