

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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NatWest, Spinningfields

Noise survey and plant noise egress assessment

London, Manchester, Edinburgh, Birmingham, Belfast, Leeds

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D	18 Jul 22	Updated AHU noise data and additional plant items	Jose M. Gonzalez	Mark Howarth
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Summary

Sandy Brown has been commissioned by NatWest Group to provide acoustic advice in relation to the proposed development at NatWest Spinningfields, 182 Deansgate, Manchester M3 3LY.

An environmental noise survey has been carried out to determine the existing sound levels in the area. The noise survey was performed between 10:25 on 17 December 2021 and 11:55 on 22 December 2021.

The representative background sound levels measured during the survey were:

- L_{A90} 55 dB during the daytime and L_{A90} 49 dB at night to the north and west
- L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night to the south and east.

Based on the requirements of the Manchester City Council and on the results of the noise survey, noise egress limits have been set. These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied, and the limits will be more stringent than those set.

A noise egress assessment has been carried out to determine any additional acoustic mitigation measures required to achieve the noise egress criteria at the nearest noise sensitive premises.

On the basis that the generators are replacing current diesel rotary UPS units, it may be acceptable to relax generator plant noise limits to match those of the existing plant. This is subject to agreement by Manchester City Council.

The generators are proposed to run for planned maintenance, and simultaneously when there is a building mains failure as well as for emergencies. This could be during the day and night-time.

The predicted noise levels from the proposed plant and attenuation measures meet the day and night-time limits at the nearest noise sensitive premises.

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1 Introduction

Sandy Brown has been commissioned by NatWest Group to provide acoustic advice in relation to the proposed reconfiguration of rooftop plant at NatWest Spinningfields, 182 Deansgate, Manchester M3 3LY

As part of this, an environmental noise survey is required, the purpose of which is to establish the existing background sound levels in the vicinity of nearby noise sensitive premises. These are used to set appropriate limits for noise egress from building services plant in accordance with Manchester City Council requirements.

This report presents the survey method and results, and a discussion of acceptable limits for noise emissions from building services plant.

2 Site description

2.1 The site and its surrounding

The site location in relation to its surroundings is outlined in red in Figure 1.



Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The site is adjacent to the following premises:

- The Old Courthouse (residential, offices and commercial) highlighted in pink in Figure 1
- Yotel Deansgate (hotel), highlighted in dark green in Figure 1.
- Moxy Hotel, highlighted in red in Figure 1.
- DFW (offices) highlighted in blue in Figure 1.
- 3 Hardman Street (offices) highlighted in light green in Figure 1.
- 1 The Avenue (offices and commercial) highlighted in yellow in Figure 1.
- St John's House (offices and commercial) highlighted in cyan in Figure 1.
- Centurion House (offices) highlighted in purple in Figure 1.
- 1 Hardman Street (offices) highlighted in orange in Figure 1.

3 Development proposals

The proposals include changes to the rooftop plant on the NatWest building on Deansgate, Manchester. The proposal includes two generators on level 8, two AHUs and two condenser units on level 7, and three source heat pumps at level 6.

The building has an existing roof plant room in which there is a diesel rotary UPS alongside other electrical equipment. The proposal includes the removal of these plant items and install two generators in the same area within acoustic cabinets.

In addition to this, the proposal is to 'extend' the plant room on Level 6 (which currently contains three chillers and water plant room) such that it encroaches onto the terrace above. The extended area will include new AHUs at level 7.

4 Building services noise egress criteria

4.1 Standard guidance

BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS 4142) provides a method for assessing noise from items such as building services plant against the existing background sound levels at nearby noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

4.1 Local authority requirements

Manchester City Council (MCC) provides guidance in relation to plant noise emissions in their *Planning and Noise Technical Guidance* document dated December 2015. The following is stipulated:

‘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 (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.’

4.2 Existing plant noise egress

Noise data for the existing rooftop diesel rotary UPS has been provided and summarized in Table 1.

Table 1 Provided data for the existing rooftop diesel rotary UPS

	Sound pressure levels at 1 m, L_{eq} (dB), Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Discharge louvres	87	97	83	70	62	61	58	60
Inlet louvres	86	82	76	69	62	59	55	57
Enclosure front corner	83	84	77	66	65	62	58	63
Enclosure rear corner	80	84	72	63	57	52	48	46
90 degree exhaust outlet	103	111	101	84	76	76	73	68

Data for the existing AHUs has not been provided.

Based on this data, it is calculated that the existing rooftop diesel rotary UPS contribution at 1 m from the facade of the nearest noise sensitive receptor (St John’s House) is L_{Aeq} 56 dB when operational.

5 Noise survey method

The survey included unattended noise measurements.

5.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 6 days.

Details of the equipment used and the noise indices measured are provided in Appendix A.

The unattended measurements were taken over 15 minute periods between 10:25 on 17 December 2021 and 12:10 on 22 December 2021. The equipment was installed by Jessica Wright and collected by Christian Clark.

The measurement positions used during the survey are indicated in Figure 1, denoted by the numbers '1' and '2'. A photograph showing the measurement locations are provided in Figure 2.

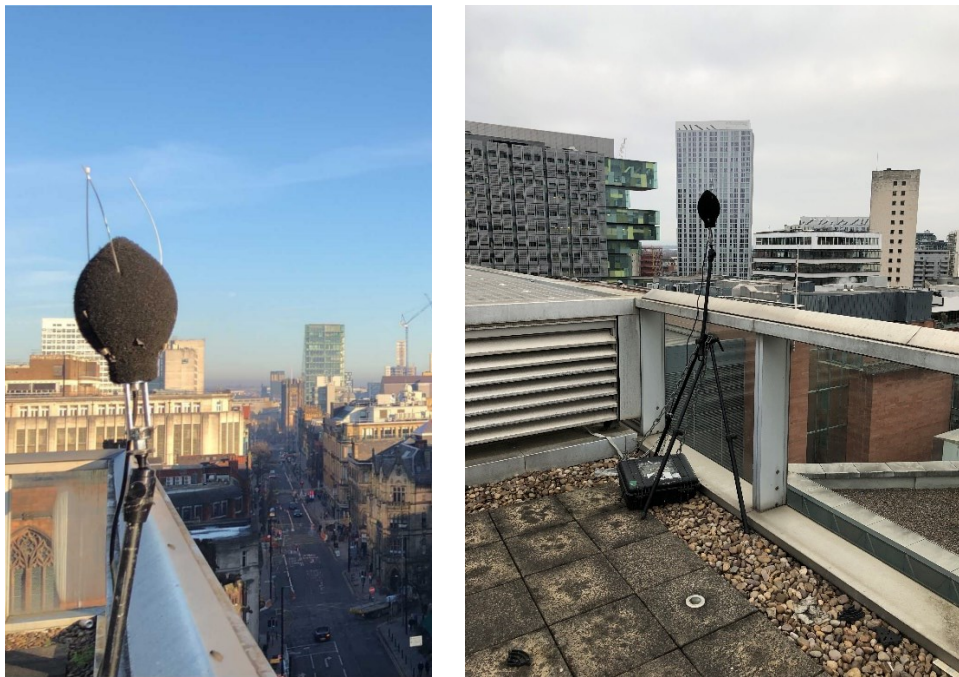


Figure 2 Photographs of measurement positions 1 (left) and 2 (right)

These locations were chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises. However, the existing plant was not operational during the visit so the levels measured do not include its contribution.

5.2 Weather conditions

Weather conditions during the survey are described in Appendix A.

6 Noise survey results

6.1 Noise measurement results

A graph showing the results of the unattended measurements is provided in Appendix B.

Day and night-time ambient noise levels measured during the unattended survey are presented in Table 2 and Table 3.

Table 2 Ambient noise levels measured during the unattended survey at position 1

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Friday 17 December 2021	-	62
Saturday 18 December 2021	64	65
Sunday 19 December 2021	65	58
Monday 20 December 2021	62	57
Average	64	61

Table 3 Ambient noise levels measured during the unattended survey at position 2

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Tuesday 21 December 2021	64 ^[1]	55
Wednesday 22 December 2021	71 ^[1]	-
Average	-	55

^[1] Measurement not made over full period due to monitoring start and end time (the measurement on 21 December 21 was over 12 hours, and on 22 December 21 over 5 hours); not included in the average.

In line with BS 4142:2014+A1:2019, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Daytime and night-time statistical analysis of representative values for the site are given in Figure 3 and Figure 5 at position 1 and Figure 4 and Figure 6 at position 2.

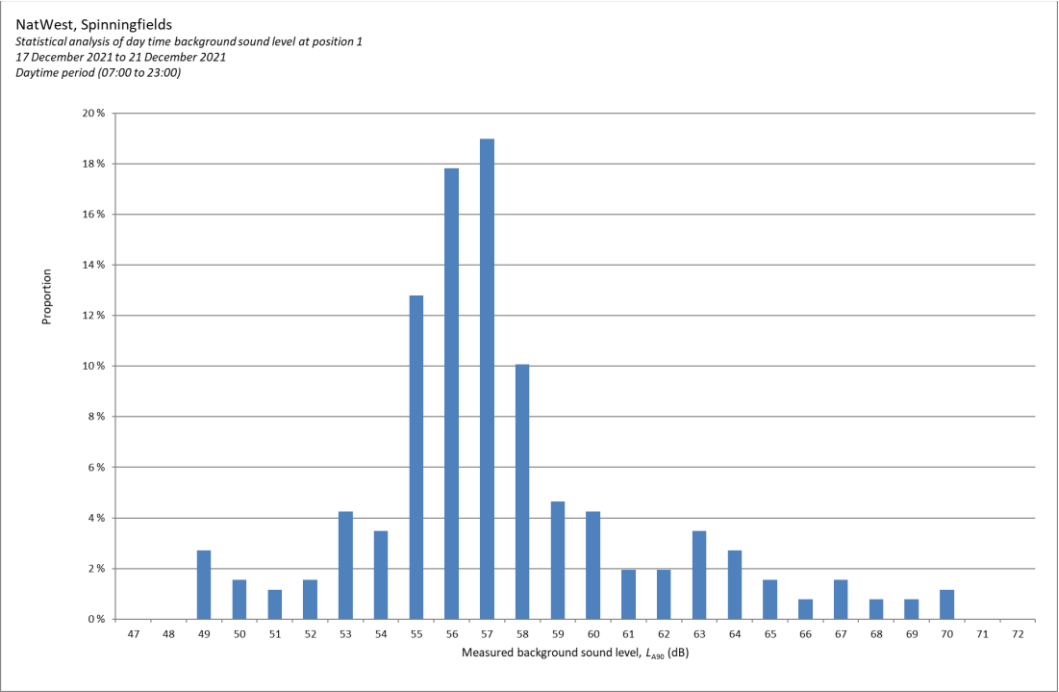


Figure 3 Statistical analysis of daytime background sound levels at position 1

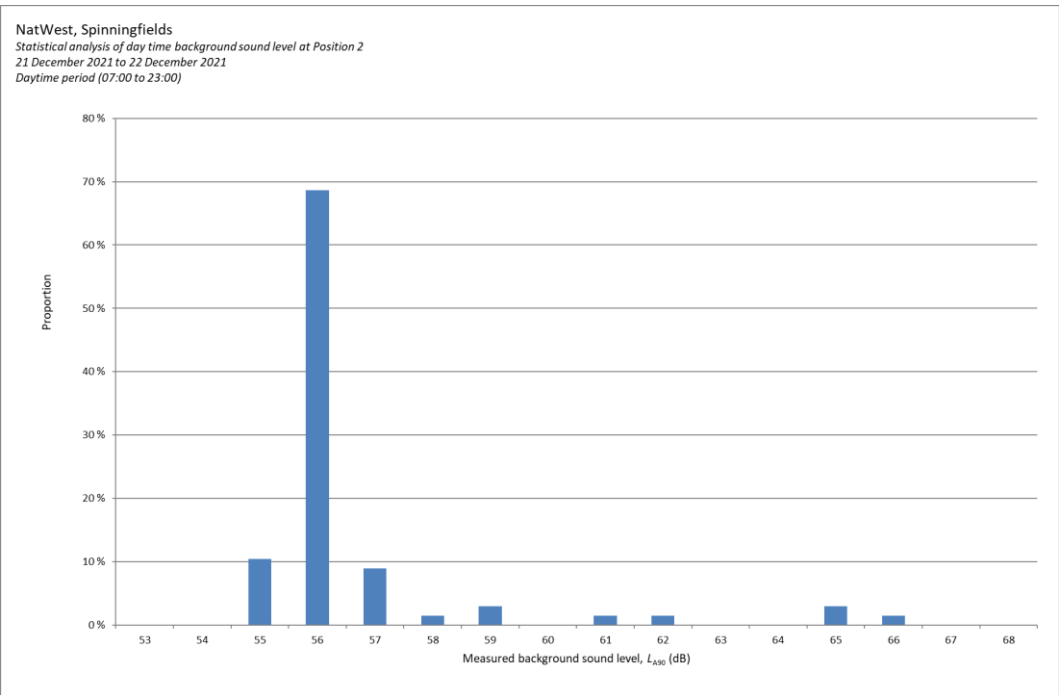


Figure 4 Statistical analysis of daytime background sound levels at position 2

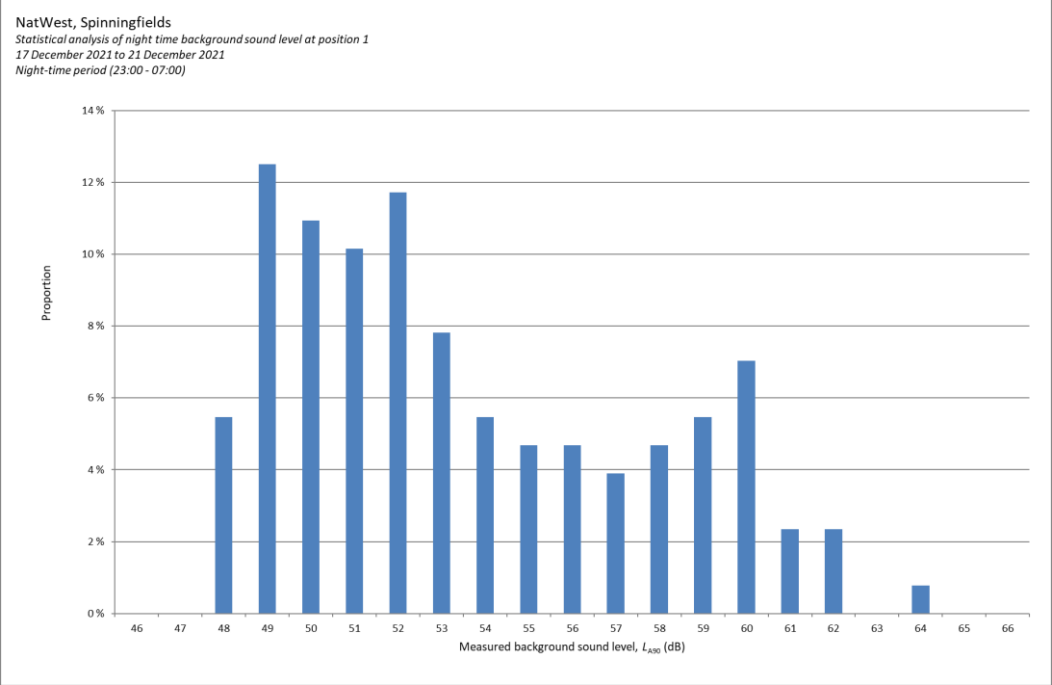


Figure 5 Statistical analysis of night-time background sound levels at position 1

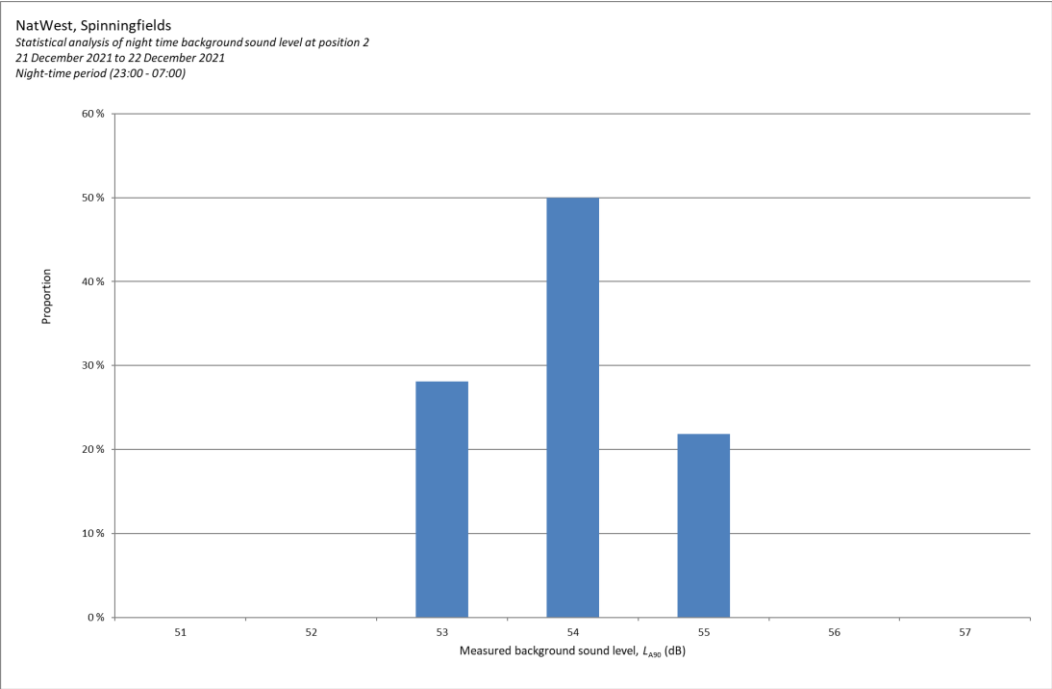


Figure 6 Statistical analysis of night-time background sound levels at position 2

From this analysis, the representative free-field background sound levels measured during the survey were:

- Position 1: L_{A90} 55 dB during the daytime and L_{A90} 49 dB at night
- Position 2: L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night.

6.2 Plant noise limits

6.2.1 Basic limits

If noise from existing plant is not accounted for, based on the above criteria and the measurement results, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 4.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. These have been corrected relative to the measured free-field background noise levels by the addition of 3 dB. In this case these limits would apply at the locations shown in Table 4.

Table 4 Plant noise limits at 1 m from the nearest noise sensitive premises

Location	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)
The Old Courthouse, Yotel, Moxy Hotel	53	47
Centurion House, St John's House	53	-
1 The Avenue, 3 Hardman Street, DFW, 1 Hardman Street	54	-

[1] The limits set out in Table 4 do not include any attention catching features. Penalty corrections for attention catching features may be significant and will need to be considered as the building services design progresses. This is discussed in Appendix D.

6.2.2 Adjusted limits accounting for contributions from existing diesel rotary UPS

On the basis that the generators are replacing current diesel rotary UPS units, it may be acceptable to relax generator plant noise limits to match those of the existing plant. This is subject to agreement by Manchester City Council.

6.3 Proposed plant noise assessment

The proposed development comprises the installation of the following items of plant

Ground level

- 1 x Daikin AHU with supply and extract connection to louvres (highlighted in red in Figure 7)

Level 6

- 3 x Air source heat pumps (AHSP) with AA203S (highlighted in green in Figure 8)

Level 7

- 2 x Daikin AHUs, AHU 7 and AHU 8 (highlighted in orange in Figure 9)
- 2 x FläktGroup condenser units (highlighted in blue in Figure 9)

Level 8

- 2 x MTU Generators highlighted in pink in Figure 10), these units are proposed to operate simultaneously when there is a building main failure and during planned maintenance.

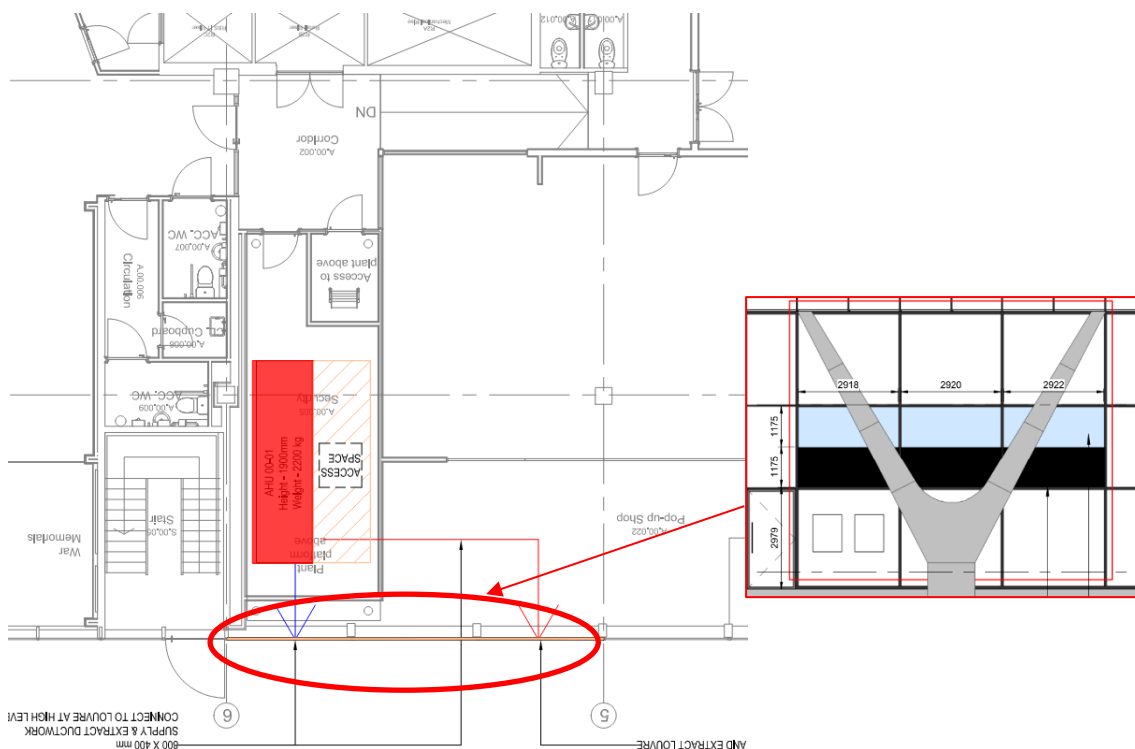


Figure 7 Proposed AHU at ground level with connections to atmosphere side

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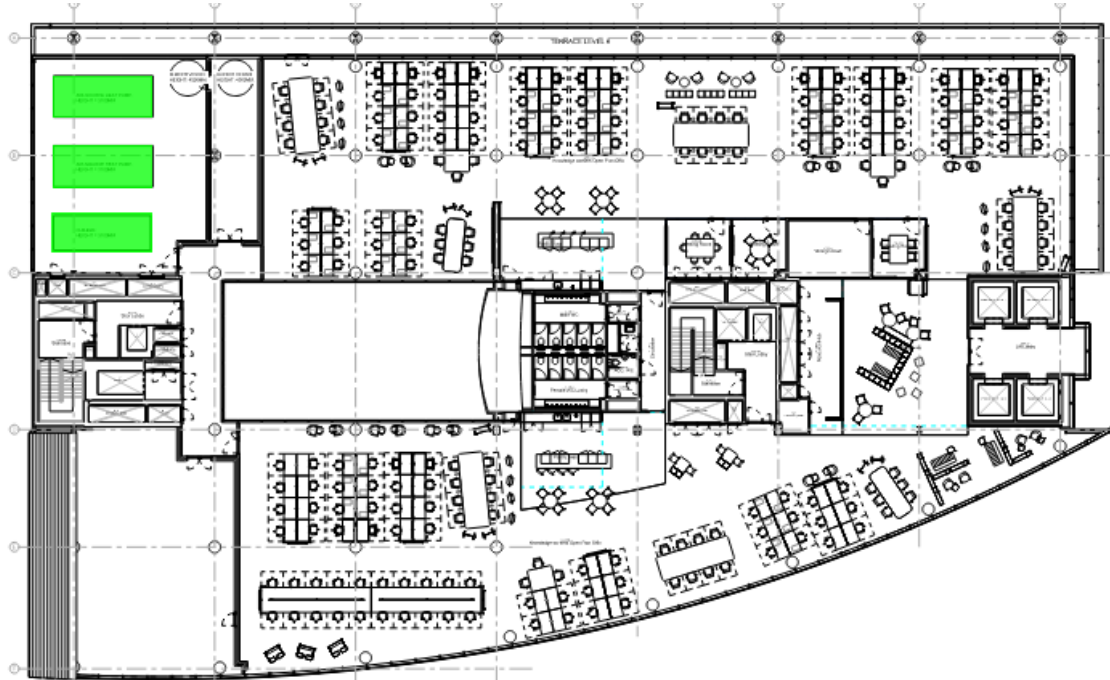


Figure 8 Proposed plant items at level 6

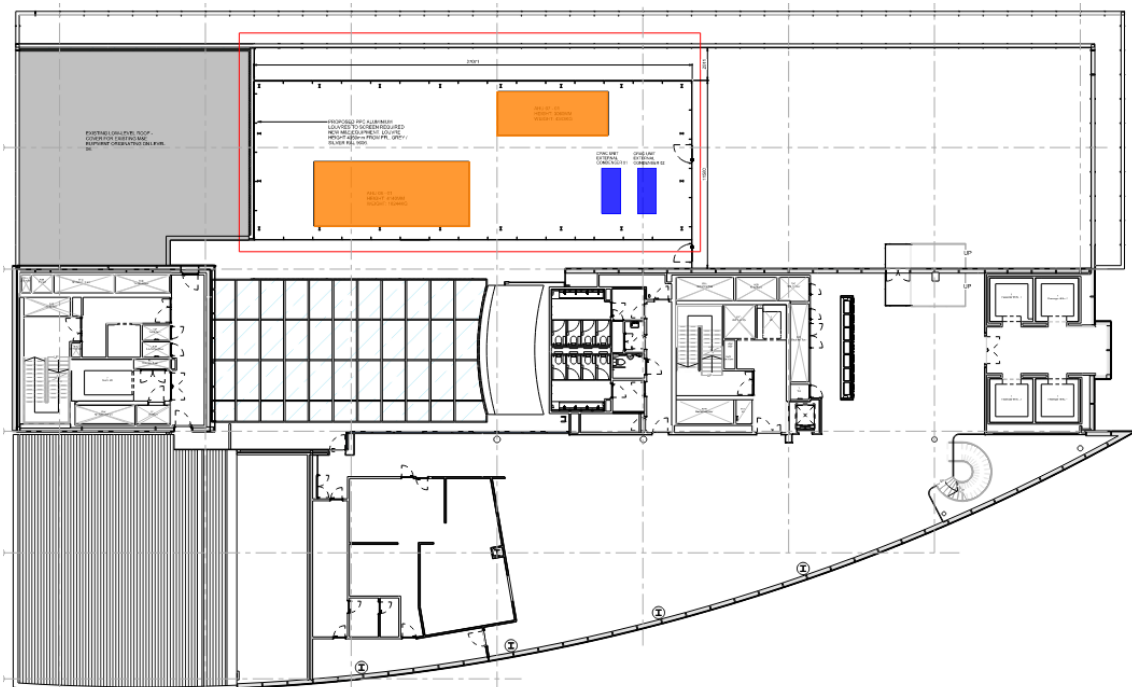


Figure 9 Proposed plant items at level 7

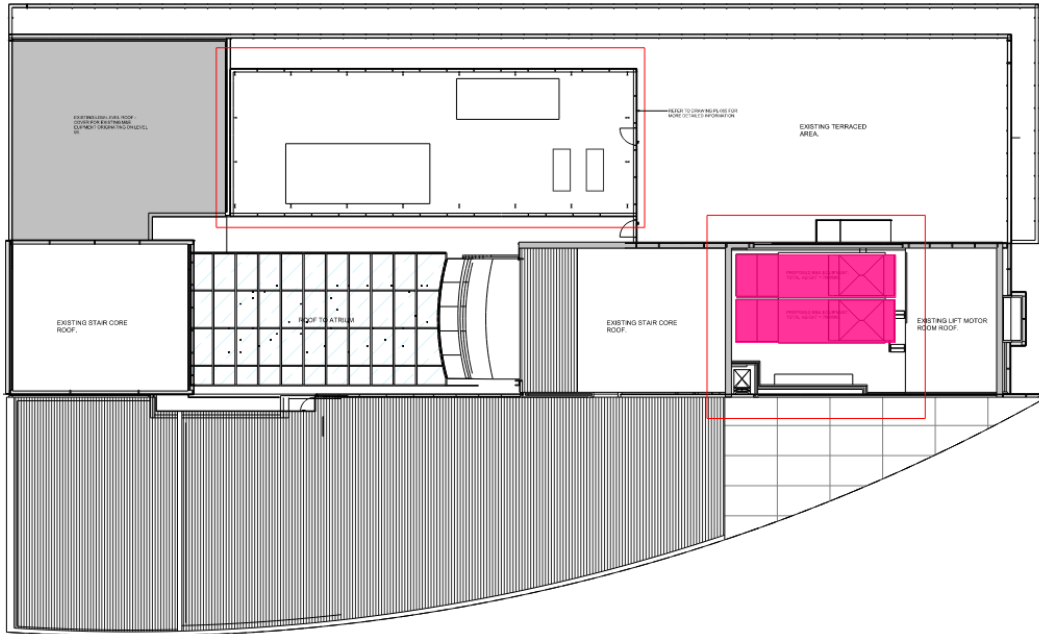


Figure 10 Proposed plant items at level 8

The manufacturer's acoustic data received for the proposed items of plant are summarised in Table 5 to Table 7.

Table 5 Noise data for the proposed AHUs

Plant item	Sound power level, L_w (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
<i>AHU Ground floor</i>								
<i>Intake</i>	56	64	51	42	32	31	37	41
<i>Exhaust</i>	63	70	57	56	49	46	50	51
<i>AHU 7</i>								
Supply	62	70	53	43	31	30	37	45
Supply airborne	56	68	53	53	50	45	29	22
Exhaust	70	81	63	60	51	49	56	57.0
Return airborne	55	68	52	53	51	44	29	21

Plant item	Sound power level, L_w (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
<i>AHU 8</i>								
Supply	71	73	58	49	37	35	44	52.
Supply airborne	62	70	58	58	55	51	35	28
Exhaust	79	83	69	65	55	53	61	63
Return airborne	64	70	58	58	55	49	34	27

Table 6 Noise data for the proposed ASHPs

Plant item	Sound power level, L_w (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Air source heat pump (ASHP)- each	43	52	62	60	59	57	54	36

The data for the proposed generator units is summarised in Table 7. In each case the data relates to 2 units in operation at the same time (worst-case). The levels include attenuation measures.

Table 7 Noise data for the proposed generators

Plant item	Sound pressure level, L_p (dB) at 1m							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
<i>Intake (attenuated)- 2 units</i>	96	94	80	60	53	52	51	65
<i>Outlet (attenuated)- 2 units</i>	96	90	77	59	52	55	58	60
Case radiation (attenuated)- 2 units	84	91	80	73	68	62	56	48

The data presented for the generators are unweighted octave band sound pressure levels.

The generators are proposed to run for planned maintenance, and simultaneously when there is a building mains failure, this could be during the day and night-time.

6.4 Noise egress assessment

The predicted noise rating levels at the nearest noise sensitive premises take into account the following:

- Attenuation due to distance and screening
- AHUs and Condenser units in continuous operation during the day and night-time periods
- Two generators being in continuous operation during power shortage
- The location of the plant and directivity due to reflection from nearby surfaces
- 3 dB correction for facade reflection at the nearest noise sensitive premises.

6.4.1 Predicted noise egress levels

The predicted noise levels for operating plant, including the generators, at the nearest noise sensitive premises are summarised in Table 8.

Table 8 Predicted noise egress from rooftop plant at the nearest noise sensitive premises

Location	Predicted sound pressure level at 1 m from noise sensitive premises, L_{Aeq} (dB)
The Old Court house	44
Yotel Deansgate (Hotel)	47
Moxy Hotel	44
DFW	49
3 Hardman Street	54
1 Hardman Street	44
1 The Avenue	54
Centurion House	53

The predicted levels meet the daytime and night-time limits at the nearest noise sensitive premises and further noise mitigation measures are not required.

7 Conclusion

A noise survey has been carried out to determine the representative background sound levels in the vicinity of the site and surrounding noise sensitive premises.

The representative background sound levels measured during the survey were $L_{A90,15min}$ 55 dB during the daytime and $L_{A90,15min}$ 49 dB at night at position 1 and L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night at position 2.

Based on the requirements of the Local Authority, the relevant plant noise limits are:

- The Old Courthouse, Yotel and Moxy Hotel: L_{Aeq} 53 dB during the day and L_{Aeq} 47 dB during the night
- St John's House and Centurion House: L_{Aeq} 53 dB during the day
- 1 The Avenue, 3 Hardman Street, DFW and 1 Hardman Street: L_{Aeq} 54 dB during the day

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent than those set out above. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied.

An assessment of the proposed plant items associated with the development has been carried out. The predicted noise egress levels from the proposed plant and attenuation measures comply with the noise egress limits during the day and at night.

Appendix A

Survey details

Equipment

The unattended noise measurements were taken using a Rion NL-52 sound level meter.

Calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL-52/01143564	Rion	15 Dec 22	TCRT20/1738
Microphone	UC-59/10153	Rion	15 Dec 22	TCRT20/1738
Pre-amp	NH-25/43581	Rion	15 Dec 22	TCRT20/1738
Calibrator	NC-74/34257023	Rion	14 Dec 22	TCRT20/1736

[1] Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meter used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.

Weather conditions

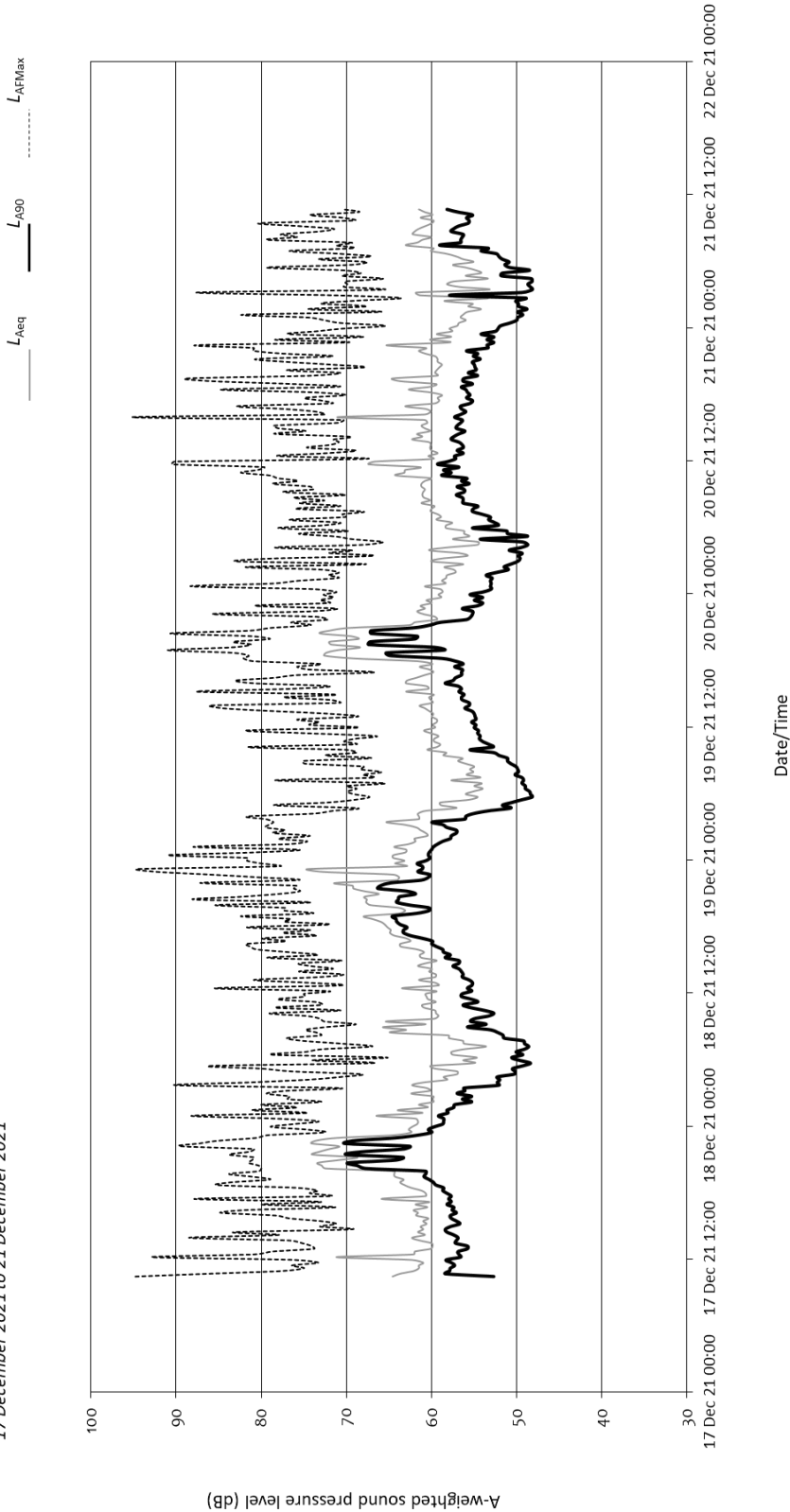
During the unattended noise measurements, weather reports for the area indicated that temperatures varied between -1°C at night and 9°C during the day, and the wind speed was less than 3 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at position 1

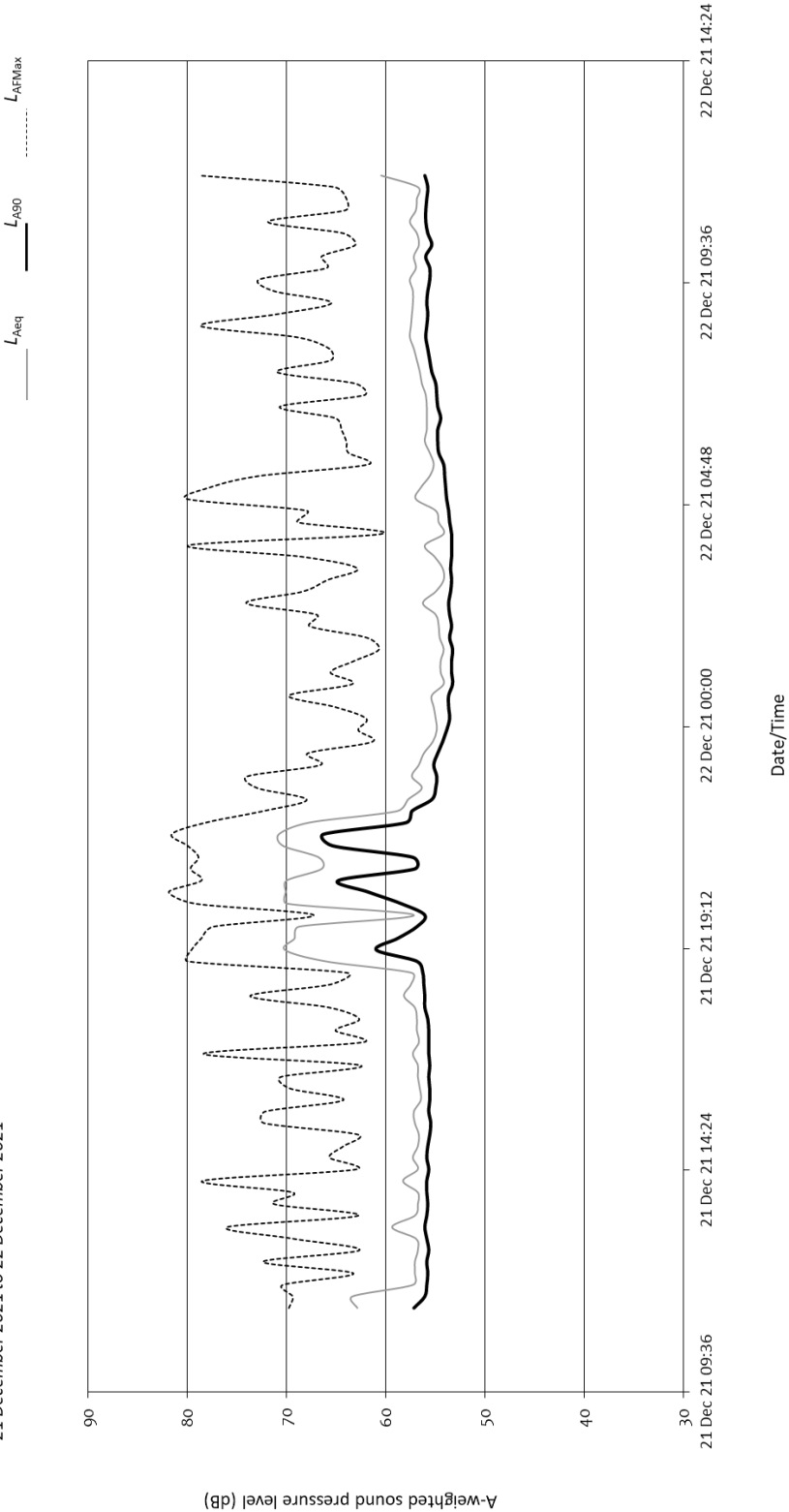
NatWest, Spinningfields
Results of noise logging survey at position 1
17 December 2021 to 21 December 2021



Appendix C

Results of unattended measurements at position 2

NatWest, Spinningfields
Results of noise logging survey at position 2
21 December 2021 to 22 December 2021



Appendix D

BS 4142 corrections for attention catching features

The following applies where plant noise is assessed in accordance with BS 4142:2014+A1:2019.

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), penalty corrections should be applied based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible.

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible.

For noise which is equally both impulsive and tonal, then both features can be accounted for by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

If a subjective assessment of tonality is not appropriate, an objective assessment can be made by analysis of time-averaged, third-octave band sound pressure levels. A noise source is deemed to be tonal if the level in a third-octave band exceeds the level in adjacent third-octave bands by the level differences given below:

- 15 dB in the low frequency third-octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency third-octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency third-octave bands (500 Hz to 10000 Hz).

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.