auricl
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Uncommon Holborn

Templar House

London

Plant Noise Assessment Report

11 May 2020

For

Uncommon

Contents

SUMMARY

New building services plant items are proposed as part of the refurbishment of Templar House, located on High Holborn in London.

The new plant will be subject to plant noise limits specified by a planning condition.

A background noise survey has been undertaken to determine background noise levels at the nearest noise sensitive properties and an assessment of plant noise emissions has been carried out.

The results of the assessment show that noise emissions associated with the proposed plant are predicted to be 10 dB less than the lowest measured background noise level at the nearest noise sensitive properties and therefore meet the planning condition requirement.

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1.0 Introduction

New building services plant items are proposed as part of the refurbishment of Templar House, located on High Holborn in London .

The plant will be subject to plant noise limits specified by a planning condition.

auricl has been appointed to carry out a background noise survey at the site and undertake an assessment of noise emissions from the proposed plant at the nearest noise sensitive properties.

The following report presents the methodology and results of the survey, and an assessment of noise emissions from the proposed plant, to determine compliance with the Camden Council requirements.

The report is technical in nature, and such, a summary of noise units and acoustic terminology are included in Appendix A for reference.

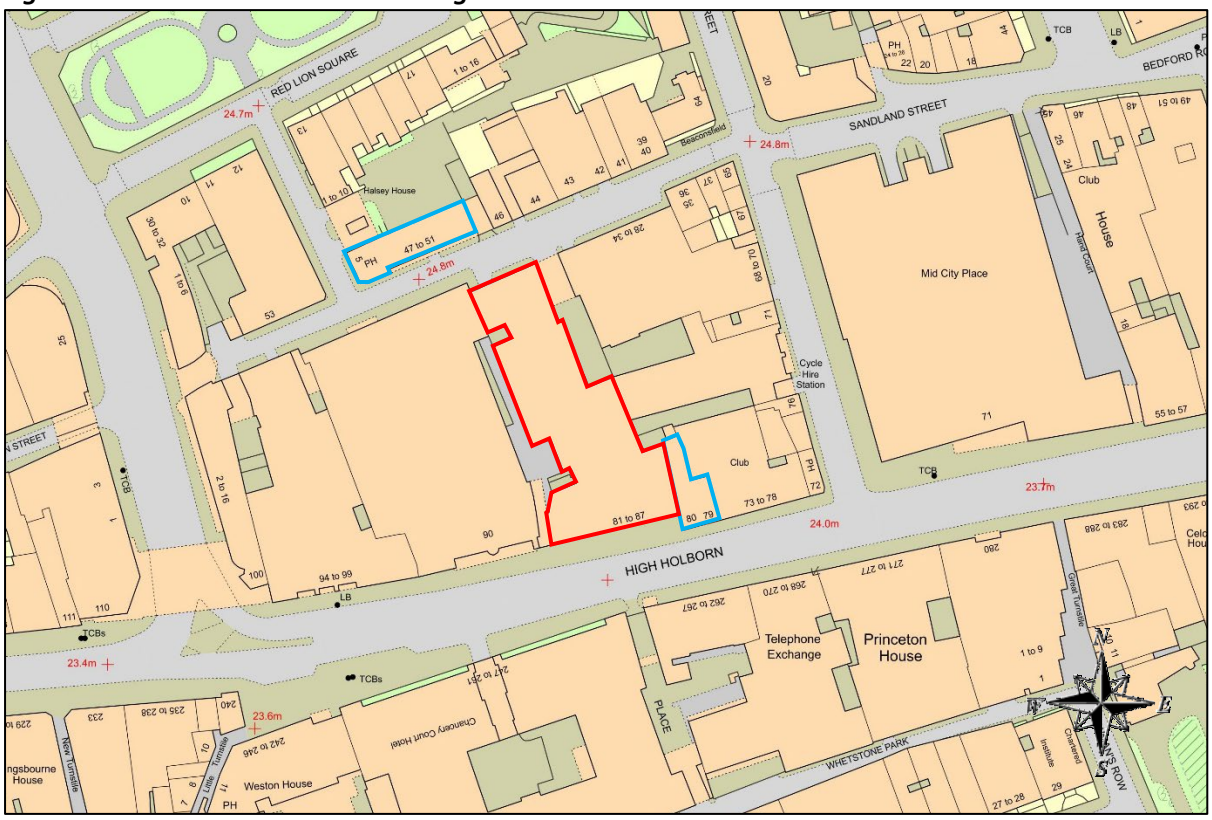
2.0 Site Description

The site is located at 81-87 High Holborn within a predominantly commercial area. The building has façades facing onto High Holborn to the south/south-east and Eagle Street to the north/north-west.

Commercial properties are located to the east, west and south of the site, and residential properties are located to the north-west of the site, on the northern side of Eagle Street, and to the east of the site, within 79-80 High Holborn.

Figure 2.1 shows the site extent in **red** in relation to the surrounding area with the nearest residential properties indicated in **blue**.

Figure 2.1 Site Extent and Surroundings



3.0 Camden Council Requirements

Planning condition 7 of the planning permission for the refurbishment of the building (ref: 2018/5903/P) states the following:

"*7. Before the relevant part of the development commences, an independent noise assessment including details of the external noise level emitting from plant/machinery/equipment and mitigation measures as appropriate shall be submitted to and approved in writing by the local planning authority. The design and installation of new items of fixed plant shall be such that when operating the cumulative noise level L_{Aeq} arising from the proposed plant, measured or predicted at 1m from the façade of the nearest noise sensitive premises, shall be a rating level of at least 10 dB(A) below the typical background noise level L_{AF90} (15 dBA where tonality of impulsivity is perceptible). The measurement and/or prediction of the noise should be carried out in accordance with the methodology contained within BS 4142: 2014.*"

A background noise survey and plant noise assessment have therefore been undertaken to address the above.

4.0 Noise Survey Methodology and Results

4.1 Methodology

An unmanned noise survey was carried out over a 4-day period between Thursday 14 November 2019 and Tuesday 19 November 2019 to determine existing background noise levels at the nearest noise sensitive properties.

Noise measurements were undertaken at two positions which are considered to be representative of background noise levels at the nearest noise sensitive properties.

The measurement positions are indicated in **purple** in Figure 4.1 and described in Table 4.1.

Figure 4.1 Site Plan Indicating Noise Measurement Positions

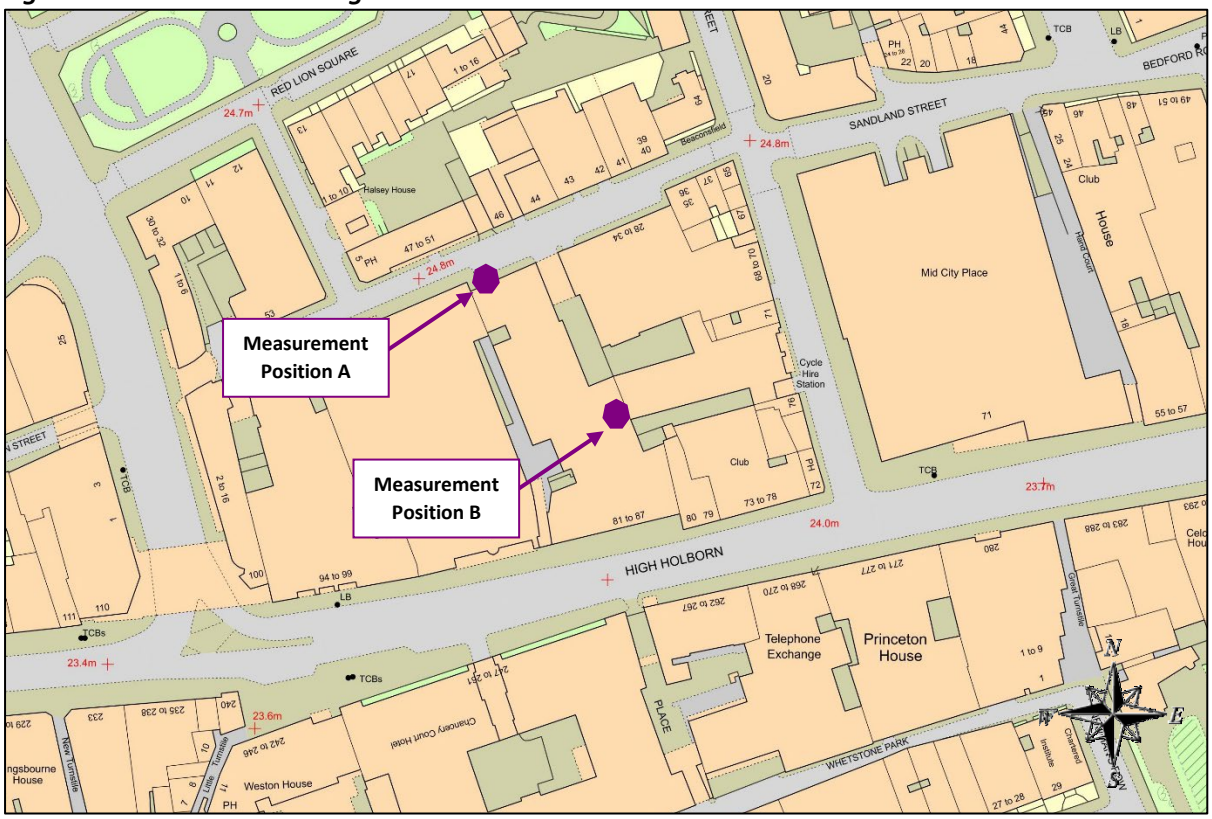


Table 4.1 Description of Measurement Positions

Measurement Position	Description
A	Measurement microphone attached to a balustrade at roof level on the northern side of the site towards Eagle Street
B	Measurement microphone attached to a balustrade at roof level on the eastern side of the site

The equipment used for the noise survey is summarised in Table 4.2.

Table 4.2 Description of Equipment used for Noise Survey

Item	Make & Model	Serial Number
Type 1 automated logging sound level meter	01dB FUSION	12032
Type 1 ½" microphone	GRAS 40CE	33089
Calibrator	01dB CAL21	34375252

The noise monitoring equipment was calibrated before and after the survey. No significant change was found. Laboratory equipment calibration certificates can be provided upon request.

Due to the nature of the noise survey, i.e. unmanned, we are unable to comment on the weather conditions throughout the entire noise survey period, however at the beginning and end of the survey period, there was noted to be no rainfall, a clear sky and only light wind. These conditions are understood to be representative of the majority of the survey period and are considered appropriate for undertaking environmental noise measurements.

4.2 Noise Survey Results & Observations

Appendix B presents time history graphs showing the L_{Aeq} and L_{A90} sound pressure levels measured throughout the noise survey at each measurement position (shown as 15-minute intervals).

The proposed plant is to operate during typical office hours (08:00 – 18:00 hours, weekdays) during which time the lowest measured background noise level was **45 dB L_{A90}** at position A and **52 dB L_{A90}** at position B.

During our site visits the noise climate at the site was observed to be dominated by noise due to road traffic using surrounding roads, in particular High Holborn to the south and Procter Street to the west.

5.0 Plant Noise Assessment

5.1 Nearest Noise Sensitive Properties

The nearest noise sensitive properties are considered to be the residential apartments located to the north-west of the site on the northern side of Eagle Street (47-51) and the to the east of the site within 79-80 High Holborn, as indicated on Figure 2.1 above

5.2 Plant Noise Limit

Based on the lowest measured background noise level presented in Section 4.2 and the planning condition requirements outlined in Section 3, the noise limit for plant noise emissions when measured 1m from the façade of the noise sensitive properties on Eagle Street is **35 dB L_{Aeq}**. Whilst the limit at the noise sensitive properties at 79-80 High Holborn is **42 dB L_{Aeq}**.

5.3 Proposed Plant

Condenser units and air handling units are to be located on the roof of the building.

The plant will be surrounded by a vertical acoustic screen. In addition, acoustic hit-and-miss panels are to be fitted over the top of the air handing units on the roof on the northern/Eagle Street side, to provide additional acoustic attenuation.

We have also considered the kitchen extract fan, which is located at lower ground floor level with ductwork terminating at roof level.

The kitchen extract fan and all of the air handling units will be fitted with acoustic attenuators on the atmospheric-side and room-side and the casing of the air handling units has been upgraded to reduce noise emissions.

Octave band noise data for the unit is shown in the detailed plant noise calculations in Appendix C. Examination of the manufacturer's octave band noise data (in accordance with the methodology described in Annex C of BS 4142: 2014) confirmed that the noise is not tonal. The plant will not operate intermittently and is not expected to be impulsive in nature.

5.4 Assessment and Conclusion

We have undertaken calculations to predict noise emissions associated with the proposed plant at the nearest noise sensitive properties.

Detailed plant noise calculations and spectral noise data for the plant are included in Appendices C and D for the noise sensitive properties on Eagle Street and within 79-80 High Holborn respectively.

As previously noted, noise from the units is not tonal, intermittent or impulsive, therefore no feature corrections have been applied in the calculations.

The plant noise calculation results at the nearest noise sensitive windows are summarised in Table 5.1 below.

Table 5.1 Plant Noise Calculation Results – Eagle Street

Element	Level (dB)
Condenser Units	34
Air Handling Unit Grilles	16
Air Handling Unit Casings	25
Kitchen Extract Fan	1
Total Plant Noise Level	**35**
Lowest Measured Background Noise Level	**45**
Difference	**-10**

Table 5.2 Plant Noise Calculation Results – 79-80 High Holborn

Element	Level (dB)
Condenser Units	41
Air Handling Unit Grilles	25
Air Handling Unit Casings	34
Kitchen Extract Fan	9
Total Plant Noise Level	**42**
Lowest Measured Background Noise Level	**52**
Difference	**-10**

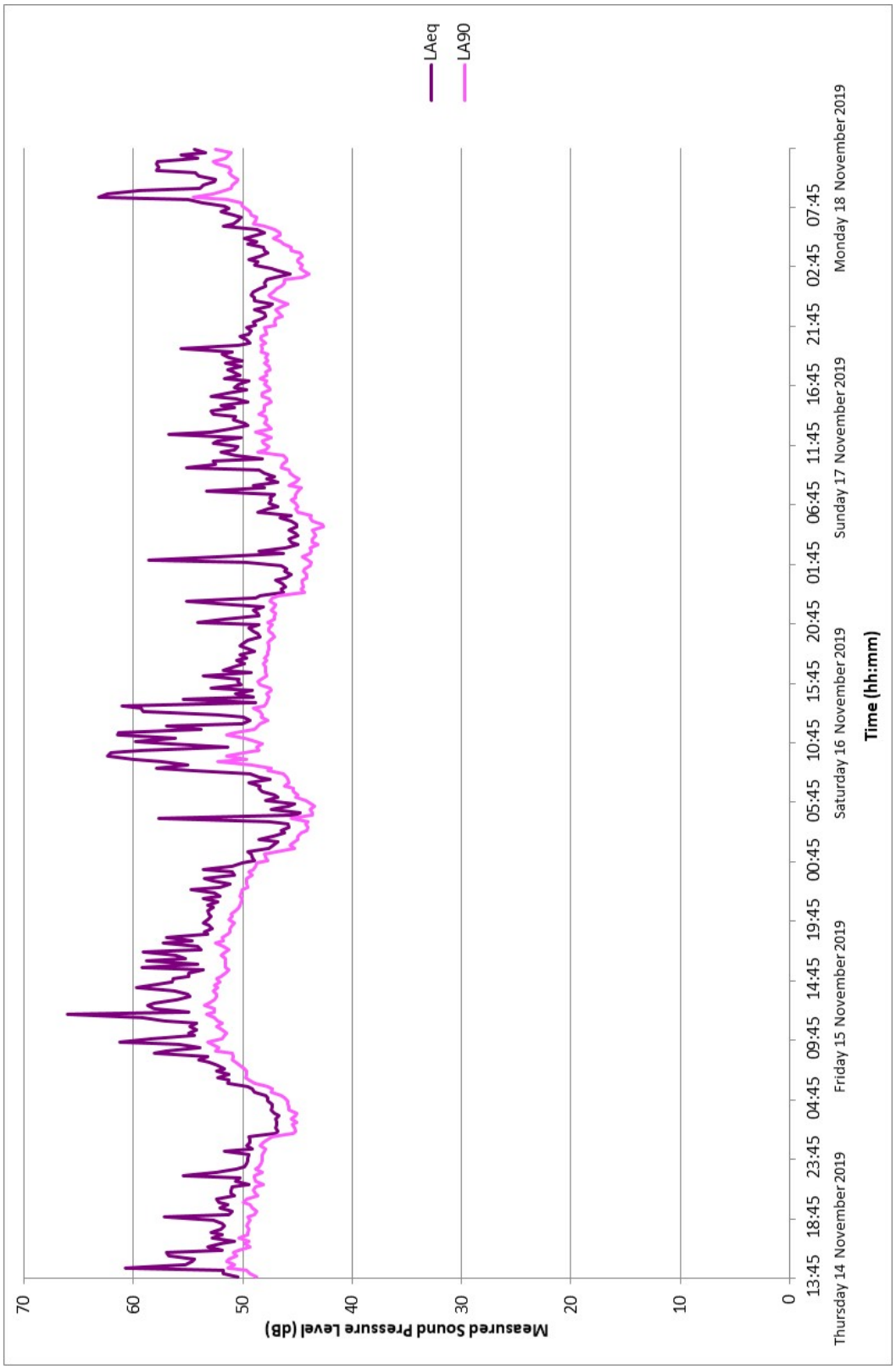
The results show that noise emissions associated with the proposed plant are predicted to be 10 dB less than the lowest measured background noise level at the nearest noise sensitive properties and therefore meet the planning condition requirement.

Appendix A – Acoustic Terminology

Parameter	Description
Decibel (dB)	A logarithmic scale representing the sound pressure or power level relative to the threshold of hearing ($20x10^{-6}$ Pascals).
Sound Pressure Level (L_p)	The sound pressure level is the sound pressure fluctuation caused by vibrating objects relative to the threshold of hearing.
A-weighting (L_A or dBA)	The sound level in dB with a filter applied to increase certain frequencies and decrease others to correspond with the average human response to sound.
L_{Amax}	The A-weighted maximum noise level measured during the measurement period.
$L_{Aeq,T}$	The A-weighted equivalent continuous noise level over the time period T (typically T= 16 hours for daytime periods, T = 8 hours for night-time periods). This is the sound level that is equivalent to the average energy of noise recorded over a given period.
$L_{A90\ (15\ min)}$	The noise level exceeded for 90% of the time (also referred to as the background noise level), measured over a 15-minute period

Appendix B – Noise Survey Results

Position A



Position B


LAeq
LA90
Measured Sound Pressure Level (dB)
70
60
50
40
30
20
10
0
14:15
16:45
19:15
21:45
00:15
02:45
05:15
07:45
10:15
12:45
Monday 18 November 2019
Tuesday 19 November 2019
Time (hh:mm)

Appendix C – Detailed Plant Noise Calculations – Eagle Street

Condenser Units

Condenser Unit Reference	Sound Power Level (L_{wA} dB)	Unit Attenuation (dB)	Distance Attenuation (dB)	Screening Attenuation (dB)	Predicted Noise Level at Nearest Noise Sensitive Property (dB)
1	82	-10	-45	-15	12
2	86	-10	-41	-15	20
3	81	-10	-40	-15	16
4	87	-10	-45	-15	17
5	90	-10	-40	-15	25
6	86	-10	-39	-15	22
7	87	-10	-45	-15	17
8	85	-10	-40	-15	20
9	85	-10	-39	-15	17
10	87	-10	-44	-15	18
11	85	-10	-44	-15	16
12	81	-10	-39	-15	17
13	82	-10	-44	-15	12
14	85	-10	-44	-15	16
15	86	-10	-38	-15	23
16	87	-10	-44	-15	18
17	86	-10	-43	-15	18
18	81	-10	-38	-15	18
19	83	-10	-44	-15	14
20	81	-10	-43	-15	13
21	85	-10	-41	-15	19
22	84	-10	-44	-15	15
23	89	-10	-41	-15	23
24	87	-10	-39	-15	23
25	85	-10	-39	-15	21
26	90	-10	-39	-15	26
27	82	-10	-44	-15	13
28	85	-10	-42	-15	18
				Total	**34**

Air Handling Unit Grilles

Air Handling Unit 1 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	78	79	64	47	46	49	49	43	
Attenuator Insertion Losses	-2	-4	-9	-15	-17	-14	-10	-8	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-40	-40	-40	-40	-40	-40	-40	-40	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**19**	**18**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**3**

Air Handling Unit 1 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	74	79	66	56	46	46	49	50	
Attenuator Insertion Losses	-2	-4	-9	-15	-17	-14	-10	-8	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-40	-40	-40	-40	-40	-40	-40	-40	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**15**	**18**	**1**	**<0**	**<0**	**<0**	**<0**	**<0**	**3**

Air Handling Unit 2 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	80	87	83	78	76	73	67	65	
Attenuator Insertion Losses	-6	-13	-23	-37	-43	-44	-35	-20	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-35	-35	-35	-35	-35	-35	-35	-35	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**22**	**22**	**9**	**<0**	**<0**	**<0**	**<0**	**<0**	**7**

Air Handling Unit 2 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	83	85	86	88	83	81	75	73	
Attenuator Insertion Losses	-8	-16	-28	-43	-47	-47	-39	-22	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-35	-35	-35	-35	-35	-35	-35	-35	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**23**	**17**	**7**	**<0**	**<0**	**<0**	**<0**	**<0**	**5**

Air Handling Unit 3 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	69	74	65	50	52	53	61	46	
Attenuator Insertion Losses	-12	-24	-42	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-26	-26	-26	-26	-26	-26	-26	-26	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**25**	**20**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**5**

Air Handling Unit 3 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	72	78	67	59	50	49	55	54	
Attenuator Insertion Losses	-10	-20	-36	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-26	-26	-26	-26	-26	-26	-26	-26	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**25**	**23**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**8**

Air Handling Unit 4 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	76	78	89	79	74	68	65	72	
Attenuator Insertion Losses	-10	-20	-36	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-33	-33	-33	-33	-33	-33	-33	-33	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**22**	**16**	**12**	**<0**	**<0**	**<0**	**<0**	**<0**	**5**

Air Handling Unit 4 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	76	89	85	86	85	76	74	74	
Primary Attenuator Insertion Losses	-8	-15	-25	-40	-46	-47	-43	-32	
Secondary Attenuator Insertion Losses	-8	-15	-25	-40	-46	-47	-43	-32	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-33	-33	-33	-33	-33	-33	-33	-33	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**32**	**19**	**9**	**1**	**<0**	**<0**	**<0**	**<0**	**1**

Air Handling Unit 5 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	78	81	61	50	50	56	55	43	
Attenuator Insertion Losses	-9	-17	-29	-46	-50	-50	-49	-34	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-33	-33	-33	-33	-33	-33	-33	-33	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**25**	**22**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**6**

Air Handling Unit 5 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	83	91	85	79	78	81	76	75	
Attenuator Insertion Losses	-16	-29	-46	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-33	-33	-33	-33	-33	-33	-33	-33	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**23**	**20**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**5**

Air Handling Unit 6 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	74	67	65	49	49	52	55	44	
Attenuator Insertion Losses	-5	-11	-19	-29	-36	-37	-29	-18	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-38	-38	-38	-38	-38	-38	-38	-38	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**24**	**12**	**4**	**<0**	**<0**	**<0**	**<0**	**<0**	**1**

Air Handling Unit 6 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	69	73	67	54	46	44	48	52	
Attenuator Insertion Losses	-7	-12	-20	-33	-39	-40	-35	-28	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-38	-38	-38	-38	-38	-38	-38	-38	
Screening Attenuation	-10	-10	-10	-10	-10	-10	-10	-10	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**17**	**17**	**5**	**<0**	**<0**	**<0**	**<0**	**<0**	**3**

Air Handling Unit Grilles – Summary

Air Handling Unit	Side	Predicted Noise Level at Noise Sensitive Property (dB)
1	Supply	3
	Extract	3
2	Supply	7
	Extract	5
3	Supply	5
	Extract	8
4	Supply	5
	Extract	1
5	Supply	6
	Extract	5
6	Supply	1
	Extract	3
	Total	**16**

Air Handling Unit Casings

Air Handling Unit	Sound Power Level (L_{wA} dB)	Distance Attenuation (dB)	Screening Attenuation (dB)	Predicted Noise Level at Nearest Noise Sensitive Property (dB)
1	69	-45	-15	9
2	66	-41	-15	10
3	70	-32	-15	23
4	**68**	**-39**	**-15**	**14**
5	**69**	**-34**	**-15**	**20**
6	**69**	**-43**	**-15**	**11**
			Total	**25**

Kitchen Extract Fan

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	79	84	79	78	73	68	64	62	
Attenuator Insertion Losses	-4	-9	-17	-28	-34	-32	-21	-14	
Duct Attenuation	-14	-8	-5	-3	-3	-3	-3	-3	
Grille End Reflection	-3	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-43	-43	-43	-43	-43	-43	-43	-43	
Screening Attenuation	-15	-15	-15	-15	-15	-15	-15	-15	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**5**	**13**	**5**	**<0**	**<0**	**<0**	**<0**	**<0**	**1**

Appendix D – Detailed Plant Noise Calculations – 79-80 High Holborn

Condenser Units

Condenser Unit Reference	Sound Power Level (L_{wA} dB)	Unit Attenuation (dB)	Distance Attenuation (dB)	Screening Attenuation (dB)	Predicted Noise Level at Nearest Noise Sensitive Property (dB)
1	82	-10	-40	-15	17
2	86	-10	-42	-10	24
3	81	-10	-42	-10	19
4	87	-10	-40	-15	22
5	90	-10	-42	-10	28
6	86	-10	-42	-5	29
7	87	-10	-39	-15	23
8	85	-10	-42	-10	23
9	81	-10	-42	-5	24
10	87	-10	-39	-10	28
11	85	-10	-37	-5	33
12	81	-10	-43	-5	23
13	82	-10	-36	-5	31
14	85	-10	-38	-5	32
15	86	-10	-43	-10	23
16	87	-10	-40	-10	27
17	86	-10	-40	-10	26
18	81	-10	-44	-10	17
19	83	-10	-40	-10	23
20	81	-10	-36	-10	25
21	85	-10	-41	-10	24
22	84	-10	-37	-5	32
23	89	-10	-41	-10	28
24	87	-10	-42	-10	25
25	85	-10	-43	-10	22
26	90	-10	-43	-10	27
27	82	-10	-38	-15	19
28	85	-10	-40	-10	25
				Total	**41**

Air Handling Unit Grilles

Air Handling Unit 1 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	78	79	64	47	46	49	49	43	
Attenuator Insertion Losses	-2	-4	-9	-15	-17	-14	-10	-8	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-32	-32	-32	-32	-32	-32	-32	-32	
Screening Attenuation	-15	-15	-15	-15	-15	-15	-15	-15	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**32**	**32**	**14**	**<0**	**<0**	**<0**	**<0**	**<0**	**17**

Air Handling Unit 1 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	74	79	66	56	46	46	49	50	
Attenuator Insertion Losses	-2	-4	-9	-15	-17	-14	-10	-8	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-32	-32	-32	-32	-32	-32	-32	-32	
Screening Attenuation	-15	-15	-15	-15	-15	-15	-15	-15	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**28**	**32**	**16**	**0**	**<0**	**<0**	**<0**	**1**	**17**

Air Handling Unit 2 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	80	87	83	78	76	73	67	65	
Attenuator Insertion Losses	-6	-13	-23	-37	-43	-44	-35	-20	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**31**	**31**	**18**	**<0**	**<0**	**<0**	**<0**	**<0**	**17**

Air Handling Unit 2 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	83	85	86	88	83	81	75	73	
Attenuator Insertion Losses	-8	-16	-28	-43	-47	-47	-39	-22	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	-5	-6	-6	-6	-6	-6	-6	-6	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**32**	**26**	**16**	**3**	**<0**	**<0**	**<0**	**9**	**15**

Air Handling Unit 3 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	69	74	65	50	52	53	61	46	
Attenuator Insertion Losses	-12	-24	-42	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**17**	**12**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**

Air Handling Unit 3 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	72	78	67	59	50	49	55	54	
Attenuator Insertion Losses	-10	-20	-36	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**22**	**20**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**4**

Air Handling Unit 4 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	76	78	89	79	74	68	65	72	
Attenuator Insertion Losses	-10	-20	-36	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-36	-36	-36	-36	-36	-36	-36	-36	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**29**	**23**	**19**	**<0**	**<0**	**<0**	**<0**	**<0**	**12**

Air Handling Unit 4 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	76	89	85	86	85	76	74	74	
Primary Attenuator Insertion Losses	-8	-15	-25	-40	-46	-47	-43	-32	
Secondary Attenuator Insertion Losses	-8	-15	-25	-40	-46	-47	-43	-32	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-36	-36	-36	-36	-36	-36	-36	-36	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**23**	**24**	**14**	**6**	**2**	**<0**	**<0**	**<0**	**8**

Air Handling Unit 5 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	78	81	61	50	50	56	55	43	
Attenuator Insertion Losses	-9	-17	-29	-46	-50	-50	-49	-34	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**30**	**26**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**11**

Air Handling Unit 5 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	83	91	85	79	78	81	76	75	
Attenuator Insertion Losses	-16	-29	-46	-50	-50	-50	-50	-50	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+1.5	+2	+2	+3	+3	+3	+3	+3	
Distance Attenuation	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**28**	**24**	**<0**	**<0**	**<0**	**<0**	**<0**	**<0**	**9**

Air Handling Unit 6 – Supply

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	74	67	65	49	49	52	55	44	
Attenuator Insertion Losses	-5	-11	-19	-29	-36	-37	-29	-18	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-34	-34	-34	-34	-34	-34	-34	-34	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**38**	**26**	**18**	**<0**	**<0**	**<0**	**<0**	**<0**	**15**

Air Handling Unit 6 – Extract

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	69	73	67	54	46	44	48	52	
Attenuator Insertion Losses	-7	-12	-20	-33	-39	-40	-35	-28	
Grille End Reflection	-2	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-34	-34	-34	-34	-34	-34	-34	-34	
Screening Attenuation	0	0	0	0	0	0	0	0	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**31**	**31**	**19**	**<0**	**<0**	**<0**	**<0**	**<0**	**16**

Air Handling Unit Grilles – Summary

Air Handling Unit	Side	Predicted Noise Level at Noise Sensitive Property (dB)
1	Supply	17
	Extract	17
2	Supply	17
	Extract	15
3	Supply	<0
	Extract	4
4	Supply	12
	Extract	8
5	Supply	11
	Extract	9
6	Supply	15
	Extract	16
	Total	**25**

Air Handling Unit Casings

Air Handling Unit	Sound Power Level (L_{wA} dB)	Distance Attenuation (dB)	Screening Attenuation (dB)	Predicted Noise Level at Nearest Noise Sensitive Property (dB)
1	69	-37	-15	17
2	66	-41	0	25
3	70	-45	0	25
4	68	-41	0	27
5	69	-44	0	25
6	69	-39	0	30
			Total	**34**

Kitchen Extract Fan

Element	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
In-Duct Sound Power Levels	79	84	79	78	73	68	64	62	
Attenuator Insertion Losses	-4	-9	-17	-28	-34	-32	-21	-14	
Duct Attenuation	-14	-8	-5	-3	-3	-3	-3	-3	
Grille End Reflection	-3	-1	0	0	0	0	0	0	
Directivity (0°)	+4.5	+5	+5.5	+6	+6	+6	+6	+6	
Distance Attenuation	-35	-35	-35	-35	-35	-35	-35	-35	
Screening Attenuation	-15	-15	-15	-15	-15	-15	-15	-15	L_{Aeq} (dB)
Predicted Noise Level at Noise Sensitive Property	**12**	**21**	**12**	**3**	**<0**	**<0**	**<0**	**1**	**9**