Acoustic Consultancy Report

78322/3/1/4

External Plant Assessment

Report Prepared For

Long & Partners Ltd
Corinthian House, Tottenham Court Road
16 June 2016

Issued By

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Contents

i) Executive Summary

New mechanical plant is proposed to be installed at Corinthian House, Tottenham Court Road, as part of the sensitive refurbishment of the office element of the building.

LCP has been commissioned by Long and Partners 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:

Day:	48 dB $L_{Aeq,T}$ at 27m, Centre Point;
Evening:	47 dB $L_{Aeq,T}$ at 27m, Centre Point;
Night:	41 dB $L_{Aeq,T}$ at 27m, Centre Point.

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

The design as proposed and assessed will achieve the required criteria provided the mitigation detailed in section 5 of this report is implemented; the calculated rating levels are as follows:

Day:	40 dB $L_{Aeq,T}$ at 27m, Centre Point;
Evening:	40 dB $L_{Aeq,T}$ at 27m, Centre Point;
Night:	40 dB $L_{Aeq,T}$ at 27m, Centre Point.

This report concludes that the design criteria will be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By
1	13/06/16	Initial Issue – survey results	MB
2	15/06/16	Planning issue – with plant	MB
3	16/06/16	DP9 comments incorporated	MB

1 Introduction

New mechanical plant is proposed to be installed at Corinthian House, Tottenham Court Road in London.

LCP has been commissioned by Long and Partners 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 in this report is on the basis that the mechanical plant will be consistently operating over a 24 hour period.

2 Survey

2.1 Site Description

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

2.2 Receiver Location

The site was surveyed to determine the location of the most affected receiver. The nearest receiver with direct line of sight to the plant area is Centre Point Tower, approximately 27m to the south of the site. This is shown in both the site plan in Appendix A and the photograph 'looking south' in Appendix B.

2.3 Local Noise Climate

The predominant local noise sources were traffic from the A40 and A400 and to a lesser extent construction activities.

2.4 Measurements

The noise monitoring took place on the 9th to the 10th June 2016. 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	2m/s
Wind Direction	ESE
Cloud Cover	50%
Max. Temperature	23°C
Min. Temperature	14°C
Precipitation	None

2.5 Measurement Results

The measured statistical broad-band sound pressure levels are shown within Appendix C. 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*	$L_{A90,\ 15\ mins}$ Evening*	$L_{A90,\ 15\ mins}$ Night*
MP1	58	57	51

* Day, Evening and Night periods are defined as between 07:00 - 19.00, 19.00 - 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
Outdoors in parkland and conservation areas*	-	-	-

* 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

Camden Development Policies 2010-2025 Local Development Framework - DP28. Noise and vibration - Table E, contains the following criteria applicable to noise levels from plant and machinery.

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	55dBL_{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
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) $L_{Aeq, 12\ hr}$	Design Level (Evening) $L_{Aeq, 4\ hr}$	Design Level (Night) $L_{Aeq, 8\ hr}$
Centre Point	27	48	47	41

4 Review of Current Design

Plant used in this assessment are contained within Appendix D.

The proposed plant shall be located as shown in Appendix F.

The guidance in this report is on the basis that the mechanical plant will be consistently operating over a 24 hour period.

Limiting levels have been set for the 5 tenants comms rooms units, the limiting level for each unit is shown in Appendix D.

5 Noise Mitigation Scheme

It is necessary to introduce a suitable noise mitigation scheme by means of atmosphere side attenuators on the AHU intake and exhaust, which are shown in the table below:

Table 9: Attenuator selections

Attenuator Reference	Width (mm)	Height (mm)	Length (mm)	Percentage Free Area	Air Volume Through m^3/s
Intake	2260	1100	450	20%	3.7
Exhaust	2260	1100	450	20%	3.7

The manufacturer/supplier of any attenuators shall ensure that the air volumes through all attenuators and the configurations of the attenuators will not create regenerated noise. Alternative configurations may have to be selected.

5.1 Mitigated Results

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

The design rating levels to be adopted for this project, together with the predicted noise levels inclusive of the mitigation detailed in Section 5, are set out in the table below.

Table 10: Design and predicted mitigated rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq, 12\ hr}$	Design Level (Evening) $L_{Aeq, 4\ hr}$	Design Level (Night) $L_{Aeq, 8\ hr}$	Predicted Level $L_{Aeq,T}$
Centre Point	25	48	47	41	40

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

Calculations are shown within Appendix E.

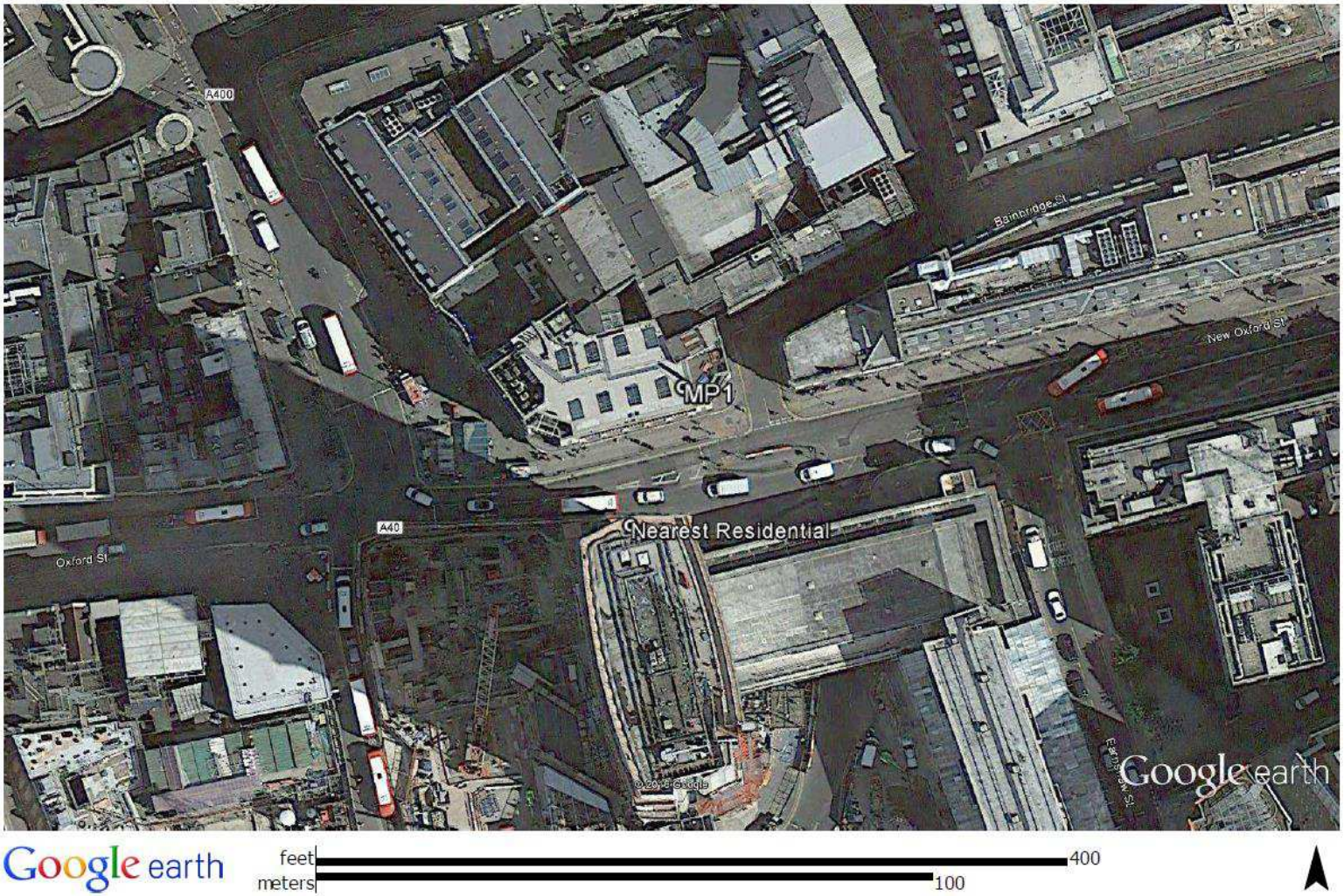
6 Conclusion

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 with the implementation the noise mitigation measures detailed in section 5 of this report the design criteria will be met.

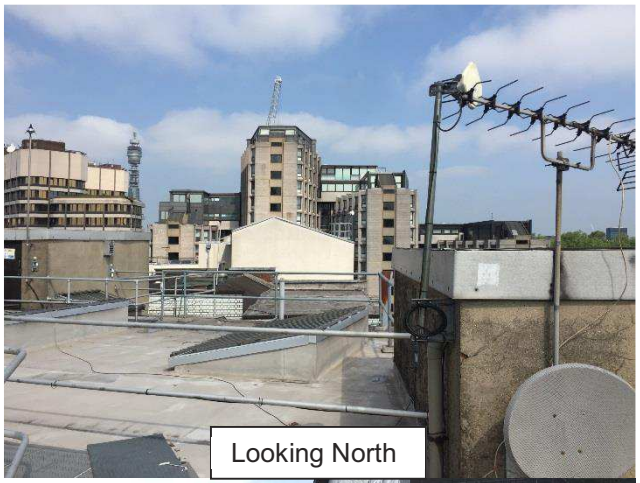
All new mechanical plant will be installed to meet the above design criteria.

Appendix A: Site Plan

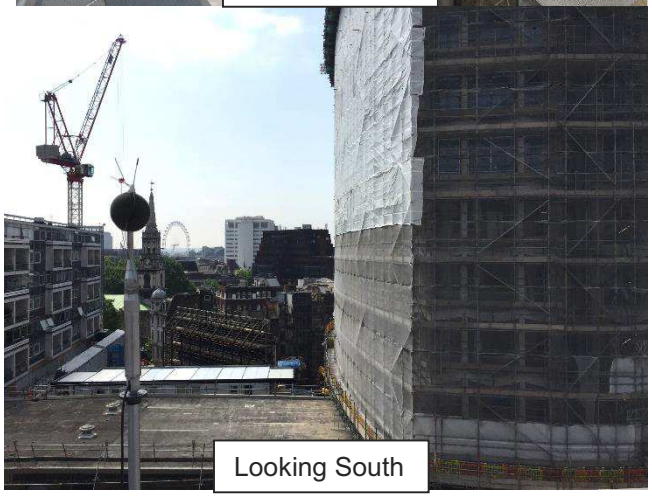


Approximate measurement position (Latitude & Longitude) 51.516558, -0.129681.

Appendix B: Photographs



Looking North

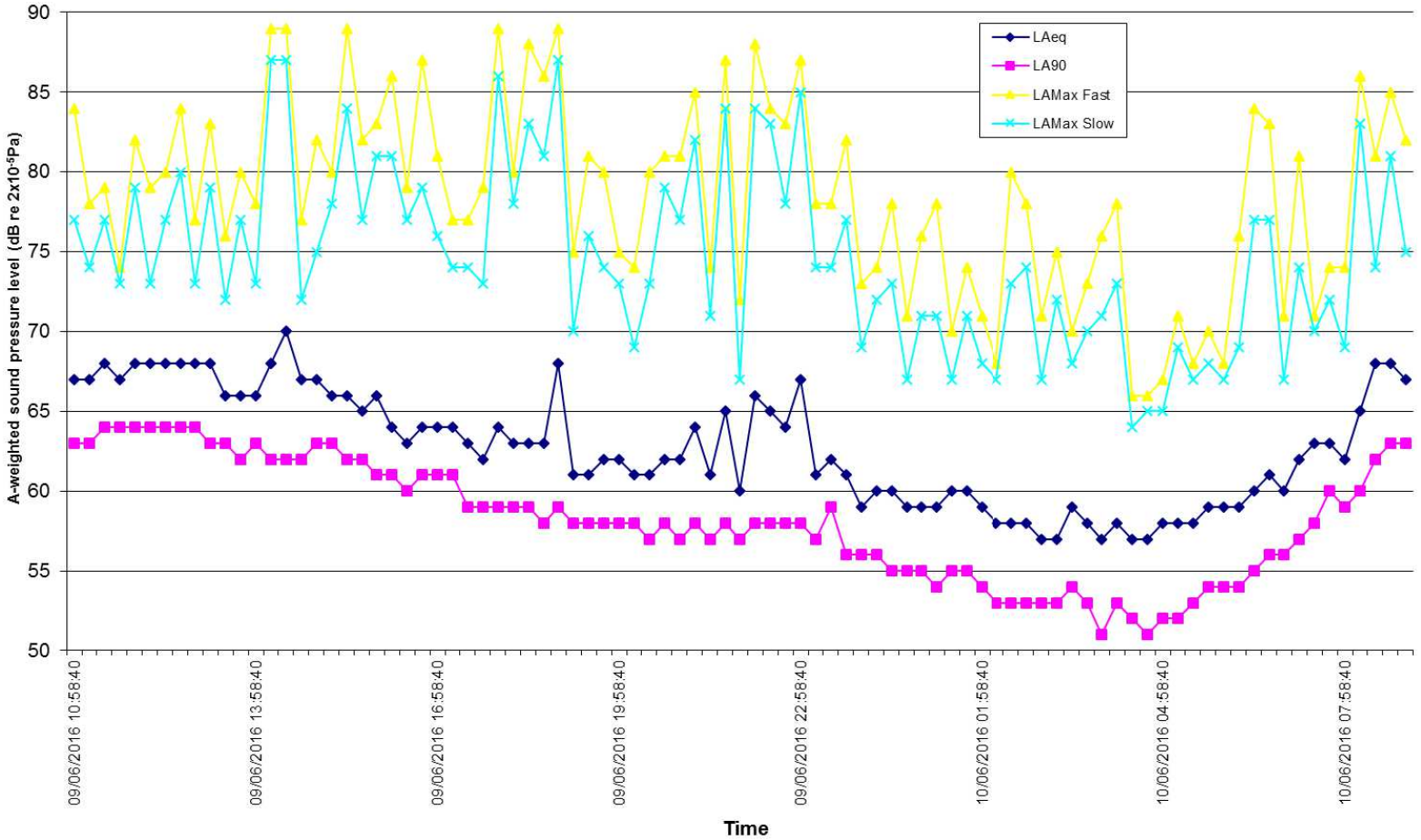


Looking South

Looking East

Looking West

Appendix C: 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: 11205
- Svantek pre-amplifier SV12L S/N: 13245 with GRAS microphone capsule 40AE S/N: 75181

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10893 complying with Class 1 specification of BS EN 60942:2003, calibration level 94.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix D: Plant Data

Plant noise data used in the preceding assessment follow.

Table 11: Plant sound power data, dB re 10^{-12} W

Plant	Octave Band Centre Frequency (Hz)								L_{WA}
	63	125	250	500	1k	2k	4k	8k	
AHU intake	73	73	83	85	85	82	78	75	89
AHU exhaust	69	70	77	82	82	81	78	71	87
WC extract	72	68	71	72	70	66	60	53	74

Table 12: 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	
Condensers (each)	1	66	65	67	64	59	55	50	44	65
Tenants Limiting Level (each)	1	56	55	57	54	49	45	40	34	55

Appendix E: Calculations

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw)									Lw	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB
			63	125	250	500	1k	2k	4k	8k	dB(A)	dB(A)																
1	AHU intake		73	73	83	85	85	82	78	75	89	89	32.00	-38	51	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3
2	AHU exhaust		69	70	77	82	82	81	78	71	87	87	29.00	-37	50	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3
3	WC extract		72	68	71	72	70	66	60	53	74	74	34.00	-39	36	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3
4	Condensers	1	66	65	67	64	59	55	50	44	65	73	37.00	-39	34	6	8	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3
5	Tenants LL	1	56	55	57	54	49	45	40	34	55	63	27.0	-37	27	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3

Ref.	plant	Receiver Lp before additional mitigation								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	AHU intake	32	32	42	44	44	41	37	34	48
2	AHU exhaust	29	30	37	42	42	41	38	31	47
3	WC extract	30	26	29	30	28	24	18	11	33
4	Condensers	39	38	40	37	32	28	23	17	39
5	Tenants LL	31	30	32	29	24	20	15	9	31
	Total	**41**	**40**	**45**	**47**	**46**	**44**	**40**	**36**	**51**

Criteria									
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
32									41

Ref.	Plant	Excess								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	AHU intake	-29	-18	0	8	12	12	10	9	7
2	AHU exhaust	-32	-20	-5	6	10	12	11	6	6
3	WC extract	-30	-23	-12	-6	-4	-5	-8	-14	-8
4	Condensers	-21	-11	-1	1	0	-1	-3	-8	-2
5	Tenants LL	-29	-19	-9	-7	-8	-9	-11	-16	-10
	Total	-19	-9	4	11	14	15	14	11	10

Duct Losses								
63	125	250	500	1k	2k	4k	8k
-6	-5	-6	-7	-8	-8	-8	-8
-2							

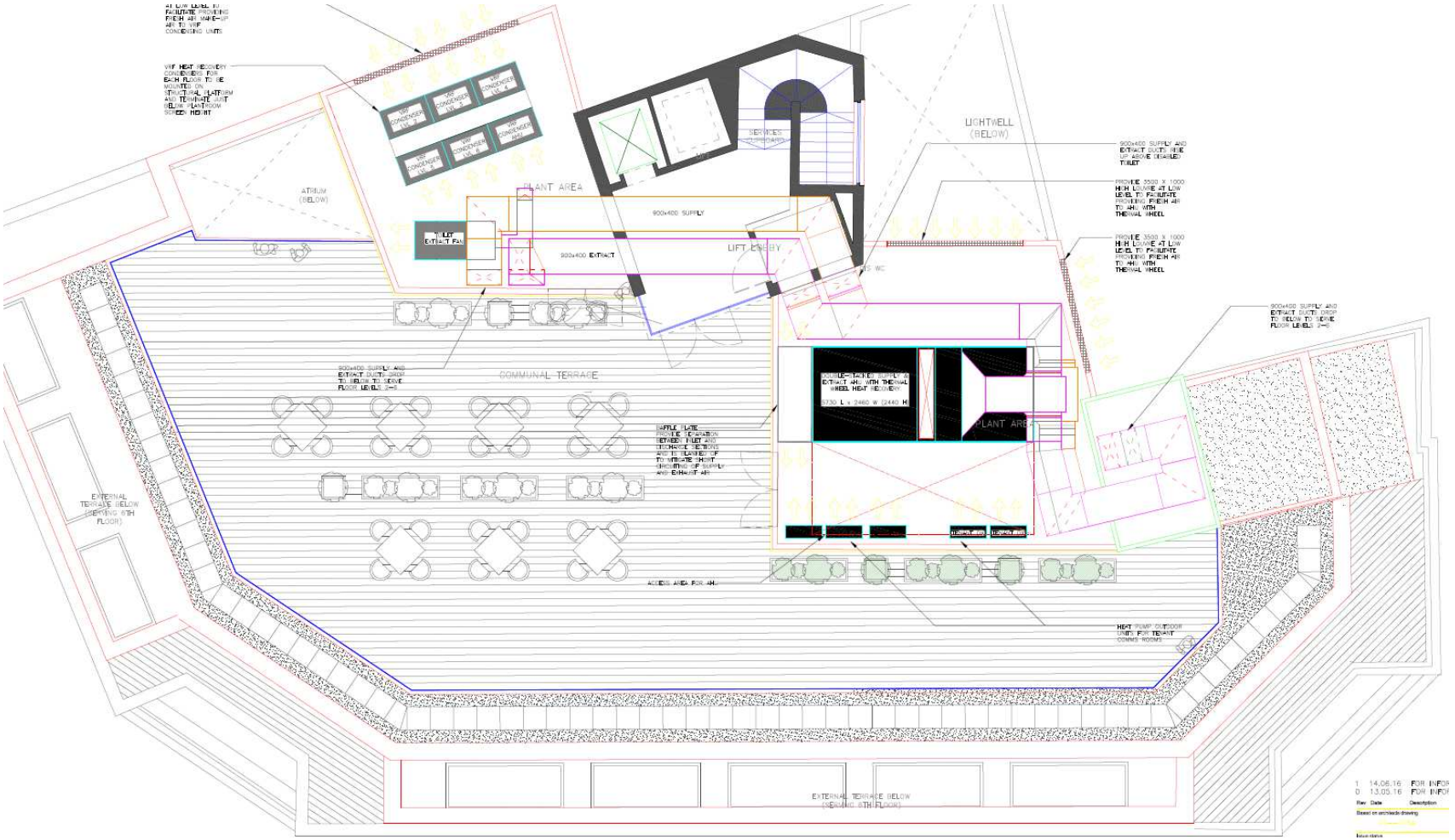
Ref.	Plant	Mitigated Receiver Lp								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	AHU intake	22	22	23	10	8	13	13	11	20
2	AHU exhaust	23	25	24	15	14	21	22	16	27
3	WC extract	30	26	29	30	28	24	18	11	33
4	Condensers	39	38	40	37	32	28	23	17	39
5	Tenants LL	31	30	32	29	24	20	15	9	31
	Total	**41**	**40**	**41**	**39**	**34**	**31**	**27**	**21**	**40**

	63	125	250	500	1k	2k	4k	8k	dB(A)
Criteria									41
Excess									-1

Attenuation								
63	125	250	500	1k	2k	4k	8k
4	5	13	27	28	20	16	15
4	5	13	27	28	20	16	15

2260*1100*450
2260*1100*450

Appendix F: Plant layout



Appendix G: 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.