SANDY BROWN

Consultants in Acoustics, Noise & Vibration

17109-R02-B

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Warner Bros, Warner House

Acoustic planning report

55 Charterhouse Street, London EC1M 6HA
68 Sackville Street, Manchester M1 3NJ
2 Walker Street, Edinburgh EH3 7LA
87 Caroline Street, Birmingham B3 1UP

T: +44 (0)20 7549 3500
T: +44 (0)161 771 2020
T: +44 (0)131 235 2020
T: +44 (0)121 227 5020

post@sandybrown.com
www.sandybrown.com

Sandy Brown Associates LLP
Registered in England & Wales No. OC 307504

Registered Office: 55 Charterhouse Street, London EC1M 6HA

Version	Date	Comments	Author	Reviewer
A	5 May 17	DRAFT	Zac Fox	Stephen Stringer
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Summary

Sandy Brown has been commissioned via CBRE to provide acoustic advice in relation to the proposed refurbishment and fit-out of Warner House, 98 Theobalds Road, London, WC1X 8WB.

An environmental noise survey has been carried out to determine the existing background sound levels in the area and to set appropriate plant noise limits in line with the requirements of the London Borough of Camden (LBC).

The noise survey was performed between 11:00 on 20 April 2017 and 11:00 on 26 April 2017.

Table 1 shows the representative background sound levels measured during the survey alongside the limits determined with the LBC requirements.

Table 1 Representative levels and limits

Time of day	Weekdays		Weekends	
	Background level $L_{A90,15min}$ (dB)	Limits L_{Aeq} (dB)	Background level $L_{A90,15min}$ (dB)	Limits L_{Aeq} (dB)
07:00–19:00	50	45	48	43
19:00-23:00	49	44	48	43
23:00-07:00	47	42	47	42

Based on the LBC requirements and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed the limits set out above. These limits are cumulative, and apply with all plant operation under normal conditions. If plant items contain tonal or attention catching features, more onerous criteria would apply.

An assessment of noise egress from the proposed plant items has been carried out and compliance with the local authority noise egress limits has been demonstrated at peak times (week day, daytime).

As there is only a 2-3 dB reduction in noise limit during the night time or at weekends, compliance with the noise egress criteria at all times would be expected due to the reduced load on ventilation and cooling plant at off peak times (evenings, nights and the weekend) providing the week day daytime limits are met.

Contents

1 Introduction

Sandy Brown has been commissioned via CBRE to provide acoustic advice in relation to the proposed refurbishment and fit-out of Warner House, 98 Theobalds Road, London, WC1X 8WB.

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 and to set appropriate limits for noise egress from building services plant in line with the local authority requirements.

This report presents the survey method, results of the environmental noise survey, a discussion of acceptable limits for noise emission from building services plant and an assessment of plant noise generated from the site.

2 Site description

2.1 The site and its surrounding

The site indicated in Figure 1 in blue lies within the London Borough of Camden (LBC) on Theobalds Road and lies to the east of Harpur Street and to the west of New North Street. The monitoring position was on the 6th floor balcony on the north facade of Warner House shown in Figure 1 as a yellow circle.

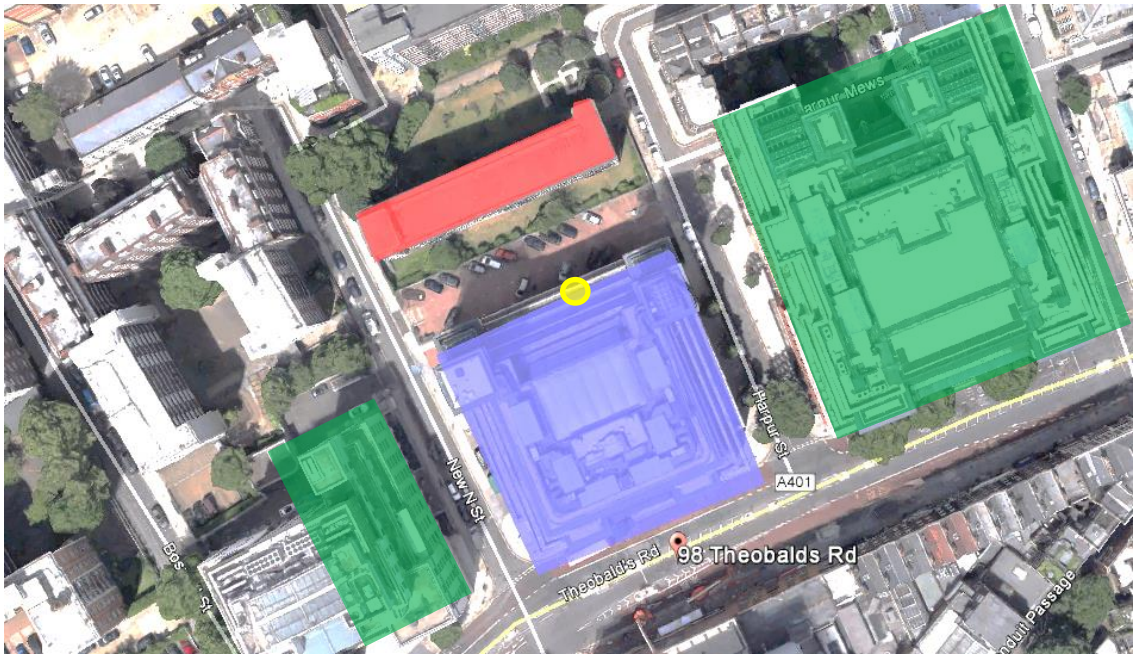


Figure 1 Warner House (blue), nearest residential receptors (red) and proposed measurement position (yellow). Image courtesy of Google Earth Pro.

2.2 Adjacent premises

The area surrounding the site is of mixed uses. The closest receiver is residential and highlighted in red in Figure 1. Other receivers are commercial in nature, these have been highlighted in green.

3 Method

Details of the equipment used, the noise indices and the weather conditions during the survey are provided in Appendix A. Further information on the specific survey method is provided in this section.

3.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 6 days to determine the existing background sound levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 15 minute periods between 11:00 on 20 April 2017 and 11:00 on 26 April 2017. The equipment was installed and collected by Zac Fox.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L'. A photograph showing the measurement location is provided Figure 2. This location was chosen to be reasonably representative of the noise levels experienced by the nearest noise sensitive premises which are considered to be the residential properties to the north.

Figure 2 Photograph of unattended logger on 6th floor balcony

4 Measurement results

4.1 Observations

The dominant noise sources observed at the site during the survey consisted of road traffic.

Less significant noise sources included construction at Great Ormond Street Hospital and existing plant from Warner House itself.

4.2 Unattended measurement results

The results of the unattended noise measurements are summarised in Table 2 and Table 3. A graph showing the results of the unattended measurements is provided in Appendix B.

The day, evening and night time ambient noise levels measured during the unattended survey are presented in Table 2. These were facade measurements.

Table 2 Ambient noise levels measured during the survey

Date	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00 - 07:00)
	$L_{Aeq,\ 12\ hour}$ (dB)	$L_{Aeq,\ 4\ hour}$ (dB)	$L_{Aeq,\ 8\ hour}$ (dB)
Thursday 20 April 2017	-	54	52
Friday 21 April 2017	57	54	52
Saturday 22 April 2017	53	53	51
Sunday 23 April 2017	52	54	53
Monday 24 April 2017	56	56	54
Tuesday 25 April 2017	57	57	55

The minimum background sound levels measured during the unattended survey are given in Table 3.

Table 3 Minimum background sound levels measured during the survey

Date	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00 - 07:00)
	$L_{A90,\ 15\ min}$ (dB)	$L_{A90,\ 15\ min}$ (dB)	$L_{A90,\ 15\ min}$ (dB)
Thursday 20 April 2017	-	48	46
Friday 21 April 2017	49	48	47
Saturday 22 April 2017	47	47	45
Sunday 23 April 2017	45	47	46
Monday 24 April 2017	50	48	47
Tuesday 25 April 2017	49	49	47

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Weekday daytime, evening and night time statistical analyses of representative values for the site are given in Figure 3, Figure 4 and Figure 5. Weekend daytime, evening and night time statistical analyses of representative values for the site are given in Figure 6, Figure 7 and Figure 8.

4.2.1 Histogram distributions of weekday data

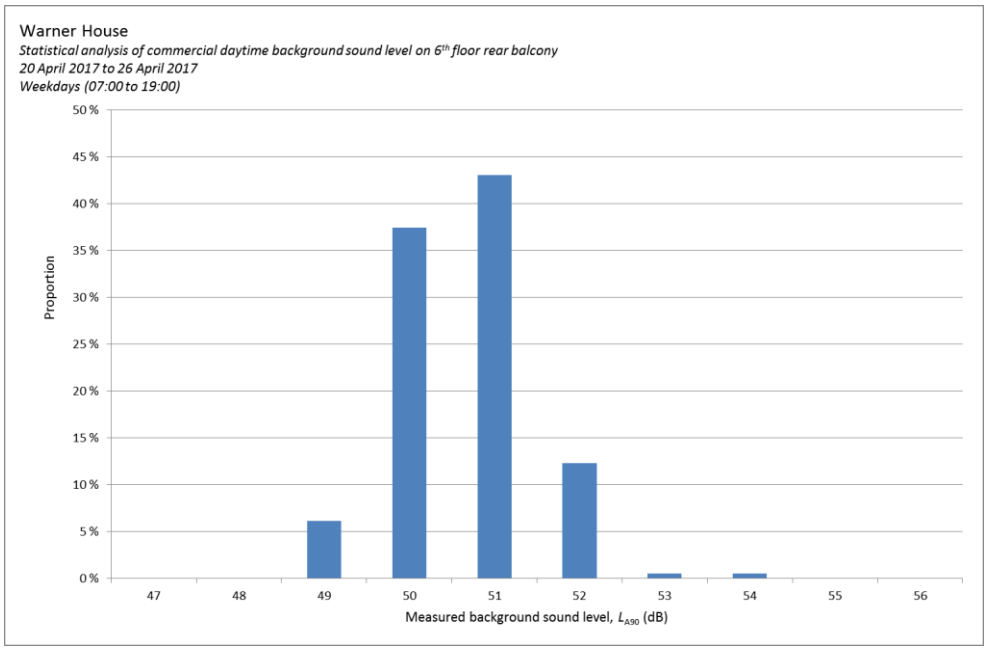


Figure 3 Histogram distribution of background sound levels in the daytime on weekdays

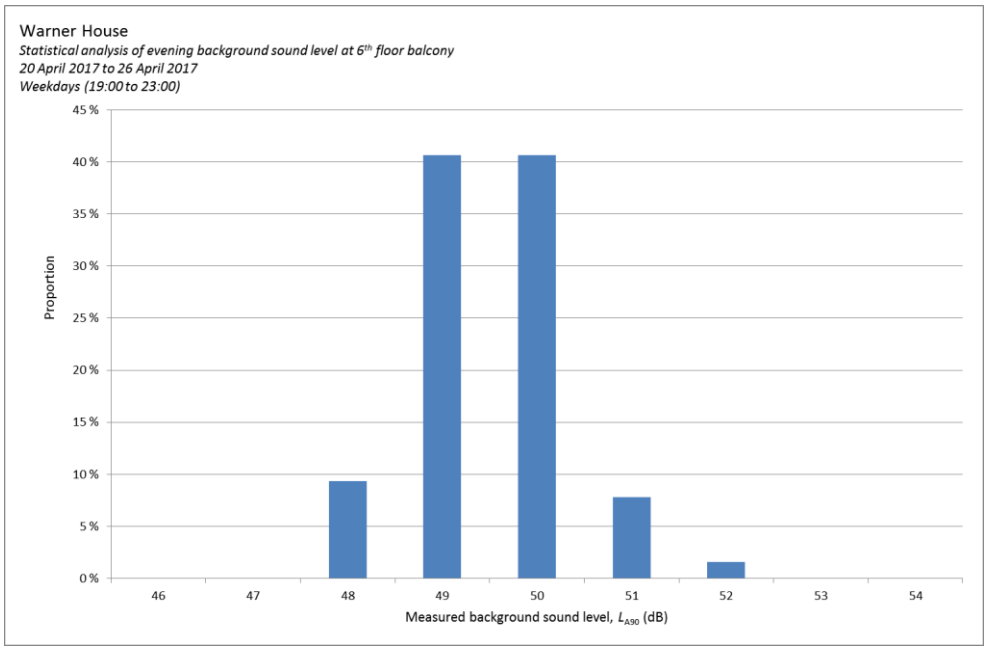


Figure 4 Histogram distribution of background sound levels in the evening on weekdays

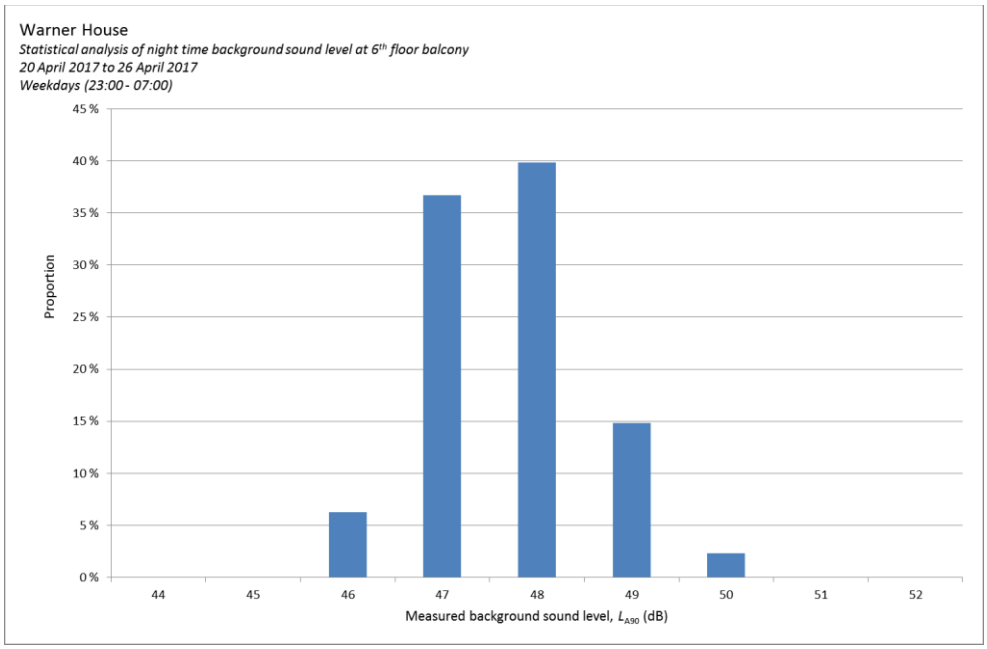


Figure 5 Histogram distribution of background sound levels at night on weekdays

From this analysis, the representative background sound levels measured on weekdays were $L_{A90,15min}$ 50 dB during the daytime, $L_{A90,15min}$ 49 dB during the evening and $L_{A90,15min}$ 47 dB at night.

4.2.2 Histogram distributions of weekend data

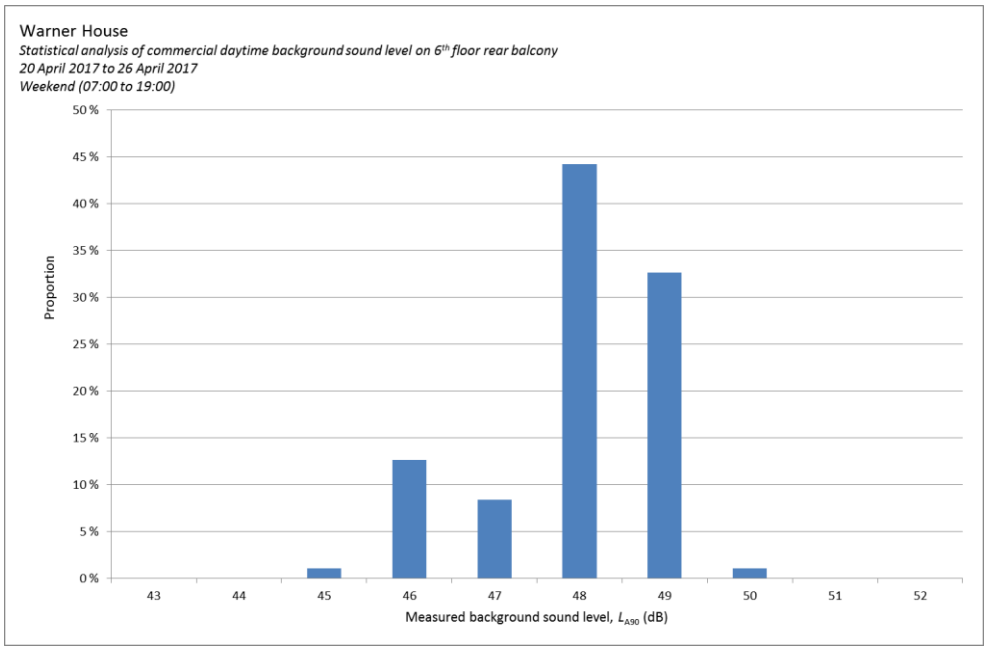


Figure 6 Histogram distribution of background sound levels in the daytime at the weekend

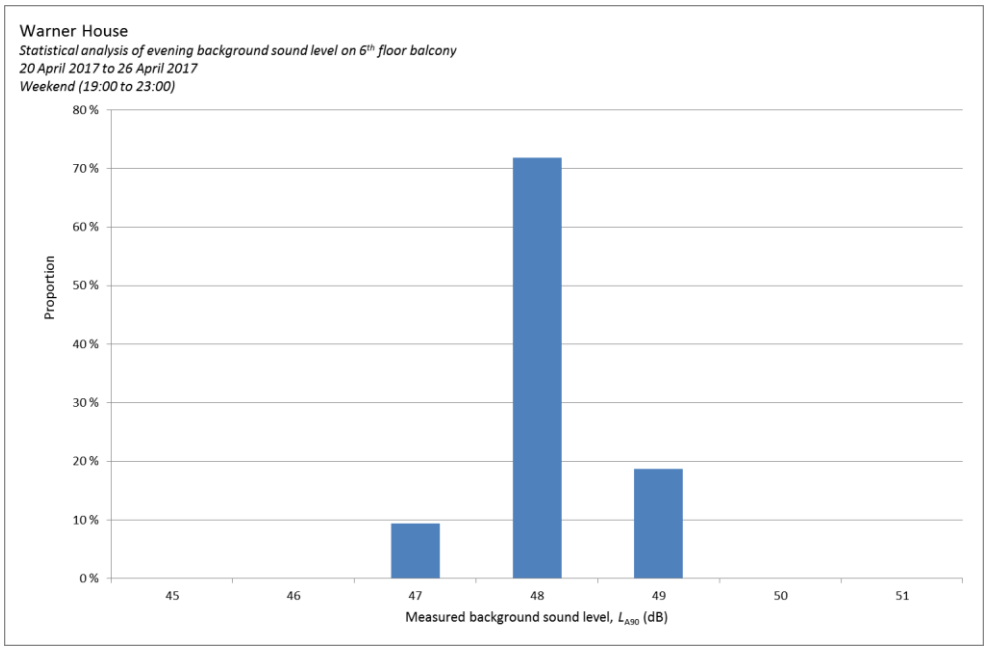


Figure 7 Histogram distribution of background sound levels in the evening at the weekend

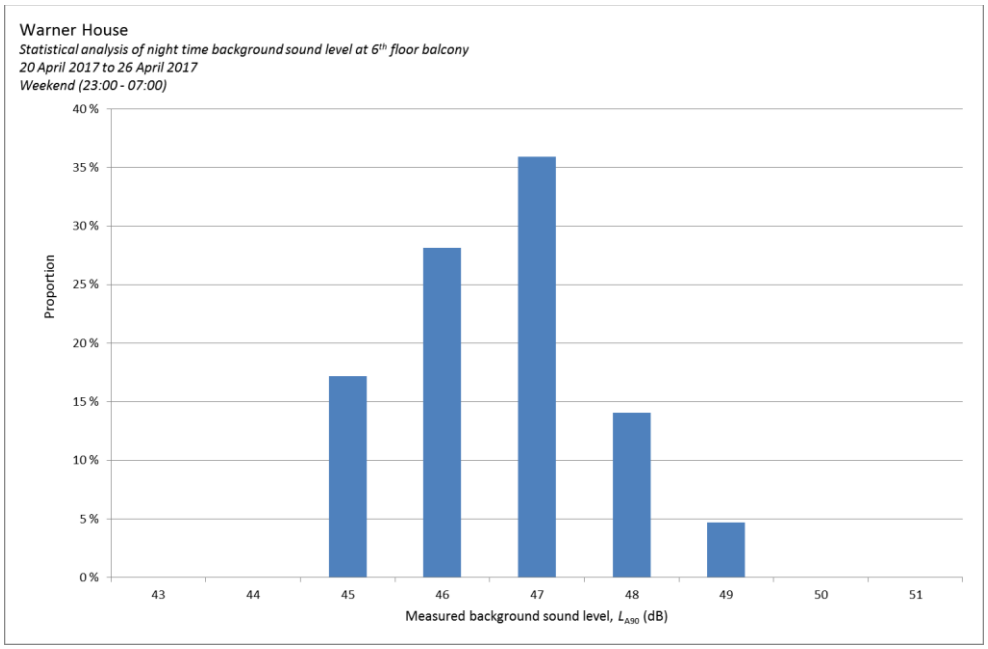


Figure 8 Histogram distribution of background sound levels at night at the weekend

From this analysis, the representative background sound levels measured on the weekend were $L_{A90,15min}$ 48 dB during the daytime, $L_{A90,15min}$ 48 dB during the evening and $L_{A90,15min}$ 47 dB at night.

5 Building services noise egress limits

5.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 '*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 the nearest noise sensitive.

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.

5.2 Local Authority criteria

Camden Council sets out in 'Camden Development Policies' Section 3 the following limits for Noise levels from plant and machinery:

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB$L_{Aeq'}$

5.3 Limits

Based on the above criteria and the measurement results, the cumulative noise level resulting from the operation of all new plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 4.

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

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises (L_{Aeq} dB)	
	Weekday	Weekend
07:00–19:00	45	43
19:00-23:00	44	43
23:00-07:00	42	42

The limits set out in Table 4 do not include any attention catching features. The penalties for attention catching features may be significant, and will need to be considered as the building services design progresses. This is discussed further in Section 5.2.

6 Assessment

6.1 Information used

The information used in the assessment is summarised in Table 5.

Table 5 Information used

Item	Reference	Dated
ChapmanBDSP Stage 3 basement primary mechanical services layout	54539-CBD-00-B1-DR-M-1150 rev P1	March 2017
ChapmanBDSP Stage 3 roof primary mechanical services layout	54539-CBD-00-B1-DR-M-1151 rev P1	March 2017
ChapmanBDSP Stage 3 roof primary mechanical services layout	54539-CBD-00-B1-DR-M-1161 rev P1	March 2017
Roof plan mark-up received via email from ChapmanBDSP	Roof plan SB mark-up	Received 5 May 2017
Plant location mark-up	SPrintroom17031314050	Received 13 March 2017
SER condenser noise data	Project Phoenix SER Cooling Schedule 07_03_17	Received 13 March 2017
MER condenser noise data	DMA 30 AH Performance Project Phoenix - MER cooling	Received 13 March 2017
Fan schedule	Specification for mechanical services revision T2	June 2017
Dry air cooler noise data (night time duty)	09GFD 090 Dry Cooler Data at Summer Night minimum chiller capacity	Received 12 May 2017
Dry air cooler datasheet received via email from ChapmanBDSP	Adiabatic Dry Air Cooler Acoustic data	Received 4 July 2017
AHU noise data	AHS Quote 17231-rev01-BDSP	Received 10 July 2017

6.2 Noise data

6.2.1 External plant items

The sound power levels for external plant items are summarised in Table 6 (items with spectral noise data) and Table 7 (items with broadband noise data).

Table 6 External plant items spectral sound power levels

Plant item	Sound power level (dB) at octave-band centre frequency (Hz)							Overall level
	63	125	250	500	1000	2000	4000	dBA
AHU 1 & 2 inlet	93	89	87	77	72	70	68	82
AHU 1 & 2 outlet	77	77	81	76	76	73	71	81
AHU 3 inlet	86	80	85	77	76	74	69	82
AHU 3 outlet	81	76	86	82	82	77	74	86
AHU 4 inlet	84	78	87	75	74	71	67	81
AHU 4 outlet	84	80	88	86	85	80	75	89
EF 1 outlet	85	103	81	73	73	72	68	88
EF 1 breakout	82	96	77	67	60	58	52	80
EF 2 outlet	75	77	76	73	73	73	67	78
EF 3 & 4 outlet	76	79	88	91	85	80	73	91
EF 3 & 4 breakout	63	76	77	65	55	50	53	70
Dry air coolers Maximum design duty	-	66	72	74	75	75	69	80

Table 7 External plant items broadband sound power levels

Plant item	Overall sound power level (dBA)
MER condensers (2 no.)	75
Dry air coolers Night time duty	52(1)

(1) Based on the datasheet sound pressure level of 31 dBA at a distance of 1 m and taking into account 5-sided box losses

6.2.2 Dry air cooler acoustic enclosures

The 3 no. dry air coolers are to be situated in existing acoustic louvered enclosures. The precise specification of the existing acoustic louvres is unknown so the assessment has been based on a standard performance 150 mm thick acoustic louvre, with insertion losses as set out in Table 8.

Table 8 Insertion losses for a standard performance 150 mm thick acoustic louvre

	Octave band centre frequency (Hz)						
	125	250	500	1k	2k	4k	8k
Insertion loss (dB)	4	6	10	12	13	13	14

6.2.3 Atmospheric connections

The sound power levels for plant items with atmospheric connections are set out in Table 9.

Table 9 Sound power levels for atmospheric connections

Plant item	Sound power level (dB) at octave-band centre frequency (Hz)							Overall level
	63	125	250	500	1000	2000	4000	dBA
EF 5 & 6 outlet - general duty(1)	77	80	89	92	86	81	74	91
EF 7 outlet	79	82	80	78	72	69	67	79
EF 8 outlet	73	70	67	68	66	60	56	70
EF 9 outlet	87	87	70	67	61	59	54	73
EF 10 outlet	-	78	91	88	88	83	79	92
EF 11 outlet	88	85	71	62	58	53	49	71
EF 12-15 outlet	82	82	84	86	82	80	74	87
EF 16 outlet	72	65	63	53	50	51	47	59
SF 07 inlet	73	70	55	50	45	40	28	56
Shower AHU inlet	77	74	78	71	69	69	66	76
Shower AHU outlet	66	70	81	77	78	75	70	82

(1) Spectral data based on EF 3 and 4, corrected according to datasheet broadband levels

6.3 Receptors

Noise egress has been assessed to receptors to the west (W), north (N) and east (E). Mark-ups of the receptors are presented in Figure 9, Figure 10 and Figure 11, respectively.

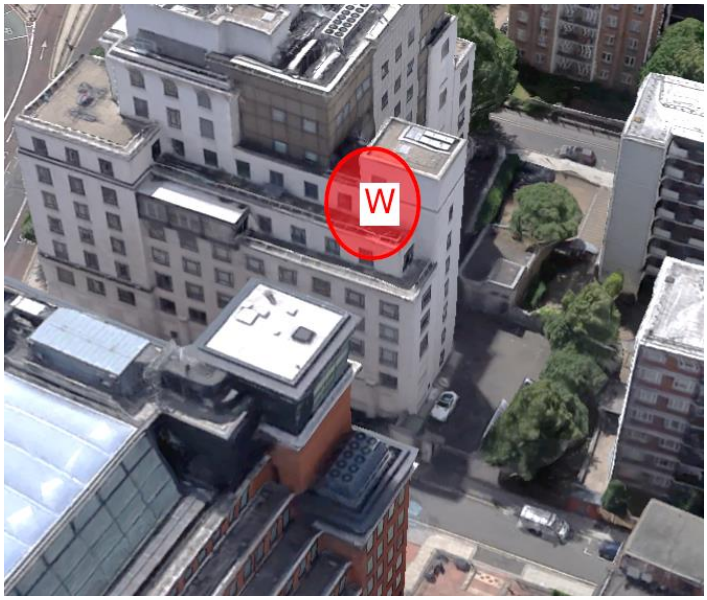


Figure 9 Receptor W to the west

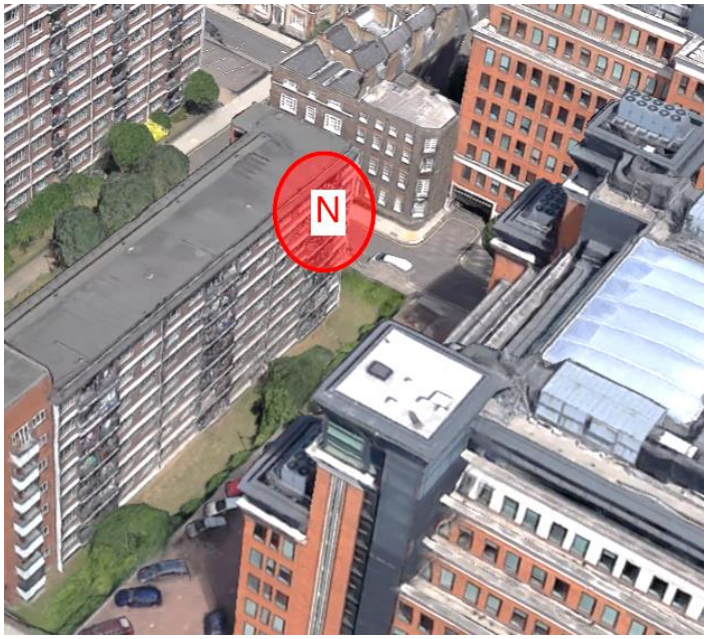


Figure 10 Receptor N to the north

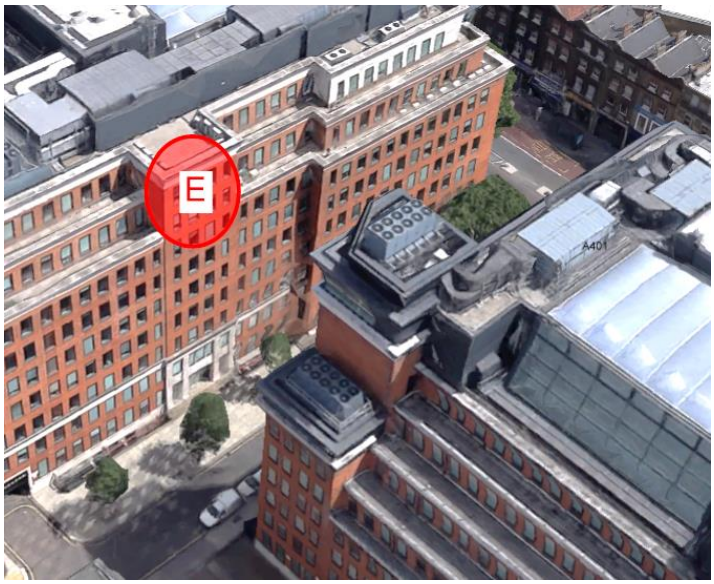


Figure 11 Receptor E to the east

6.4 Operational scenario

Warner House itself is commercial in nature and is expected to be only lightly occupied outside of normal working hours (09:00 - 17:00, Monday to Friday). As such, the load placed on building services plant outside these hours would be considerably smaller, and would result in a corresponding reduction in noise egress.

The approach taken has been to assess the noise level expected from all normal plant items operating simultaneously at design duty, and compare this to the weekday daytime noise limit. A reduction greater than the 2-3 dB required in order to meet the weekend or night time noise limits is expected due to reduced load during off-peak operation, so providing the weekday day time noise limits are met, noise limits at all other times are also expected to be met.

6.5 Attenuation measures

The following attenuation measures have been included as part of the assessment.

6.5.1 Air handling units

The air handling units are to have attenuators installed according to the acoustic performances set out in Table 10.

Table 10 External AHU attenuator requirements

Plant item	Decibel (dB) at octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
AHU 1 inlet							
Minimum insertion loss	5	6	9	13	18	14	10
Maximum regenerated sound power level	47	47	46	43	54	55	44
AHU 2 inlet							
Minimum insertion loss	7	13	17	30	36	33	26
Maximum regenerated sound power level	47	47	46	43	54	55	44
AHU 1 & 2 outlet							
Minimum insertion loss	5	6	9	13	18	14	10
Maximum regenerated sound power level	47	47	46	43	54	55	44
AHU 3 & 4 inlet							
Minimum insertion loss	7	12	16	28	35	35	28
Maximum regenerated sound power level	34	29	34	30	32	33	24
AHU 3 & 4 outlet							
Minimum insertion loss	7	12	16	28	35	35	28
Maximum regenerated sound power level	34	29	34	30	32	33	24

No data has been received for casing breakout from the proposed AHUs. As such maximum limits set out in Table 11 will be met to ensure that breakout noise is not a significant contribution to the noise levels at nearby receptors.

Table 11 AHU casing breakout noise limits

Plant item	Maximum casing breakout sound power level (dB) at octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
AHU1	62	61	62	53	48	49	51
AHU2	76	66	60	39	44	45	36
AHU3	71	64	66	54	50	52	49
AHU4	69	62	68	52	49	50	47

6.5.2 Extract fans

In order to control noise egress from the proposed extract fans, the attenuator performances set out in Table 12 are to be adopted.

Table 12 Attenuator requirements for extract fans

Plant item	Decibel (dB) at octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
EF 1 outlet							
Minimum insertion loss	8	12	23	26	25	19	16
Maximum regenerated sound power levels	48	48	47	44	55	56	45
EF 2 outlet							
Minimum insertion loss	5	6	9	13	18	14	10
Maximum regenerated sound power levels	48	48	47	44	55	56	45
EF 3 & 4 outlet							
Minimum insertion loss	5	6	9	13	18	14	10
Maximum regenerated sound power levels	48	48	47	44	55	56	45
EF 5 & 6 outlet							
Minimum insertion loss	11	21	25	43	47	44	39
Maximum regenerated sound power levels	43	43	42	39	50	51	40

Plant item	Decibel (dB) at octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
EF 7 outlet							
Minimum insertion loss	7	12	16	28	35	35	28
Maximum regenerated sound power levels	56	50	50	48	47	50	43
EF 8 outlet							
Minimum insertion loss	5	6	9	13	18	14	10
Maximum regenerated sound power levels	52	51	47	45	38	36	36
EF 9 outlet							
Minimum insertion loss	7	12	16	28	35	35	28
Maximum regenerated sound power levels	55	55	43	29	28	28	28
EF 10 outlet							
Minimum insertion loss	21	29	47	53	53	46	36
Maximum regenerated sound power levels	47	43	46	44	46	50	45
EF 11 outlet							
Minimum insertion loss	5	10	16	32	38	35	26
Maximum regenerated sound power levels	41	41	40	37	48	49	38
EF 12-15 outlet							
Minimum insertion loss	11	21	25	43	47	44	39
Maximum regenerated sound power levels	56	50	50	48	47	50	43

6.6 Results

Based on the sound power levels and attenuation measures set out in Section 6.5 the expected noise levels at the facade of the worst-affected receptors as identified in Section 6.3 (receptor E to the east, N to the north and W to the west) have been calculated.

The calculations have taken into account losses for distance and screening, in addition to reflections from the installation of the plant items and from the receiving facade.

The full spectral results are included in Appendix C.

Table 13, Table 14 and Table 15 present summaries of the assessed noise levels at receptors E, N and W, respectively.

Table 13 Receptor E - assessment summary

Plant item	Overall level at facade (dBA)
AHUs	38
External fans	40
Internal fans (atmospheric terminations)	30
Dry air coolers	42
External condensers	31
Total	45

Table 14 Receptor N - assessment summary

Plant item	Overall level at facade (dBA)
AHUs	28
External fans	37
Internal fans (atmospheric terminations)	30
Dry air coolers	40
External condensers	25
Total	42

Table 15 Receptor W - assessment summary

Plant item	Overall level at facade (dBA)
AHUs	38
External fans	38
Internal fans (atmospheric terminations)	27
Dry air coolers	36
External condensers	30
Total	42

As seen above, compliance with the planning noise limit of L_{Aeq} 45 dB at the facade of noise-sensitive receptors (daytime, weekday) is expected with all plant operating at full design duty.

As the building is commercial in nature, a significantly reduced duty will be placed on ventilation and cooling plant during the night and at weekends. For example, the dry air coolers will reduce in overall noise level by 28 dB during the night, and a typical reduction of at least 5-10 dB would be expected from other plant items due to the reduced load. As such, providing that compliance with the noise egress criteria is achieved during the peak hours (daytime, weekday, as demonstrated herein) then compliance would be achieved at all times.

7 Conclusion

Table 1 shows the representative background sound levels measured during the survey alongside the limits determined with the LBC requirements.

Time of day	Weekdays		Weekends	
	Background level $L_{A90,15min}$ (dB)	Limits L_{Aeq} (dB)	Background level $L_{A90,15min}$ (dB)	Limits L_{Aeq} (dB)
07:00–19:00	50	45	48	43
19:00-23:00	49	44	48	43
23:00-07:00	47	42	47	42

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.

An assessment has been undertaken based on meeting the local authority noise egress planning criteria, in addition to limiting the noise level at ground floor louvres/light wells to around L_{Aeq} 55 dB at a distance of 1 m. This is not a planning requirement but is considered good practice.

Compliance with the noise egress limits at peak times (weekday, daytime) has been demonstrated, assuming all plant items are operating simultaneously at design duty.

The night time and weekend noise egress limits are 2-3 dB lower than the week day, daytime limits. A considerable reduction in noise emissions from cooling and ventilation plant of at least 5 dB would be expected due to the reduced load at night or during weekends. The night time duty for the dry air coolers is 28 dB lower than during the day. As such, if the week day daytime limits are met, compliance will be achieved at all times.

Appendix A

Survey details

Equipment

A Svantek 957 sound level meter was used to undertake the unattended measurements. The 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	SVAN957/12327	Svantek	2 Nov 17	1511575
Microphone	ACO7052H/43273	Svantek	2 Nov 17	1511575
Pre-amp	SV12L/13569	Svantek	2 Nov 17	1511575
Calibrator	SV30A/7451	Svantek	30 Oct 17	1510572

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. 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 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.

The L_{A90} is considered most representative of the background sound level for the purposes of complying with any local authority requirements.

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.*

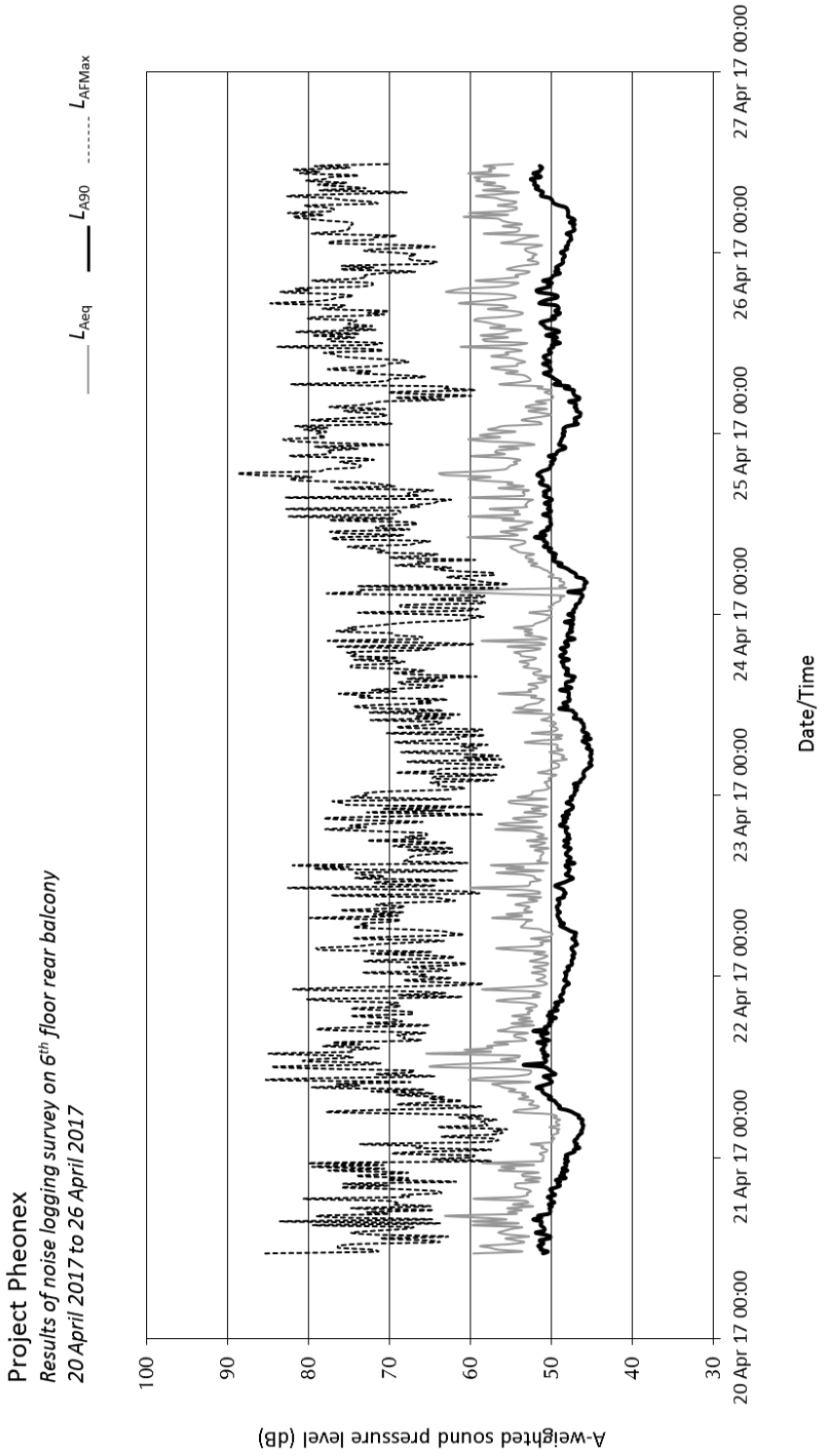
Weather conditions

During the unattended noise measurements between 20 April 2017 and 26 April 2017, weather reports for the area indicated that temperatures varied between 0°C at night and 16°C during the day, and the wind speed was less than 7.5 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements on 6th floor rear balcony


Project Pheonex
Results of noise logging survey on 6th floor rear balcony
20 April 2017 to 26 April 2017
LAeq
LA90
LAFMax
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
20 Apr 17 00:00
21 Apr 17 00:00
22 Apr 17 00:00
23 Apr 17 00:00
24 Apr 17 00:00
25 Apr 17 00:00
26 Apr 17 00:00
27 Apr 17 00:00
Date/Time

Appendix C

Full assessment results

East receptor (E)	Sound pressure level (dB) 1 m from the facade at octave-band centre frequency (Hz)							Overall
Plant item	63	125	250	500	1000	2000	4000	dBA
AHU 3 inlet	38	30	31	17	12	10	5	
AHU 3 outlet	33	27	34	26	20	18	18	
AHU 4 inlet	34	27	32	14	9	8	2	
AHU 4 outlet	35	30	35	29	22	20	18	
AHU 1 inlet	43	37	31	16	6	5	2	
AHU 1 outlet	27	25	25	15	7	6	5	
AHU 2 inlet	51	41	35	13	19	20	11	
AHU 2 outlet	37	36	37	28	23	24	26	
Shower inlet	28	27	28	13	8	12	14	
Shower outlet	18	17	24	8	2	-1	1	
EF 1 outlet	35	49	16	6	13	14	8	
EF 1 breakout	40	54	35	24	17	14	7	
EF 2 outlet	27	28	24	17	14	16	11	
EF 3 outlet	29	26	29	16	12	12	3	
EF 3 breakout	20	33	34	22	12	6	7	
EF 4 outlet	27	25	28	15	10	10	2	
EF 4 breakout	19	32	33	21	10	4	6	
EF 5 & 6 outlet	38	31	36	21	18	19	10	
EF 10 outlet	5	10	7	2	6	10	7	
EF 16 facade level	20	17	18	8	5	4	0	
Dry air coolers (3 No)	-	34	38	38	37	35	28	
Spectral total	53	56	46	40	38	36	31	45
MER condensers								31
Total at facade								45

North receptor (N)	Sound pressure level (dB) 1 m from the facade at octave-band centre frequency (Hz)							Overall
Plant item	63	125	250	500	1000	2000	4000	dBA
AHU 3 inlet	32	23	22	7	0	0	0	
AHU 3 outlet	27	19	23	12	4	0	0	
AHU 4 inlet	30	21	24	5	0	0	0	
AHU 4 outlet	30	23	25	16	7	3	1	
AHU 1 inlet	43	37	30	14	4	2	0	
AHU 1 outlet	27	25	24	13	5	3	2	
AHU 2 inlet	40	29	21	0	0	0	0	
AHU 2 outlet	26	24	23	12	4	2	1	
EF 1 outlet	33	46	12	0	5	4	0	
EF 1 breakout	38	51	31	19	9	4	0	
EF 2 outlet	26	26	21	12	7	7	0	
EF 3 outlet	27	24	26	11	4	2	0	
EF 3 breakout	19	31	31	17	4	0	0	
EF 4 outlet	27	24	26	11	4	2	0	
EF 4 breakout	28	32	32	18	7	3	0	
EF 5 & 6 outlet	34	26	31	15	10	8	0	
EF 9 outlet	45	40	19	4	0	0	0	
EF 10 outlet	1	6	2	0	0	0	0	
EF 11 outlet	40	35	17	0	11	12	1	
EF 12 - 15	40	30	28	18	16	19	12	
Dry air coolers (3 No)	-	33	38	36	35	33	27	
Spectral total	50	53	42	36	35	33	27	42
MER condensers								25
Total at facade								42

West receptor (W)	Sound pressure level (dB) 1 m from the facade at octave-band centre frequency (Hz)							Overall
Plant item	63	125	250	500	1000	2000	4000	dBA
AHU 3 inlet	37	30	31	17	11	10	4	
AHU 3 outlet	33	27	33	25	20	18	18	
AHU 4 inlet	35	28	33	15	10	8	3	
AHU 4 outlet	36	31	35	29	23	21	19	
AHU 2 inlet	50	40	34	12	18	19	10	
AHU 2 outlet	36	35	36	27	22	23	25	
AHU 1 inlet	42	36	30	15	6	5	1	
AHU 1 outlet	26	24	24	14	7	5	4	
EF 1 outlet	32	46	13	4	10	11	5	
EF 1 breakout	37	51	32	22	14	11	4	
EF 2 outlet	27	28	24	16	14	16	11	
EF 3 outlet	26	24	27	14	10	9	1	
EF 3 breakout	18	31	32	20	9	3	5	
EF 4 outlet	28	26	29	15	11	11	3	
EF 4 breakout	20	33	33	21	11	5	7	
EF 7 outlet	36	34	28	16	12	14	9	
EF 8 outlet	25	25	21	19	12	10	10	
EF 9 outlet	30	29	9	0	0	0	0	
EF 11 outlet	33	28	9	0	0	0	0	
EF 12 - 15	35	25	22	10	6	6	0	
SF 07	25	27	16	13	9	4	0	
Dry air coolers (3 No)	-	28	32	32	32	30	22	
Spectral total	52	53	44	36	34	32	28	42
MER condensers								30
Total at facade								42