Acoustic Consultancy Report

72970/3/3/2

External Plant Assessment

Report Prepared For

Fowler Martin
7 Queen Square
24 May 2016

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Contents

i) Executive Summary

New mechanical plant is to be installed at 7 Queen Square, in London.

LCP has been commissioned by Fowler Martin on behalf of University College London to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The design criterion is as follows:

Residential Day:	45 dB $L_{Aeq,T}$ at 2m, nearest residential window;
Commercial Day:	55 dB $L_{Aeq,T}$ at 6m, nearest commercial window to roof over the first floor.

Any new mechanical plant will be installed to meet the above design criteria.

The design as proposed and assessed will achieve the required criteria; the calculated rating levels are as follows:

Residential Day:	45 dB $L_{Aeq,T}$ at 2m, nearest residential window;
Commercial Day:	46 dB $L_{Aeq,T}$ at 6m, nearest commercial window to roof over the first floor.

This report concludes that the design criteria can be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	17th July 2015	Initial Issue	VB	MB
2	21st July 2015	Minor alterations	VB	MB
3	4th May 2016	Updated plant location	VB	MB
4	24th May 2016	Updated plant	VB	JN
5	24th May 2016	Minor alteration	VB	JN

1 Introduction

New mechanical plant is to be installed at 7 Queen Square, in London.

LCP has been commissioned by Fowler Martin on behalf of University College London to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The report details recommendations for necessary noise mitigation where necessary.

The guidance contained in this report is given on the basis that the operational period of the proposed plant may potentially be continuous between 07:00 and 20:00.

2 Survey

2.1 Site Description

The site layout together with the measurement position is shown in the drawing contained within Appendix A.

2.2 Receiver Location

The site was surveyed to determine the location of the most affected receiver. The nearest residential receiver with direct line of sight to the plant area located on the roof over the first floor is approximately 2m to the west of the site.

The nearest commercial receiver with direct line of sight to the plant area located on the roof over the first floor is 6m to the east of the site. This is shown in the site plan in Appendix A.

2.3 Local Noise Climate

The predominant local noise sources were existing mechanical plant within the vicinity and road traffic noise from local road networks.

2.4 Measurements

The noise monitoring took place on 8th July 2015 to the 10th July 2015. The measurement period was considered sufficient to establish the representative background sound levels corresponding to the operational period of the plant. The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	1m/s
Wind Direction	West
Cloud Cover	20%
Max. Temperature	24°C

Weather	Value
Min. Temperature	12°C
Precipitation	None

2.5 Measurement Results

The measured statistical broad-band sound pressure levels are shown within Appendix B. The representative background sound level(s) obtained being as follows:

Table 2: Representative background sound levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 15\ mins}$ Day*
MP1	55
MP2	54

* Day, Evening and Night periods are defined as between 07:00 - 23.00 and 23:00 - 07:00 respectively.

3 Evaluation of Design Criteria

3.1 Residential Design Criterion

3.1.1 BS4142:2014

BS4142:2014 states that the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

Table 3: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Indication of a significant adverse impact
+ 5 dB	Indication of an adverse impact
0 dB	Indication of low impact

Certain acoustic features can increase the significance of impact. The specific sound level should be corrected if a tone, impulse or other acoustic feature is expected to be present.

Table 4: Corrections for acoustic features, subjective method

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	2	4	6
Impulsivity	3	6	9
Other Characteristics	3		
Intermittency	3		

Typically the acoustic feature correction would not be expected to exceed 10dB.

Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty.

3.1.2 World Health Organisation Night Noise Guidelines for Europe (2009)

The WHO's document 'Night Noise Guidelines for Europe (NNG) states the following:

"*…it is recommended that the population should not be exposed to night noise levels greater than 40 dB of* $L_{night,\ outside}$ *during the part of the night when most people are in bed*."

It then goes on to say:

"*An interim target (IT) if 55 dB* $L_{night,\ outside}$ *is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons*."

As the above guideline values consider the combined level of noise external to a façade (i.e. vehicular traffic, air traffic, building services noise etc, it is recommended that a criterion of 10 dB below these given levels is applied, depending on the particulars of the site in question.

3.1.3 World Health Organisation (WHO) Guidelines for Community Noise (1999)

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 5: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

Specific Environment	$L_{Aeq,\ T}$ dB	Time Base (hours)	L_{Amax}, fast dB
Outdoor living area (serious annoyance, daytime and evening)	55	16	-
Outdoor living area (moderate annoyance, daytime and evening)	50	16	-
Dwelling, indoors	35	16	-
Inside bedrooms	30	8	45
Outside bedrooms	45	8	60

* Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

The WHO's 'Guidelines for Community Noise' also gives the following general guidance on the expected sound insulation performance of a façade with a partly open window, it states that:

"*At night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.*"

3.1.4 BS8233:2014

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise.

Using the general guidance from above, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in table 4 of BS8233 in order to obtain acceptable external noise levels.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

Table 6: External ambient noise levels for dwellings, based on BS8233, dB re $2x10^{-5}$ Pa

Activity	**Location**	**Time period**	
		07:00 to 23:00	**23:00 to 07:00**
Resting	Living Room	50 $L_{Aeq,16\ hour}$	-
Dining	Dining Room/area	55 $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	50 $L_{Aeq,\ 16\ hour}$	45 $L_{Aeq,\ 8\ hour}$

In addition to the above criteria, BS8233 goes on to say:

"*For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 $L_{Aeq,\ T}$, with an upper guideline value of 55 dB $L_{Aeq,\ T}$ which would be acceptable in nosier environments*."

The above criteria are in line with the recommendations made in WHO's 'Guidelines for Community Noise'.

3.1.5 Local Authority Requirements

The London Borough of Camden published "*Camden Development Policies 2010 – 2025*", Section 3 of which provides the following table.

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$L_{Aeq'}$

3.1.6 Recommended Residential Design Rating Level

On the basis of the above the recommended residential design rating level should therefore be:

Residential Design Rating Level
Representative $L_{A90,\ 15\ mins}$ - 10 dB

3.2 Commercial Design Criterion (BS8233:2014)

External design criteria for non-residential buildings have been derived from BS8233:2014.

Using the general guidance from WHO, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in tables 2 and 6 of BS8233 in order to obtain acceptable external noise levels.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

Table 7: External ambient noise levels for non-domestic buildings, based on BS8233, dB re $2x10^{-5}$ Pa

Activity	**Location**	**Design Level $L_{Aeq,\ 16\ hr}$**
Speech or telephone communications	Department store, cafeteria, canteen, kitchen	70
	Concourse, corridor, circulation space	70

Activity	Location	Design Level $L_{Aeq, 16\ hr}$
Study and work requiring concentration	Library, gallery, museum	65
	Staff/meeting room, training room	60
	Executive office	55
	Open plan office	65
Listening	Place of worship, counselling, meditation, relaxation	50

3.2.1 Recommended Commercial Design Rating Level

On the basis of the above the recommended commercial design rating level should therefore be:

Commercial Design Rating level
$L_{Aeq, T}$ 55 dB

3.3 Design Rating Levels

The design levels to be adopted for this project are set out in the table below.

Table 8: Design rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq, 16\ hr}$
Nearest residential	2	45
Nearest commercial to second floor roof	6	55

4 Review of Current Design

4.1 Current Design

The proposed plant shall comprise of eight Vent-Axia S9WW extract fans located on the flat roof at the rear of the property. In addition, two Vent-Axia S7WL fans, which shall be speed controlled to achieve 31dB(A) at 3m, shall be installed on the second floor at the rear. The plant location is shown in Appendix C.

4.2 Calculated Results

Calculations of the predicted noise levels have been carried out with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in table 9.

Table 9: Design and predicted rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq,\ 16\ hr}$	Predicted Level $L_{Aeq,T}$
Nearest residential	2	45	45
Nearest commercial to second floor roof	6	55	46

Plant noise level data used in this assessment are contained within Appendix D.

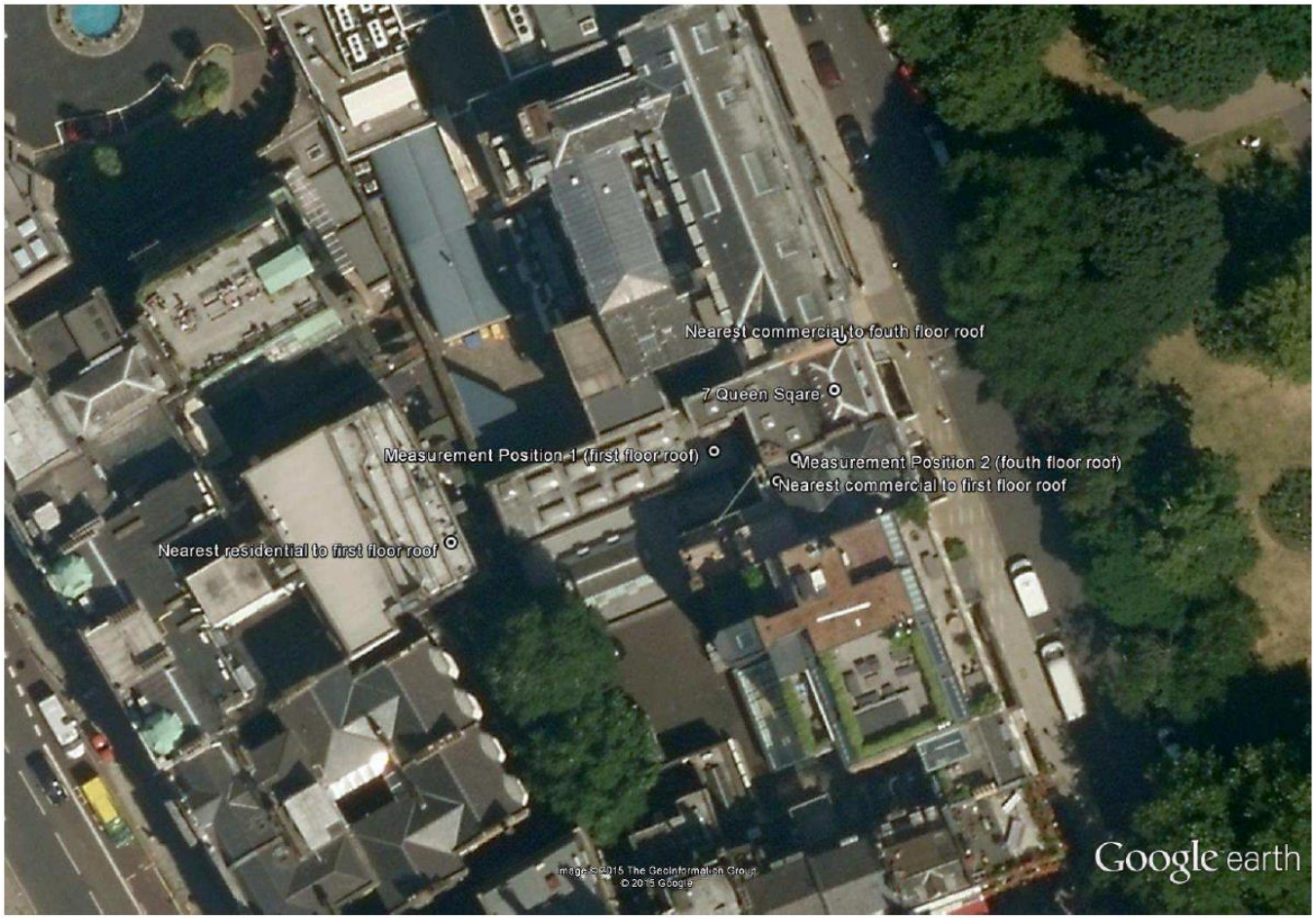
Calculations are shown within Appendix E.

5 Conclusion

An environmental noise survey has been undertaken in order to establish the representative background sound levels local to the site generally in accordance with the method contained within BS4142: 2014.

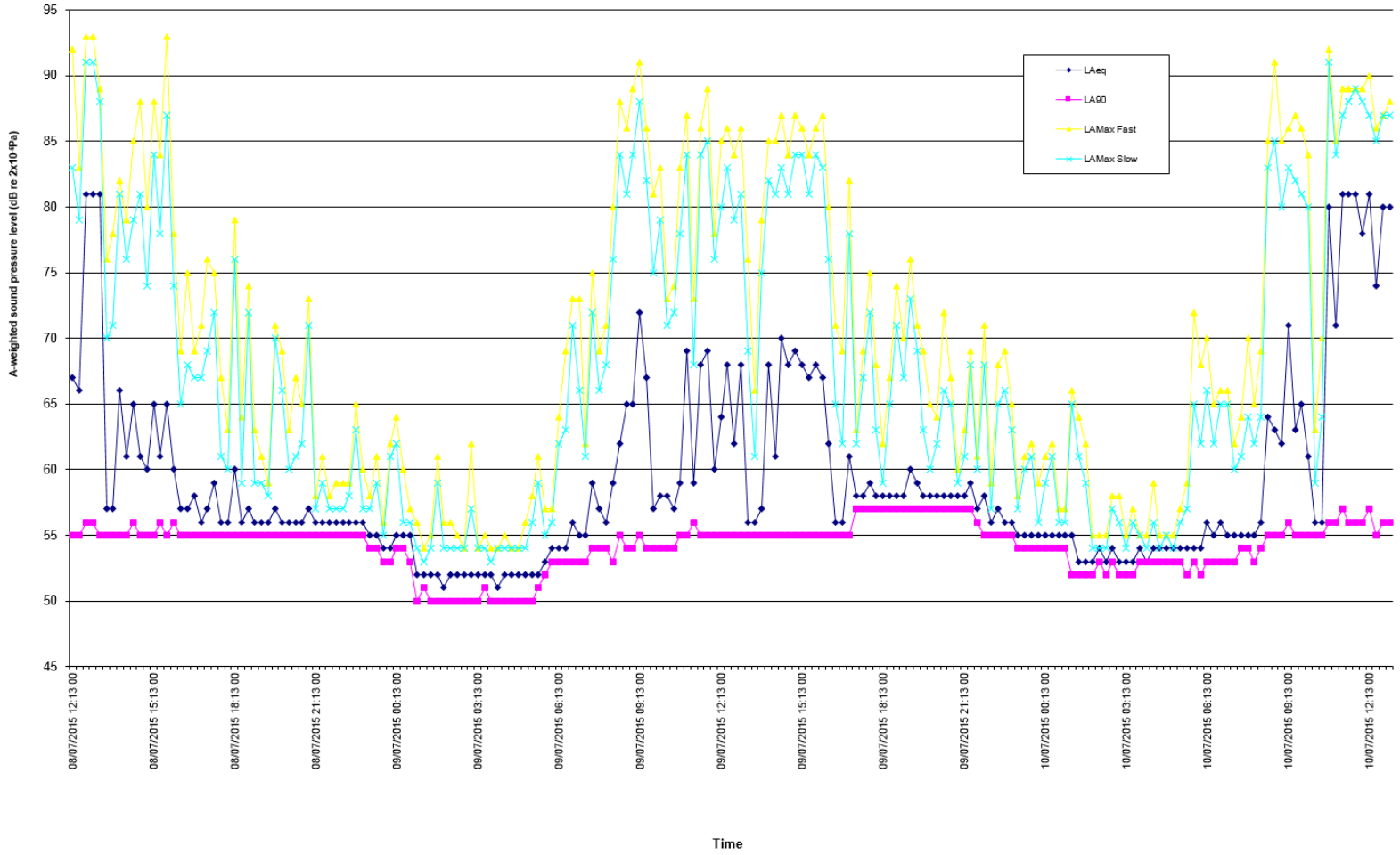
Calculations have been carried out to determine the noise levels at the nearest receiver premises. The calculations show that the design criteria will be met.

Appendix A: Site Plan



Approximate measurement position 1 (Latitude & Longitude) 51°31'17.37"N, 0° 7'22.63"W.
Approximate measurement position 2 (Latitude & Longitude) 51°31'17.38"N, 0° 7'22.27"W.

Appendix B: Measurement Data



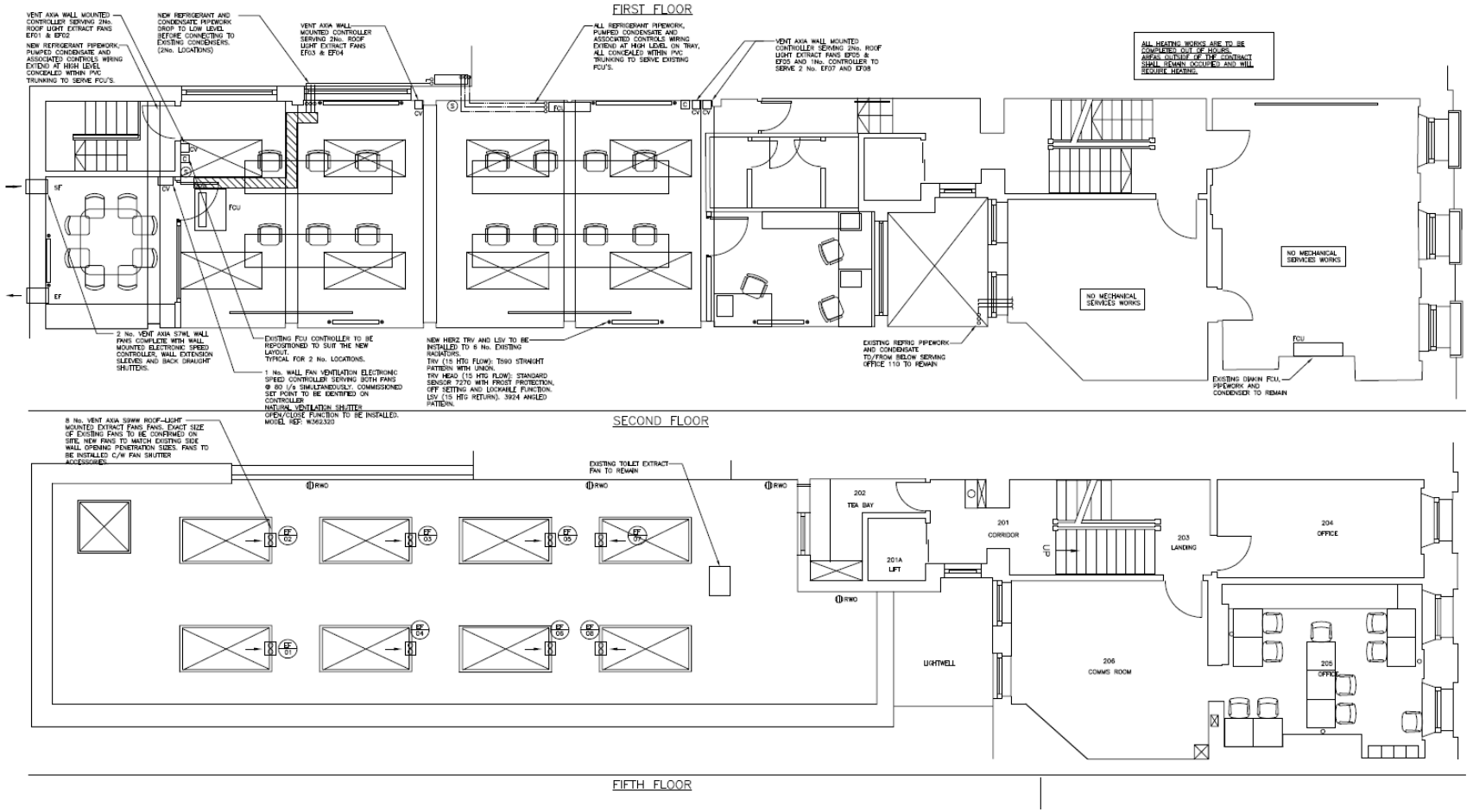
Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 86548

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 43066 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Plant Location

Roof over first floor:



Appendix D: Plant Data

Plant noise data used in the preceding assessment follow.

Table 10: Manufacturer's plant sound pressure data, dB re $2x10^{-5}$ Pa

Plant	Distance (m)	Octave Band Centre Frequency (Hz)								L_{PA}
		63	125	250	500	1k	2k	4k	8k	
Vent-Axia S9WW*	3	37	37	36	35	34	32	29	29	39
Vent-Axia S7WL*	3	29	29	28	27	26	24	21	21	31

* The sound pressure spectrum for this unit has been estimated based upon the manufacturer's single figure broadband value.

Appendix E: Calculations

Nearest Residential to roof over first floor:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB	Façade correction	dB
1	Meeting room 107	3.00	29	29	28	27	26	24	21	21	31	49	2.0	-14	35	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
2	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	8.0	-26	31	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
3	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	11.0	-29	28	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
4	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	15.0	-32	25	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
5	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	18.0	-33	24	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	41	41	40	39	38	36	33	33	43
2	Extract fan	36	36	35	34	33	31	28	28	39
3	Extract fan	34	34	33	32	31	29	26	26	36
4	Extract fan	32	32	31	30	29	27	24	24	34
5	Extract fan	30	30	29	28	27	25	22	22	32
	Total	**43**	**43**	**42**	**41**	**40**	**38**	**35**	**35**	**45**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				2.0	-0.76	0	0	0	0	0	0	0	0
1.0				8.0	-0.94	0	0	0	0	0	0	0	0
1.0				11.0	-0.95	0	0	0	0	0	0	0	0
1.0				15.0	-0.97	0	0	0	0	0	0	0	0
1.0				18.0	-0.97	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
36	64	53	45	40	36	33	31	29	45

Barrier SRI		63	125	250	500	1k	2k	4k	8k	Rw
	Manual									0
	Unknown	100	100	100	100	100	100	100	100	101

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	-23	-13	-6	-1	2	2	2	3	-2
2	Extract fan	-27	-17	-10	-5	-3	-2	-2	-1	-6
3	Extract fan	-30	-19	-12	-8	-5	-4	-5	-3	-8
4	Extract fan	-32	-22	-15	-10	-7	-7	-7	-6	-11
5	Extract fan	-34	-23	-17	-12	-9	-8	-9	-7	-13
	Total	-21	-10	-3	1	4	5	4	6	1

Barrier Deration		Meeting room 107	0	0	0	0	0	0	0	0
		Extract fan	0	0	0	0	0	0	0	0
		Extract fan	0	0	0	0	0	0	0	0
		Extract fan	0	0	0	0	0	0	0	0
		Extract fan	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	41	41	40	39	38	36	33	33	43
2	Extract fan	36	36	35	34	33	31	28	28	39
3	Extract fan	34	34	33	32	31	29	26	26	36
4	Extract fan	32	32	31	30	29	27	24	24	34
5	Extract fan	30	30	29	28	27	25	22	22	32
	Total	**43**	**43**	**42**	**41**	**40**	**38**	**35**	**35**	**45**

Net barrier loss		Meeting room 107	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Nearest Commercial to roof over first floor:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB	Façade correction	dB
1	Meeting room 107	3.00	29	29	28	27	26	24	21	21	31	49	24.0	-36	13	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
2	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	8.0	-26	31	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
3	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	12.0	-30	27	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
4	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	15.0	-32	25	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3
5	Extract fan	3.00	37	37	36	35	34	32	29	29	39	57	19.0	-34	23	2	3	None	0	0	0	0	0	0	0	0	1	3	Yes	3

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	20	20	19	18	17	15	12	12	22
2	Extract fan	37	37	36	35	34	32	29	29	40
3	Extract fan	34	34	33	32	31	29	26	26	36
4	Extract fan	32	32	31	30	29	27	24	24	34
5	Extract fan	30	30	29	28	27	25	22	22	32
	Total	**43**	**43**	**42**	**41**	**40**	**38**	**35**	**35**	**46**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				24.0	-0.98	0	0	0	0	0	0	0	0
1.0				8.0	-0.94	0	0	0	0	0	0	0	0
1.0				12.0	-0.96	0	0	0	0	0	0	0	0
1.0				15.0	-0.97	0	0	0	0	0	0	0	0
1.0				19.0	-0.97	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
47	73	63	56	51	47	44	42	40	55

Barrier SRI						63	125	250	500	1k	2k	4k	8k	Rw
					Manual									0
					Unknown	100	100	100	100	100	100	100	100	101

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	-53	-43	-37	-33	-30	-29	-30	-28	-33
2	Extract fan	-35	-25	-19	-15	-13	-12	-13	-11	-15
3	Extract fan	-39	-29	-23	-19	-16	-15	-16	-14	-19
4	Extract fan	-41	-31	-25	-21	-18	-17	-18	-16	-21
5	Extract fan	-43	-33	-27	-23	-20	-19	-20	-18	-23
	Total	-29	-20	-13	-9	-7	-6	-7	-5	-9

Barrier Deration						Meeting room 107	0	0	0	0	0	0	0	0
						Extract fan	0	0	0	0	0	0	0	0
						Extract fan	0	0	0	0	0	0	0	0
						Extract fan	0	0	0	0	0	0	0	0
						Extract fan	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Meeting room 107	20	20	19	18	17	15	12	12	22
2	Extract fan	37	37	36	35	34	32	29	29	40
3	Extract fan	34	34	33	32	31	29	26	26	36
4	Extract fan	32	32	31	30	29	27	24	24	34
5	Extract fan	30	30	29	28	27	25	22	22	32
	Total	**43**	**43**	**42**	**41**	**40**	**38**	**35**	**35**	**46**

Net barrier loss						Meeting room 107	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
						Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
						Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
						Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
						Extract fan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Appendix F: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

'A' Weighting
Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).
Airborne Noise
Noise transmitted through air.
Ambient Noise
The total noise level including all 'normally experienced' noise sources.
dB or Decibel
Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

$D_{nTw}+C_{tr}$	
The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.	
D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.

C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.

L_{Amin}

The 'A' weighted minimum measured noise level.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

Subjective Effect of Changes in Sound Pressure Level

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.