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Project:

UCL Central House, 2nd Floor

Title:

Plant noise impact assessment

quietly moving forward

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Revision	Date	Author	Checked
0	23/06/17	Stefan De Vito	Tim Meed

CONTENTS:

1 INTRODUCTION

1.01 Environmental Equipment Corporation Limited has been commissioned by Fowler Martin to undertake a noise assessment of a bespoke Air Handling Unit (AHU) to serve Central House, part of the University College London campus.

1.02 This noise assessment has been conducted in accordance with the policies and requirements of London Borough of Camden Council (LBCC) and is based on a noise survey carried out at the site over a typical weekday period.

1.03 This assessment includes:

- the setting of plant noise limits in accordance with the requirements of LBC and national planning policy, standards and guidance; and
- the prediction of noise impacts at the worst affected noise sensitive receptors based on the proposed items of plant and their location.

1.04 This report is prepared solely for Fowler Martin. Environmental Equipment Corporation Limited accepts no responsibility for its use by any third party.

1.05 Whilst every effort has been made to ensure that this report is easy to understand, it is necessarily technical in nature. To assist the reader, an explanation of the terminology used in this report is contained in Appendix A.

2 SITE

2.01 UCL Central House is a seven-storey University building part of the UCL campus in a mixed commercial and residential area near Euston Station. The rear of this building has a courtyard facing Ambassadors Bloomsbury Hotel.

2.02 The property is bound by the following:

- North – St Pancras Parish Church;
- East – Four-storey residential buildings along Dukes Road;
- South – The Ambassadors Bloomsbury Hotel a seven-storey hotel complex with restaurants on the ground floor; and
- West – Upper Woburn Place with the Hilton London Euston Hotel a six-storey hotel complex beyond.

2.03 This application is for 1 No. bespoke *FläktWoods* Air Handling Unit which is to be located internally. This will intake air from, and exhaust to, the courtyard area at the rear of the building, as presented in Appendix B.

2.04 The closest noise sensitive receptor to the proposed plant item is the northeast facing first-floor window of the Ambassadors Bloomsbury Hotel.

2.05 All other noise sensitive receptors are at a greater distance from the proposed location of the units, or are protected by more screening by the intervening structures, and as such will be subject to lower levels of noise.

3 GUIDANCE

3.01 Local and National Planning Policy for London Borough of Camden Council (LBCC) are presented in Appendix C of this document.

3.02 A summary of the pertinent points relating to this application are presented below.

Noise from new plant affecting existing residential amenity is considered to be acceptable where:

- Daytime - its rating level is at least 10dB less than the existing background noise (in Gardens and at the facades of noise sensitive dwellings)
- Night time - its rating level is at least 10dB less than the existing background noise (at the facades of noise sensitive dwellings)
- Plant should be designed to be 15dB less than the background noise if and where it contains distinguishing tonal characteristics.

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a weekday period, between 1155 hours on Wednesday 17th May 2017 and concluded 0900 hours the following Friday, to establish the existing noise levels at the site. The survey methodology and results are set out below.

4.02 Noise measurements have been carried out at the following position, as shown in Appendix B and described as being located approximately 1.5 metres above the courtyard area. The measurement was approximately 2 metres from a reflecting surface, other than the mounding surface. Therefore a - 3 dB correction has been applied to all measured noise levels.

4.03 This position is considered to be representative of the nearest windows to the proposed plant location.

5 EQUIPMENT

5.01 Equipment for the survey was as follows:-

- Brüel & Kjær type 2250 Light Integrating Sound Level Meter conforming to Class 1 BS EN 61672, Type 1 BS EN 60804 & BS EN 60651: 1994.
- Brüel & Kjær Outdoor Microphone, type 4952/UA1679;
- Tripod.

5.02 The equipment holds current UKAS or equivalent accreditation and serial numbers as follows:

Sound Level Meter B&K2250L	Serial No.	2766725
	Calibration Date	28th July 2015
	Cal Certificate No.	U19314
Outdoor ½" Condenser Mic. B&K 4952	Serial No.	2751633
	Calibration Date	28th July 2015
	Cal Certificate No.	19313
Calibrator B&K4231	Serial No.	2389051
	Calibration Date	24th October 2016
	Cal. Certificate No.	U22948

N.B. Copies of calibration certificates are available upon request.

5.03 The equipment was calibrated both before and after the survey with no difference noted in the levels.

6 RESULTS

6.01 The weather during the survey was suitable for noise measurement, with sporadic light rain during the day with little wind for the duration of the survey. The periods of light rainfall are not considered to have affected the results of the survey.

6.02 Noise sources at the site were dominated by local plant serving the neighbouring hotel, this plant was in operation continuously.

6.03 A list of the levels measured is included in Appendix D and represented graphically in Appendix E.

6.04 A summary of the time averaged ambient levels and lowest measured background levels over the measurement periods are shown in Table 6.1. The minimum L_{A90} is the lowest five-minute measurement in the specified period.

Position	Period	Average $L_{Aeq,T}$ – dB	Minimum L_{A90} – dB
1	Day time (0700-1900 hrs)	55	51
	Evening (1900-2300 hrs)	55	52
	Night-time (2300-0700 hrs)	53	51

Table 6.1: Free-Field Measured Ambient and Lowest Background Noise Levels

7 PLANT ASSESSMENT

7.01 This application is for the installation of a bespoke *FläktWoods* Air Handling Unit to be located internally at second floor level, this will intake air from, and exhaust to, the courtyard area at the rear of the building.

7.02 Based on the standard requirements of LBCC and the lowest measured background noise level in each time period, Table 7.1 sets out the recommended noise limits that the proposed items of plant should meet.

7.03 Please note, that in accordance with the requirements of LBCC, the proposed noise limits are based on being 10 dB below the measured background noise level.

Location	Period	Measured Existing $L_{A90,T}$	Proposed Noise Limit L_{Ar}
1	Day	51 dB	41 dB
	Evening	52 dB	42 dB
	Night	51 dB	41 dB

Table 7.1: Suggested Plant Noise Emission Limits Based on Lowest Measured L_{A90}, Free-field dB

7.04 Note that the limits suggested above are rating levels and as such any design should take into account the acoustic characteristics of the plant. In this instance, the proposed units display none of the characteristics whereby the acoustic correction should be applied.

7.05 Assuming the proposed items meet the noise limits set out in Table 7.1 noise will be below the NOEL with respect to the NPPF.

7.06 The proposed AHU unit has the manufacturers stated sound power levels as set out in Table 7.2.

	Sound Power level per octave band (dB)								LwA
Octave band (Hz)	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
Fresh Air Inlet	52	55	74	60	48	54	52	46	65
Supply Air	66	66	70	65	67	67	66	62	73
Extract Air	53	56	72	62	50	55	53	48	66
Exhaust Air	68	68	73	69	71	71	71	69	78
Breakout Noise	50	54	66	47	33	45	42	30	58

Table 7.2: *FläktWoods* bespoke AHU noise data

7.07 The AHU is to be located internally and is to be fitted with attenuators on the atmosphere side duct terminations. These are the Fresh Air Inlet and Exhaust.

7.08 Predicted noise levels have been calculated at the closest noise sensitive windows, the northeast facing first-floor window of the Ambassadors Bloomsbury Hotel.

7.09 Other residential receptors located further from the site will be subject to lower noise levels than those predicted at the above locations.

7.10 Tables 7.3 – 7.6 present the results of worst-case plant noise predictions at the worst-case locations.

Item	Noise Level	Notes
Fresh Air Inlet	65 dB(A)	In-duct sound power level
Distance Losses over 8 m	- 29 dB	Distance to closest window
Noise control	- 10 dB	EEC Attenuator
Reflections	+ 6 dB	Additional reflections - back wall and side wall
Total Noise Level	32 dB(A)	Ambassadors Bloomsbury Hotel

Table 7.3: First-floor window of the Ambassadors Bloomsbury Hotel Plant Noise Calculation

Item	Noise Level	Notes
Exhaust air	78 dB(A)	In-duct sound power level
Distance Losses over 9 m	- 30 dB	Distance to closest window
Noise control	- 14 dB	EEC Attenuator
Reflections	+ 6 dB	Additional reflections - back wall and side wall
Total Noise Level	40 dB(A)	Ambassadors Bloomsbury Hotel

Table 7.4: First-floor window of the Ambassadors Bloomsbury Hotel Plant Noise Calculation

Item	Noise level
Fresh Air Inlet	32 dB(A)
Exhaust Air	40 dB(A)
Total Noise Level	**41 dB(A)**

Table 7.5: First-floor window of the Ambassadors Bloomsbury Hotel Plant Noise Calculation

Property	Period	Proposed Noise Limit L_{Ar}	Predicted $L_{Aeq,T}$	Exceedance of noise limit
Ambassadors Bloomsbury Hotel	Daytime	41 dB	41 dB	0 dB
	Evening	42 dB		- 1 dB
	Night-time	41 dB		0 dB

Table 7.6: Assessment of Predicted Noise Levels Based on Proposed Noise Limit, Free-field dB(A)

7.11 It can be seen from the above tables that the noise limits are not exceeded at any period of proposed operation.

7.12 Assuming that the proposed plant and attenuators are included in the installation, predicted noise levels will meet the requirements of the Local Authority during all periods of operation and at the closest noise sensitive receptors.

7.13 With respect to the NPPF, achieving the noise limits would be classified as being below the NOEL and meeting the limits of the LOAEL as defined by LBCC.

7.14 The proposals are therefore expected to meet the 'Green' criterion in line with LBCC Local Plan whereby noise emissions are considered to be acceptable.

8 CONCLUSIONS

8.01 Fowler Martin has appointed Environmental Equipment Corporation Limited to undertake a noise assessment for a proposed bespoke *FläktWoods* air handling unit that is to serve the Central House building on the UCL campus.

8.02 The assessment has been carried out in accordance with national planning guidance and the requirements of the LBCC, and is based on an environmental noise survey conducted at the site over a mid-week period.

8.03 A noise assessment has been undertaken to evaluate the potential noise impact of the proposed air handling unit at the closest existing noise sensitive receptors.

8.04 Plant noise limits have been set based on the methodology contained in BS4142, the results of a background noise survey and the requirements of LBCC, to control the noise from the proposed air handling unit. In accordance with the LBCC, the noise limit has been set 10 dB below the lowest measured background noise level.

8.05 Predictions have shown that the noise criterion is met at all assessment locations during all periods of the plant's proposed operation, assuming, the atmosphere side duct terminations are attenuated to levels shown in Table 7.5.

8.06 Assessing the site in accordance with the principles of the National Planning Policy Framework has shown that predicted noise levels would be below the level at which no effects are observed to occur, the NOEL and will be below the LOAEL as defined in LBCC's Local Plan, Appendix 3.

8.07 On the basis of this assessment it is considered that noise does not pose a material constraint to the operation of the air handling unit.

APPENDIX A

GLOSSARY OF TECHNICAL TERMS

TECHNICAL TERMS AND UNITS

Decibel (dB) - This is the unit used to measure sound. The human ear has an approximately logarithmic response to sound over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure levels, intensities and power levels. The logarithms used are to base 10; hence, an increase of 10 dB in sound pressure level corresponds to a doubling in perceived loudness of the sound.

Sound Power Level (SWL) - This is a function of the noise source alone and is independent of its surroundings. It is a measure of the amount of sound power output measured in decibels.

Sound Pressure Level (SPL) - This is a function of the source and its surroundings and is a measure of the sound pressure at a point in space. For example, a sound pressure level measured at 1 metre from a sound source of certain sound power in reverberant room will not be the same as the sound pressure level a 1 metre from the sound source measured in open space.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a range of approximately 20 Hz to 20 KHz and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For finer analysis, each octave band may be split into one-third octave bands.

"A" Weighting - A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used weighting is the "A" weighting. The "A" weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content.

Noise Rating (NR) Curves - The "A" weighted sound pressure level cannot be used to define a spectrum or to compare sounds of different frequencies. NR curves convey frequency information in a single-figure index. This is done by defining the maximum permissible sound pressure level at each frequency for each curve. To measure the noise rating of a given environment, the SPL is measured in octave or one-third octave bands and the noise rating is then the highest NR curve touched by the measured levels.

Intermittency and Time-Weighting - The degree of annoyance caused by a noise also depends on its duration and intermittency of a noise. Intermittent, impulsive or repetitive noises tend to be more annoying than continuous noises. Various time-weightings have been derived to measure sounds of differing intermittences and these can be measured directly on modern equipment. The most common time-weightings in use are as follows:-

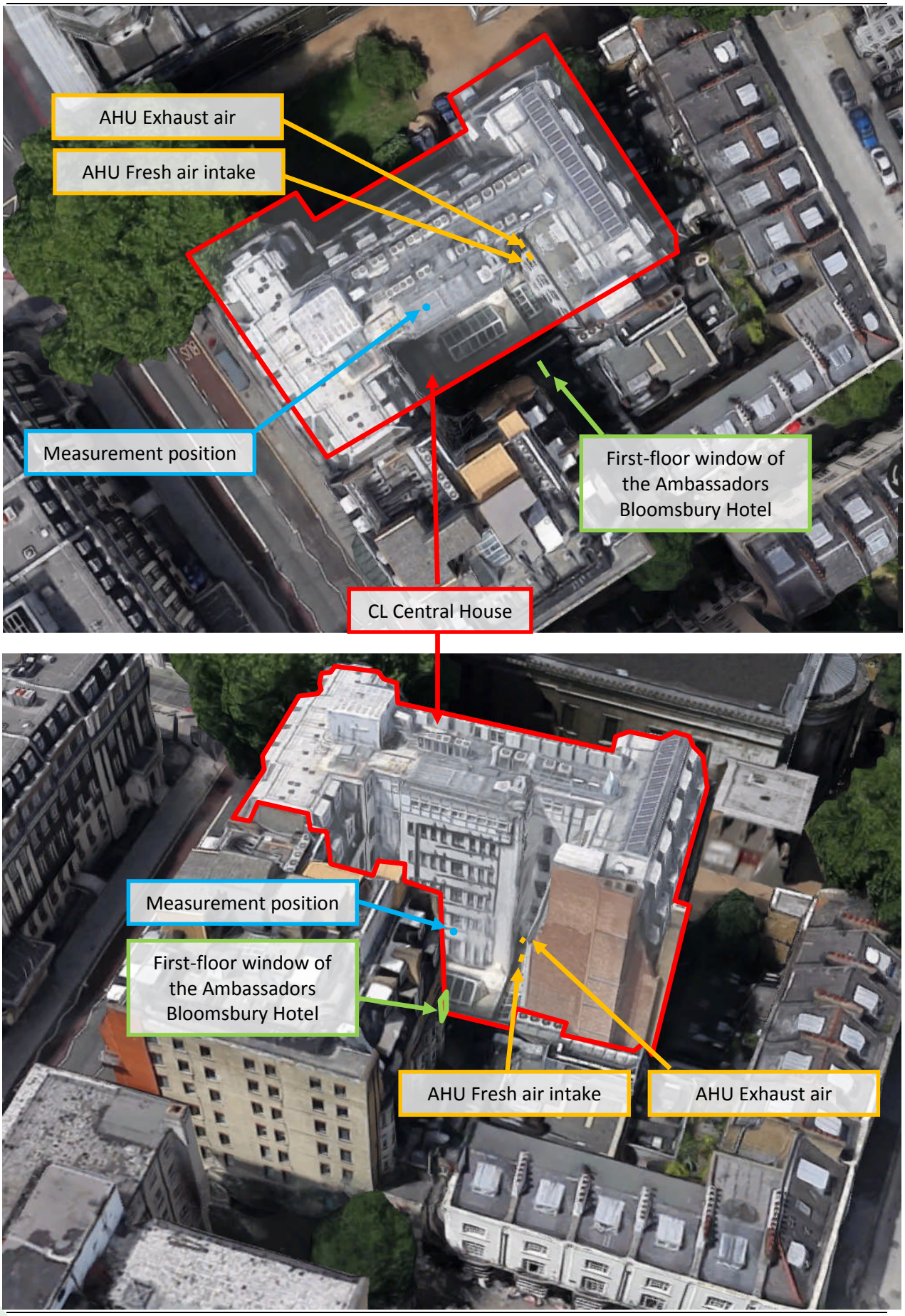
L_{90} This is the sound pressure level exceeded for 90% of the measurement period. It is widely used to measure background noise levels.

L_{10} This is the sound pressure level exceeded for 10% of the measurement period. It is widely used to measure traffic noise. For a given measurement period, the L_{10} level is by definition greater than or equal to the L_{90} level.

L_{eq} The equivalent continuous noise level is often used to measure intermittent noise. It is defined as the notional steady noise level that would contain the same acoustic energy as the varying noise. Because the averaging process used is logarithmic, the L_{eq} level tends to be dominated by the higher noise levels measured.

APPENDIX B

SITE PLAN
&
MEASUREMENT LOCATION



APPENDIX C

PLANNING POLICY AND GUIDANCE

PLANNING POLICY AND GUIDANCE

Planning Policy in the London Borough of Camden

London Borough of Camden's planning policy is set out in a range of documents that constitute its 'development plan'. This includes its **Local Plan** and proposed supplementary planning guidance (SPG's) documents. The Local Plan was adopted on 3 July 2017 and has replaced the 'Core Strategy' and 'Camden Development Policy' documents; as the basis for planning decisions and future development in the borough. The SPG's are in the process of being updated at time of writing (Sept 2017).

Policy A4 – *Noise and Vibration* outlines the following aims:

> *The Council will seek to ensure that noise and vibration is controlled and managed.*
>
> *Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*
>
> *We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.*

Appendix 3 of the Local Plan outlines noise thresholds for both noise generating and noise sensitive developments and identifies three basic design criteria upon which the acceptability of any proposal is likely to be assessed:

- Green – where noise is considered to be at an acceptable level.
- Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
- Red – where noise is observed to have a significant adverse effect.

In the context of National Planning Policy Framework and Noise Policy Statement for England, Camden Council consider the above criteria to fall into three associated categories in terms of their noise 'effects':

- LOAEL Green
- LOAEL to SOAEL Amber
- SOAEL Red

Table C of Appendix 3 defines the target noise levels for mechanical services plant and machinery:

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

National Planning Policy Framework and the Noise Policy Statement for England

The Department for Communities and Local Government published the National Planning Policy Framework (NPPF) on 27th March 2012 and upon its publication, the majority of planning policy statements and guidance notes were withdrawn, including Planning Policy Guidance 24 Planning and Noise, which previously presented the government's overarching planning policy on noise.

The NPPF contains four aims, which are set out at paragraph 123 in Section 11 of the document, titled *Conserving and enhancing the natural environment*:

> *"Planning policies and decisions should aim to:*
>
> *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
>
> *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
>
> *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
>
> *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

The Department for Environment Food and Rural Affairs published the Noise Policy Statement for England (NPSE) in March 2010. The explanatory note of NPSE defines the following terms used in the NPPF:

> *"NOEL – No Observed Effect Level*
>
> *This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
>
> *LOAEL – Lowest Observed Adverse Effect Level*
>
> *This is the level above which adverse effects on health and quality of life can be detected.*
>
> *2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.*
>
> *SOAEL – Significant Observed Adverse Effect Level*
>
> *This is the level above which significant adverse effects on health and quality of life occur."*

The NPSE does not define any of the above effect levels numerically.

The NPSE presents the Noise Policy Aims as:

> *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy and sustainable development:*
>
> *avoid significant adverse impacts on health and quality of life;*
>
> *mitigate and minimise adverse impacts on health and quality of life; and*
>
> *where possible, contribute to the improvement of health and quality of life."*

It can be seen that the first two bullet points are similar to Section 11 of the NPPF, with a third aim that seeks to improve health and quality of life. The NPSE later expands on the Noise Policy Aims, stating:

> *2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).*
>
> *2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.*
>
> *2.25 This aim* (the third aim)*, seeks where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."*

It is clear that noise described in the NPSE as SOAEL that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, termed the LOAEL, but not so high that it leads to significant adverse effects.

British Standard 4142

To assess the acceptability of the resultant noise levels we have consulted the relevant standards. BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' has been used to assess the likelihood any adverse impacts based on the resultant noise level from the new plant item, including any corrections for the character of the noise against the existing background noise level.

BS4142 gives guidance on assessing the likelihood of adverse impacts by calculating a 'rating level' of the new noise source and comparing its magnitude at noise sensitive locations to the existing or underlying background noise level. The background noise level is subtracted from the 'rating level' to assess the likelihood of complaints:

- The greater the difference the greater the likelihood of complaints.
- A difference of around +10dB or more is an indication of a significant adverse impact, depending on the context.
- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background noise level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low sound impact, depending on the context.

This assessment is carried out over a one hour period for the daytime and a fifteen minute period for the night-time. For the purposes of the standard it states that daytime and night-time are typically 07:00 to 23:00 hours and 23:00 to 07:00 hours respectively.

The 'rating level' of the noise source is obtained taking the following factors into consideration:

- The new plant noise (the specific noise) is measured or predicted in terms of L_{Aeq}.
- An additional correction shall be included if the noise contains a distinguishable, discrete continuous note, if the noise contains distinct impulses or if the noise is irregular enough to attract attention. The value for any tonal noise can be an addition of up to 6dB and for impulsive noise of up to 9dB.

BS 4142 goes onto state 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. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.'

BS4142 has been referenced in setting noise limits for any fixed plant proposed as part of the proposed development.

APPENDIX D

SURVEY RESULTS
(TABULAR)

EC 15431 - UCL Central House

Fowler Martin

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
11:55	55	66	53
12:00	55	66	55
12:05	55	65	55
12:10	56	61	55
12:15	55	58	54
12:20	55	58	54
12:25	55	59	54
12:30	55	57	54
12:35	55	57	54
12:40	55	60	54
12:45	54	60	53
12:50	56	73	53
12:55	54	60	53
13:00	55	59	54
13:05	55	60	54
13:10	55	63	54
13:15	55	60	54
13:20	55	60	54
13:25	55	60	54
13:30	55	59	54
13:35	56	63	54
13:40	57	72	54
13:45	54	60	54
13:50	55	67	53
13:55	54	61	53
14:00	54	62	53
14:05	54	62	53
14:10	54	55	53
14:15	53	55	53
14:20	54	65	53
14:25	55	60	54
14:30	54	56	54
14:35	55	62	54
14:40	55	59	54
14:45	55	62	54
14:50	54	58	54
14:55	54	57	54
15:00	54	59	54
15:05	55	63	54
15:10	56	67	54
15:15	54	62	53
15:20	53	57	53
15:25	53	63	52
15:30	54	64	53
15:35	54	62	53
15:40	54	60	53
15:45	54	59	53
15:50	54	63	53

Time	L_{Aeq}	L_{AMax}	L_{A90}
15:55	54	65	53
16:00	54	59	53
16:05	55	57	54
16:10	55	61	54
16:15	55	61	54
16:20	55	64	54
16:25	55	60	54
16:30	55	61	54
16:35	55	58	55
16:40	55	59	55
16:45	54	61	54
16:50	54	57	53
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18:45	55	58	54
18:50	55	59	54
18:55	56	60	55
19:00	56	63	55
19:05	56	60	55
19:10	56	61	55
19:15	56	62	55
19:20	55	59	55
19:25	56	60	55
19:30	56	60	55
19:35	55	62	55
19:40	55	60	54
19:45	55	61	54
19:50	56	60	55

EC 15431 - UCL Central House

Fowler Martin

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
19:55	55	61	55
20:00	56	59	55
20:05	56	60	55
20:10	55	61	54
20:15	55	60	54
20:20	54	59	53
20:25	55	60	54
20:30	55	60	54
20:35	54	61	54
20:40	54	58	54
20:45	55	60	54
20:50	55	61	54
20:55	55	61	54
21:00	54	59	53
21:05	54	58	53
21:10	54	59	54
21:15	54	57	53
21:20	54	59	53
21:25	54	60	53
21:30	54	59	53
21:35	53	58	52
21:40	53	59	52
21:45	53	55	52
21:50	53	55	52
21:55	53	56	52
22:00	53	54	52
22:05	53	59	52
22:10	53	55	53
22:15	53	58	53
22:20	53	56	53
22:25	54	56	53
22:30	54	57	53
22:35	53	59	52
22:40	53	56	52
22:45	53	55	52
22:50	53	55	52
22:55	53	55	52
23:00	52	57	52
23:05	52	58	51
23:10	53	56	52
23:15	53	56	52
23:20	53	56	52
23:25	53	56	52
23:30	53	57	52
23:35	53	59	52
23:40	53	56	52
23:45	53	56	52
23:50	53	55	52

Time	L_{Aeq}	L_{AMax}	L_{A90}
23:55	53	55	52
00:00	53	55	52
00:05	53	55	53
00:10	53	55	52
00:15	53	56	52
00:20	53	55	52
00:25	53	55	52
00:30	53	55	52
00:35	53	59	52
00:40	53	54	52
00:45	53	54	52
00:50	53	54	52
00:55	53	55	52
01:00	53	55	52
01:05	53	55	52
01:10	53	55	52
01:15	53	58	52
01:20	53	55	52
01:25	53	55	52
01:30	53	56	52
01:35	53	55	52
01:40	53	55	52
01:45	53	55	52
01:50	53	55	52
01:55	53	55	52
02:00	53	55	52
02:05	53	56	52
02:10	53	55	52
02:15	53	55	52
02:20	53	60	52
02:25	53	59	52
02:30	53	55	52
02:35	53	55	52
02:40	53	56	52
02:45	53	55	52
02:50	53	55	52
02:55	53	55	52
03:00	53	55	52
03:05	53	55	52
03:10	52	55	52
03:15	53	55	52
03:20	53	55	52
03:25	53	54	52
03:30	53	55	52
03:35	53	55	52
03:40	53	55	52
03:45	53	57	52
03:50	53	55	52

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
03:55	53	55	52
04:00	53	55	52
04:05	53	55	52
04:10	53	55	52
04:15	53	55	52
04:20	53	55	52
04:25	53	56	52
04:30	53	56	52
04:35	53	63	52
04:40	53	55	52
04:45	53	56	52
04:50	53	55	52
04:55	52	55	51
05:00	52	54	51
05:05	52	54	51
05:10	53	55	52
05:15	53	55	52
05:20	53	57	52
05:25	52	54	52
05:30	52	55	52
05:35	52	54	52
05:40	52	56	52
05:45	52	54	52
05:50	52	54	52
05:55	52	55	51
06:00	51	53	51
06:05	51	56	51
06:10	52	54	51
06:15	52	55	51
06:20	52	55	51
06:25	53	55	52
06:30	53	57	52
06:35	53	58	52
06:40	53	56	53
06:45	52	54	52
06:50	53	57	52
06:55	54	57	53
07:00	53	56	53
07:05	53	62	52
07:10	53	57	52
07:15	54	58	53
07:20	57	71	53
07:25	54	58	53
07:30	54	57	53
07:35	54	57	53
07:40	53	57	52
07:45	53	56	52
07:50	53	58	52

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:55	53	56	52
08:00	53	57	52
08:05	53	57	52
08:10	51	55	51
08:15	52	59	51
08:20	53	64	51
08:25	52	55	51
08:30	52	57	52
08:35	52	55	52
08:40	52	59	51
08:45	52	58	51
08:50	52	60	51
08:55	51	54	51
09:00	51	54	51
09:05	53	66	52
09:10	52	54	52
09:15	52	55	52
09:20	52	58	52
09:25	53	56	52
09:30	52	55	51
09:35	53	58	52
09:40	53	65	52
09:45	53	60	52
09:50	53	61	52
09:55	54	57	53
10:00	54	57	53
10:05	53	63	53
10:10	53	58	53
10:15	54	58	53
10:20	53	57	53
10:25	54	67	53
10:30	54	68	53
10:35	54	58	53
10:40	54	68	53
10:45	54	58	53
10:50	54	59	53
10:55	54	61	53
11:00	54	63	52
11:05	53	60	52
11:10	52	57	51
11:15	53	58	52
11:20	52	61	52
11:25	53	63	52
11:30	53	62	52
11:35	53	63	52
11:40	53	61	52
11:45	53	62	52
11:50	53	56	52

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
11:55	54	59	53
12:00	54	60	53
12:05	54	65	53
12:10	54	57	53
12:15	55	67	53
12:20	55	64	54
12:25	54	59	54
12:30	54	57	53
12:35	54	63	53
12:40	54	62	53
12:45	54	61	53
12:50	54	62	53
12:55	54	65	53
13:00	54	59	53
13:05	54	62	53
13:10	54	60	54
13:15	54	63	53
13:20	54	61	53
13:25	54	65	53
13:30	54	59	54
13:35	55	61	54
13:40	55	65	54
13:45	55	61	54
13:50	54	62	54
13:55	54	62	53
14:00	55	62	53
14:05	54	65	53
14:10	53	56	53
14:15	54	64	53
14:20	54	60	54
14:25	54	61	54
14:30	55	63	54
14:35	55	63	54
14:40	55	66	53
14:45	55	60	54
14:50	54	56	54
14:55	57	69	54
15:00	55	61	55
15:05	56	63	54
15:10	55	65	54
15:15	56	62	55
15:20	56	65	55
15:25	55	60	55
15:30	55	60	55
15:35	56	60	55
15:40	57	68	55
15:45	56	60	55
15:50	57	63	56

Time	L_{Aeq}	L_{AMax}	L_{A90}
15:55	57	68	55
16:00	56	65	55
16:05	56	59	55
16:10	56	60	55
16:15	56	61	55
16:20	56	59	55
16:25	55	58	55
16:30	56	61	55
16:35	56	58	55
16:40	56	59	55
16:45	56	62	55
16:50	57	68	55
16:55	56	63	55
17:00	56	65	55
17:05	56	66	55
17:10	56	62	55
17:15	56	59	55
17:20	57	70	55
17:25	56	59	55
17:30	56	63	55
17:35	57	63	55
17:40	56	62	55
17:45	56	64	55
17:50	58	73	55
17:55	56	60	55
18:00	56	66	55
18:05	56	59	55
18:10	56	63	55
18:15	56	62	55
18:20	57	68	55
18:25	55	59	55
18:30	56	60	55
18:35	56	60	55
18:40	56	61	55
18:45	56	60	55
18:50	56	60	55
18:55	56	60	55
19:00	55	60	55
19:05	56	60	55
19:10	56	61	56
19:15	57	64	56
19:20	57	72	56
19:25	56	60	55
19:30	56	61	55
19:35	56	60	55
19:40	56	60	55
19:45	55	59	55
19:50	56	59	55

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
19:55	56	59	55
20:00	56	60	55
20:05	58	74	55
20:10	56	59	55
20:15	55	59	54
20:20	56	60	55
20:25	56	60	55
20:30	56	60	55
20:35	56	59	55
20:40	56	60	55
20:45	55	58	54
20:50	55	59	54
20:55	55	61	53
21:00	56	70	54
21:05	54	57	54
21:10	55	58	54
21:15	55	58	54
21:20	55	59	54
21:25	54	57	54
21:30	55	59	54
21:35	55	59	54
21:40	55	59	54
21:45	55	59	54
21:50	55	59	54
21:55	54	60	54
22:00	54	58	54
22:05	55	59	54
22:10	55	59	55
22:15	55	60	55
22:20	55	58	55
22:25	55	59	55
22:30	55	58	54
22:35	55	58	54
22:40	55	60	54
22:45	55	59	54
22:50	55	59	54
22:55	55	59	54
23:00	54	59	54
23:05	54	57	53
23:10	54	60	53
23:15	54	60	53
23:20	54	58	53
23:25	54	59	53
23:30	54	58	53
23:35	54	59	53
23:40	54	57	53
23:45	54	57	53
23:50	54	58	53

Time	L_{Aeq}	L_{AMax}	L_{A90}
23:55	54	58	53
00:00	54	59	53
00:05	54	58	53
00:10	54	65	53
00:15	54	57	53
00:20	53	59	53
00:25	54	59	53
00:30	54	57	53
00:35	54	57	53
00:40	54	57	53
00:45	54	57	53
00:50	54	57	53
00:55	54	57	53
01:00	54	57	53
01:05	54	57	53
01:10	54	56	53
01:15	53	56	52
01:20	54	56	52
01:25	53	57	52
01:30	53	57	52
01:35	53	56	52
01:40	53	57	52
01:45	53	56	52
01:50	54	58	52
01:55	53	57	52
02:00	54	58	52
02:05	53	58	52
02:10	54	57	52
02:15	53	57	52
02:20	54	57	53
02:25	53	56	53
02:30	53	56	53
02:35	54	57	52
02:40	53	57	52
02:45	53	57	52
02:50	53	56	52
02:55	54	57	53
03:00	53	57	53
03:05	54	57	53
03:10	53	56	53
03:15	54	60	53
03:20	53	56	52
03:25	53	57	52
03:30	54	57	53
03:35	53	56	53
03:40	54	57	53
03:45	53	56	53
03:50	53	57	52

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
03:55	54	57	53
04:00	53	57	52
04:05	54	58	52
04:10	54	59	53
04:15	54	57	53
04:20	53	61	52
04:25	54	57	53
04:30	53	57	52
04:35	54	57	52
04:40	54	57	52
04:45	53	57	52
04:50	54	57	53
04:55	54	57	53
05:00	54	59	53
05:05	53	57	53
05:10	54	56	53
05:15	54	59	53
05:20	54	57	53
05:25	54	58	53
05:30	54	57	53
05:35	54	57	53
05:40	54	58	53
05:45	53	57	52
05:50	53	56	52
05:55	53	57	52
06:00	52	55	51
06:05	52	54	51
06:10	52	57	51
06:15	52	58	51
06:20	52	54	51
06:25	52	56	51
06:30	52	62	51
06:35	52	54	51
06:40	52	56	51
06:45	53	59	52
06:50	53	57	52
06:55	53	65	53
07:00	53	57	52
07:05	53	58	52
07:10	52	55	52
07:15	53	56	52
07:20	54	57	53
07:25	54	58	53
07:30	54	58	53
07:35	53	58	51
07:40	53	72	51
07:45	53	59	51
07:50	53	63	52

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:55	53	62	52
08:00	54	71	51
08:05	52	57	51
08:10	51	53	51
08:15	52	62	51
08:20	54	59	53
08:25	54	61	53
08:30	55	62	53
08:35	55	61	53
08:40	54	60	53
08:45	56	70	53
08:50	54	57	53
08:55	54	57	53
09:00	54	57	53

APPENDIX E

SURVEY RESULTS
(GRAPHICAL)

Noise Level Time History at UCL Central House