



Westfields

MEADOWSIDE PLOTS 2 & 3

Plant Noise Assessment





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CONTENTS

1	INTRODUCTION	2
2	BACKGROUND AND DESCRIPTION	3
2.1	LOCATION	3
2.2	ROOFTOP MECHANICAL SERVICES PLANT	4
3	ASSESSMENT CRITERIA AND GUIDANCE	8
3.1	EXTERNAL NOISE CRITERIA	8
3.2	EMERGENCY PLANT	8
4	NOISE SURVEY	9
5	ASSESSMENT	10
5.1	PLOT 2 ROOFTOP PLANT ASSESSMENT	10
5.2	PLOT 3 ROOFTOP PLANT ASSESSMENT	11
5.3	GENERATOR	12
6	CONCLUSIONS	13

1 INTRODUCTION

WSP has been instructed by Westfields to undertake a plant noise assessment for the mechanical services plant installed at Meadowside, Plots 2 & 3, Manchester to discharge part (b) of Manchester City Council (MCC)'s planning condition 30, which states:

30) (a) *Prior to the first occupation of a phase, details of any externally mounted ancillary plant, equipment and servicing shall be submitted for approval. (b) The approved scheme shall be implemented and prior to the first occupation of a phase and post construction survey (including appropriate mitigation measures and timescales for implementation if necessary) shall be submitted for approval in writing by the City Council, as Local Planning Authority. The measures agreed thereafter retained and maintained in situ.*

The purpose of this report is to assess the plant noise emissions from Plots 2 & 3 against previously established noise level limits which were outlined in the Angel Meadows Stage 4 report 70051606-409 R01-V1.

This report is necessarily technical in nature and a glossary of acoustic terminology is included in Appendix A.

2 BACKGROUND AND DESCRIPTION

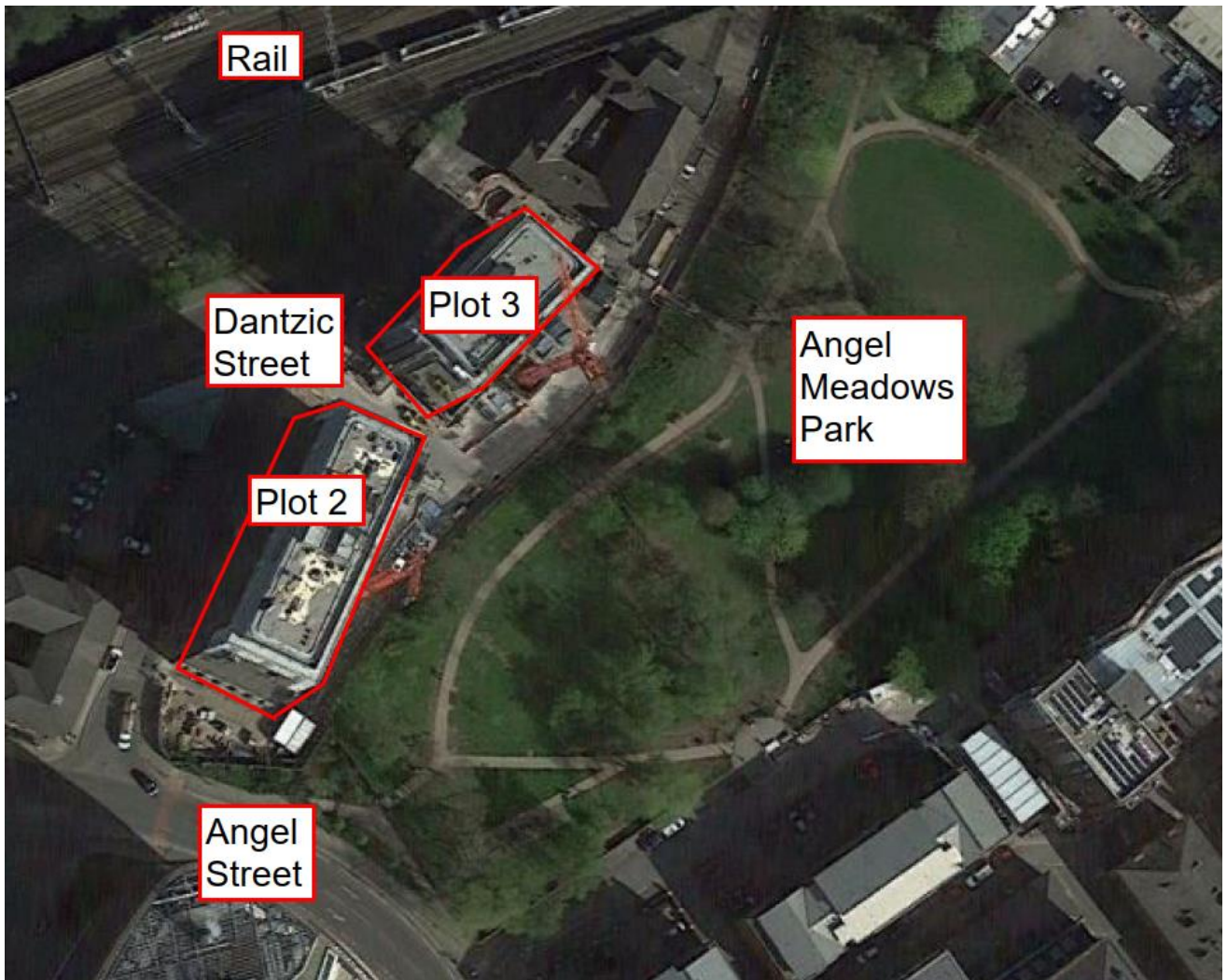
2.1 LOCATION

Meadowside Plots 2 & 3 are located beyond the northwest border of Angel Meadow Park, Manchester. Plot 2 is a 21-storey tower and Plot 3 is a 16-storey tower. Mechanical services plant is located on the roof levels of both Plots 2 & 3 and includes condenser units and smoke extract fans. On the ground floor of Plot 2 is a louvred plant room housing a generator.

The nearest noise sensitive receptors (NNSRs) to the plant located on the Plot 2 roof are the top floor apartments on the southwest facade of Plot 3. The NNSRs to the Plot 3 plant are the apartments on the northeast façade of Plot 2, many of which overlook the roof level of Plot 3 from the 17th level and upwards.

A satellite image of Plots 2 & 3 within their site context can be seen in Figure 2-1.

Figure 2-1 – Plots 2 & 3 in context



2.2 ROOFTOP MECHANICAL SERVICES PLANT

The mechanical services plant installed on the Plot 2 & 3 rooftops comprises the following Toshiba models:

Table 2-1 – Toshiba plant models installed

Toshiba Model	Sound Power Level dB(A)		
	Cooling	Heating	High
RAS-5M34U2AVG-E	-	-	68
RAS-3M26U2AVG-E	-	-	64
MCY-MHP0406HT-E	73	73	-
RAS-3M18U2AVG-E	-	-	63
MCY-MHP0506HT-E	73	74	-

The sound power levels above are based on full duty operation. It should be noted that the actual duty of any condensing unit at any given time is determined by the temperature set by the occupant and the heat gains of the dwelling at that particular time. Most heat gains are solar gains, meaning that the highest duty (and therefore the highest noise) will be during daytime periods when noise limits are also higher. The duty will be significantly lower at night, resulting in lower noise levels when the noise limits are also lower.

There are 24 Toshiba units installed on the Plot 2 roof and 16 on the Plot 3 roof. The reference number of each plant item and its Toshiba model reference are presented in Table 2-2. To see the locations of each of these plant items please refer to Figure 2-2 and Figure 2-3.

Alongside the condensers presented in Table 2-2, there are two smoke extract fans installed on the Plot 2 roof and one on the Plot 3 roof. These plant items are limited to emergency use.

Table 2-2 – Toshiba plant reference numbers

Toshiba Model	Plant reference numbers	
	Plot 2	Plot 3
RAS-5M34U2AVG-E	21.01	14.01
	19.07	15.01
		15.06
		14.03
		14.06
RAS-3M26U2AVG-E	20.01	15.03
	20.1	15.04
	19.08	14.05
	20.02	
	20.09	
	20.04	
	20.07	
	20.05	
	19.06	
	19.01	
	19.1	
	19.03	
	19.05	
MCY-MHP0406HT-E	21.03	16.02
	19.04	16.02a
	19.02	
	21.04	
	19.09	
	21.02	
RAS-3M18U2AVG-E	20.08	14.02
	20.03	15.02
	20.08	15.05
		14.04
MCY-MHP0506HT-E	-	16.01a
		16.01

Figure 2-2 – Plot 2 Mechanical Services Roof Plan

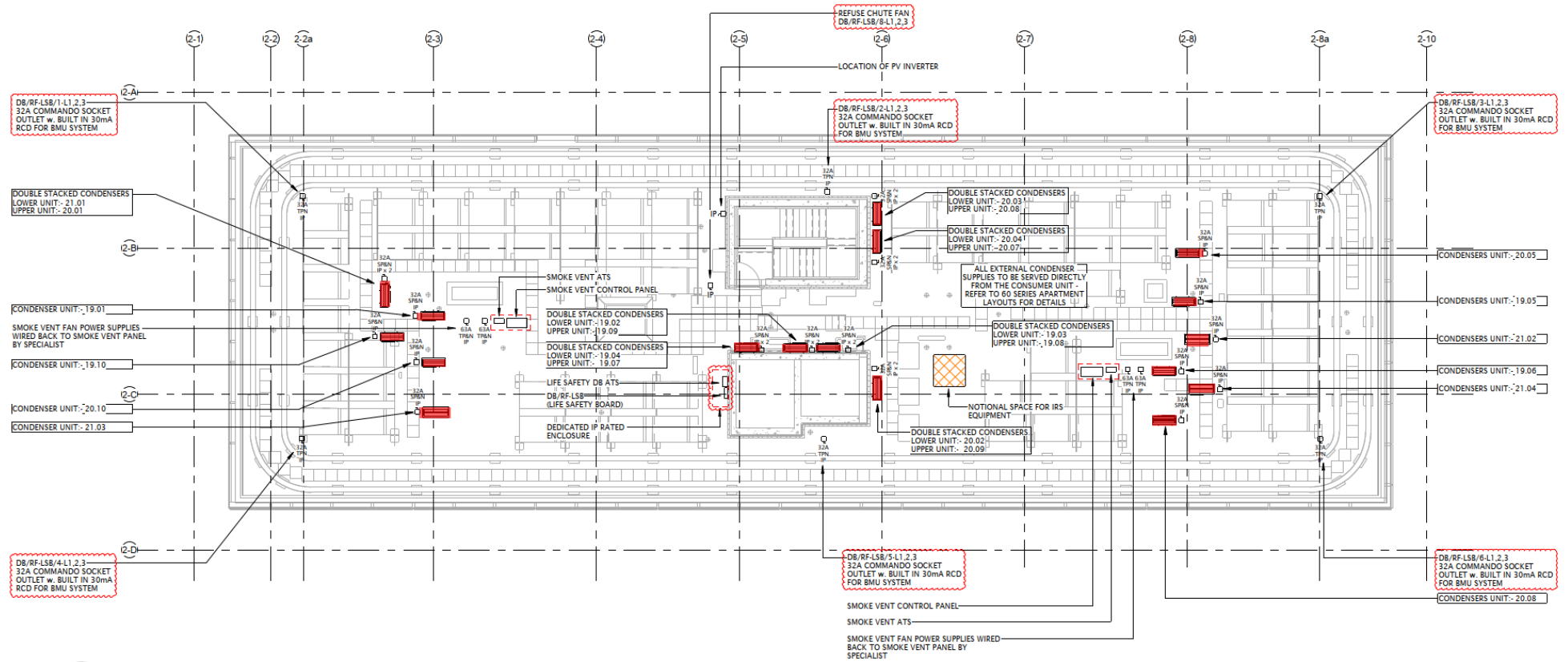
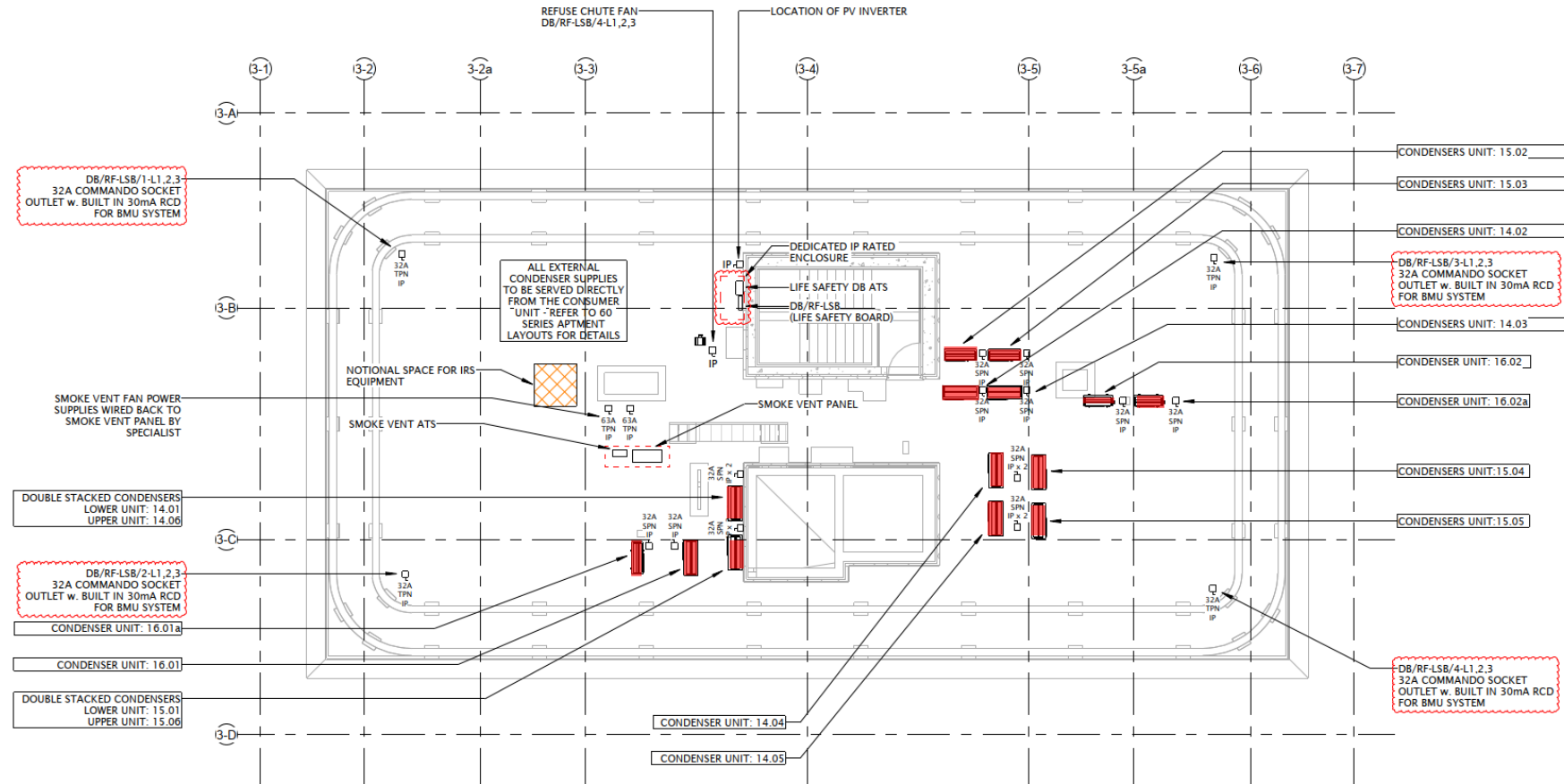


Figure 2-2 – Plot 2 Mechanical Services Roof Plan



3 ASSESSMENT CRITERIA AND GUIDANCE

The noise level limits for the mechanical services plant are outlined in the Stage 4 report 70051606-409 R01-V1 and are presented again here for ease of reference.

3.1 EXTERNAL NOISE CRITERIA

It was agreed with Manchester City Council during Stage 3 that plant noise from the development should not exceed a level 5 dB below the otherwise prevailing background sound.

It is noted that Toshiba only publishes single figure sound power levels for the plant items installed, so noise limits have also been calculated based on the A-weighted background sound levels. Therefore, the relevant limits are 48 dB $L_{A,r,Tf}$ in the daytime and 41 dB $L_{A,r,Tf}$ at night-time.

3.2 EMERGENCY PLANT

To minimise the risk of disturbance testing of emergency plant shall only occur in normal weekday daytime periods (08:00-17:00).

GENERATORS

As stipulated in the RIBA Stage 4 report, noise break-out from the generator room shall be sufficiently controlled that it does not exceed a level of 75 dB L_{Aeq} at 1 m from any external louvre.

There shall be no un-ducted atmospheric openings to the generator rooms.

4 NOISE SURVEY

Plant noise measurements were undertaken at Plots 2 & 3 on Thursday 10th February 2022. Measurements were taken 1m external to the louvre of the plant room housing the generator on the ground floor of Plot 2. A sound level of 73 dB L_{Aeq,T} was measured. The weather conditions were dry and wind speeds were <5 m/s. Temperatures ranged from 5 to 7 °C. These conditions are deemed appropriate for sound level measurements.

The measurements were carried out using the Class 1 measurement equipment, as detailed in Table 4-1. The measurement system had been calibrated to traceable standards within the previous 24 months, and the field calibrator had been calibrated within the previous 12 months. The system was calibrated on-site before starting and after finishing the measurements using a field calibrator, no significant calibration drifts occurred during the survey. Copies of the calibration certificates are available on request.

Table 4-2 – Measurement Equipment Details

ID	Equipment	Manufacturer & Type	Serial Number
Solo 13	Sound Level Meter	01dB-METRAVIB Black Solo 'Datalogging Integrating Sound Level Meter'	65303
	Pre-amplifier	01dB-Metravib PRE 21 S	15976
	Microphone	01dB Metravib MCE 212 Microphone	142812
	Calibrator	01dB-Stell Cal 21	34213780

5 ASSESSMENT

5.1 DISCUSSION ABOUT RATING CORRECTIONS

No rating corrections are necessary for this plant because it is considered very unlikely that the type of plant proposed would exhibit tonal or impulsive characteristics.

The nature of modern air conditioning plant inherently leads to varying or occasional operation in order that the plant can respond to changes in temperature efficiently. However, these changes are usually small variations as opposed to dramatic changes from 'fully off' to 'full load' and are therefore unlikely to draw attention. Furthermore, any rating correction applied for intermittent or varying operation is normally offset by the changes to the plant's on-time. As such, it is not considered appropriate to apply any correction for intermittent operation.

On this basis, the specific level (dB $L_{Aeq,T}$) is considered to be equivalent to the rating level (dB $L_{Ar,Tr}$)

5.2 PLOT 2 ROOFTOP PLANT ASSESSMENT

The NNSR to the Plot 2 roof are the top floor apartments on the southwest facade of Plot 3. The predicted cumulative noise level from the plant installed on the roof of Plot 2 at the NNSR has been calculated based on the logarithmic addition of each individual plant type after being distance calculated from its location on the roof to the NNSR. These calculations also include attenuation from screening and barriers. The predicted cumulative noise level can be seen in Table 5-1.

Table 5-1 – Calculated noise level at the NNSR to the Plot 2 rooftop plant items.

Plant Item	Worst case Sound Power Level, dB L_{WA}	Distance to the NNSR, m	Acoustic screening, dB	Sound Pressure Level at the NNSR, dB $L_{Aeq,T}$
21.01	68	53	12	14
20.01	64	53	12	10
19.01	64	51	12	10
19.1	64	53	12	10
20.1	64	51	12	10
21.03	73	51	12	19
19.04	73	39	12	21
19.07	68	39	12	16
19.02	73	37	12	22
19.09	73	37	12	22
19.03	64	36	12	13
19.08	64	27	12	15

20.03	63	34	12	12
20.08	63	34	12	12
20.02	64	34	12	13
20.09	64	34	12	13
20.04	64	34	12	13
20.07	64	34	12	13
20.05	64	23	12	17
19.05	64	23	12	17
21.02	73	22	12	26
19.06	64	23	12	17
21.04	73	22	12	26
20.08	63	23	12	16
Cumulative Sound Pressure Level				33

As demonstrated in Table 5-1, the calculated sound pressure level from the plant on the roof of Plot 2 at the NNSR is below the daytime and night-time noise limits set out in section 3.1. This is a conservative prediction as it assumes each plant item is running at full duty at the same time.

5.3 PLOT 3 ROOFTOP PLANT ASSESSMENT

The nearest noise sensitive receptor (NNSR) to the Plot 3 roof are the 17th floor apartments on the northeast façade of Plot 3. The predicted cumulative noise level from the plant installed on the roof of Plot 2 at the NNSR has been calculated based on the logarithmic addition of each individual plant type after being distance calculated from its location on the roof to the NNSR. These calculations also include any attenuation from screening and barriers. The predicted cumulative noise level can be seen in Table 5-2.

Table 5-2 – Calculated noise level at the NNSR to the Plot 3 rooftop plant items.

Plant Item	Worst case Sound Power Level, dB L _{WA}	Distance to the NNSR, m	Acoustic Screening, dB	Sound Pressure Level at the NNSR, dB L _{Aeq,T}
14.01	68	26	0	32
14.06	68	26	0	32
16.01a	74	24	0	38
16.01	74	25	0	38

15.01	68	26	0	32
15.06	68	26	0	32
15.02	63	47	15	7
15.03	64	48	15	7
14.02	63	32	0	25
14.03	68	33	0	30
16.02	73	36	0	34
16.02a	73	38	0	33
15.04	64	35	0	25
15.05	63	50	15	6
14.04	63	48	15	6
14.05	64	48	15	7
Cumulative Sound Pressure Level				44

As seen in Table 5-2 the calculated sound pressure level from the plant on the roof of Plot 3 at the NNSR is below the daytime noise limit but is slightly above the night-time noise limit set out in section 3.1.

However, this sound level prediction is based on all the condensers on the roof of Plot 3 running simultaneously and at full duty. It is reasonable and realistic to assume that the plant running at night-time would be at a reduced duty because the condensers are selected based on daytime operation when heat gains (most of which are solar gains) are at their highest. We have reviewed the heat gain calculation data for the condensers, which indicates clearly that heat gains are much lower at night. Even when comparing data for hours when the sun is risen, the total heat rejection duty for the condensers is half of the peak daytime hour.

Therefore the cumulative sound pressure level during the night-time is likely to at least 3 – 5 dB lower than predicted above, and would therefore meet the night-time noise level limits set out in section 3.1.

5.4 GENERATOR

As discussed in section 4 the noise breaking out of the louvre of the plant room housing the generator was 73 dB $L_{Aeq,T}$ at 1m. This is below the limit of 75 dB at 1m from any louvre. Therefore noise from the generator is in line with the assessment criteria.

6 CONCLUSIONS

WSP has been appointed by Westfields to undertake a plant noise assessment for the Meadowside Plots 2 & 3 development in order to discharge MCC's planning condition 30 part b. Both buildings include condenser units and emergency smoke extract plant on the rooftops. On the ground floor of Plot 2 there is a generator in a louvered plant room.

The assessment was based on guidance from MCC and noise level limits derived from survey data reported in the Stage 4 report 70051606-409 R01-V1. The condenser units were assessed using manufacturer's sound power data and calculations to account for distance propagation and acoustic screening. The results of this assessment demonstrate that the predicted noise levels meet the noise level limits and the requirements of the planning condition.

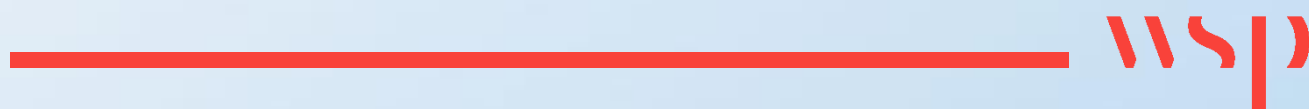
It has been agreed that the emergency plant (smoke extract fans) will only be tested during daytime hours.

Noise level measurements of the noise break out of the louvered plant room housing the generator in Plot 2 demonstrate compliance with the noise level limit for noise break out.

Based on the above, it can be concluded that the development achieves the requirements to discharge MCC's planning condition 30, part b.

Appendix A

GLOSSARY OF ACOUSTIC TERMINOLOGY



Noise is defined as unwanted sound. Human ears are 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 noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.

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(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

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

Range of sound levels commonly found in the environment

Sound levels	Location
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of pain



ACOUSTIC TERMINOLOGY

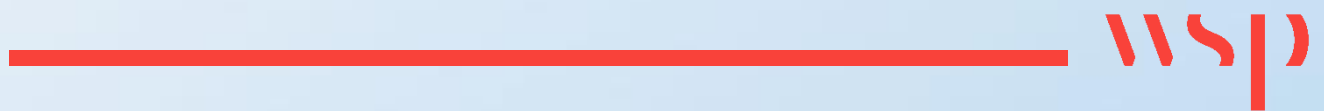
Terminology

Meaning

dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2 \times 10^{-5} \text{Pa}$).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' - weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} and L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time, and the L_{90} is the level exceeded for 90% of the time.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Façade Level	A sound field determined at a distance of 1m in front of a large sound reflecting object such as a building façade.

Appendix B

LIMITATIONS TO THIS REPORT





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