Emtec Products Ltd, Unit L Turnpike Way,
High Wycombe, Bucks, HP12 3TF

Telephone: 020 8848 3031 Fax: 020 8573 3605
Web: www.emtecproducts.co.uk Email: sales@emtecproducts.co.uk

RESULTS OF A 24-HOUR NOISE LEVEL SURVEY CARRIED OUT ON THE ROOF OF WOBURN HOUSE, 20-24 TAVISTOCK SQUARE, LONDON WC1 AND A REPORT ON THE NOISE CONTROL MEASURES REQUIRED TO MINIMISE THE NOISE IMPACT OF THE PROPOSED NEW AIR CONDITIONING PLANT

Test Engineer : M G Roberts

Report Author :

M G Roberts

Authorised for Release by :

I J Marchant

Client	:	360 Engineering Ltd
Project	:	Woburn House, 20-24 Tavistock Square, London WC1.
Emtec Ref.	:	QF8684/PF5724/RP1A
Original Issue	:	17th May 2016
First Revision	:	26th May 2016

RESULTS OF A 24-HOUR NOISE LEVEL SURVEY CARRIED OUT ON THE ROOF OF WOBURN HOUSE, 20-24 TAVISTOCK SQUARE, LONDON WC1 AND A REPORT ON THE NOISE CONTROL MEASURES REQUIRED TO MINIMISE THE NOISE IMPACT OF THE PROPOSED NEW AIR CONDITIONING PLANT

1.0. INTRODUCTION

This report details the results of a 24-hour noise survey carried out on the roof of the building known as Woburn House located at 20-24, Tavistock Square, London WC1.

The objectives of this survey were as follows:

- To assess the proposal that is to install new air conditioning condensers on the roof of the building.
- To identify the nearest properties that might be affected by plant noise.
- To establish the existing background noise level outside the nearest affected properties.
- To recommend noise limits and any necessary measures to ensure that the operation of the new plant does not disturb the occupants of the nearest affected properties.

This report has been divided into the following sections for ease of analysis:

2.0. SITE DESCRIPTION

Woburn House is a seven storey office building on the corner of Endsleigh Place/Tavistock Square and Upper Woburn Place. The ground and first floor have a stone frontage and the upper floors have brick facades. All floors have sash multi-paned windows. The front of the building, facing onto Endsleigh Place/Tavistock Square is shown on the attached photo A.

3.0. TEST INSTRUMENTATION

All measurement equipment used during the survey complied with the requirements of BS4142:2014 "Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas". Details of the equipment are as follows:

Integrating Sound Level Meter:	Rion type NL-52 class 1 Sound Level Meter fitted with a Rion type UC-59 ½ inch condenser microphone.
Statistical Analysis Modules:	Built in module capable of computing the percentile levels L1, L10, L50, L90 and L99 and also the Leq level.
Acoustic Calibrator:	Bruel & Kjaer type 4231 electronic calibrator. Serial No.: 1934160

Calibration was performed before and after the surveys and found to be, in all cases, +/- 0.1 dB from the reference source.

3.1. Existing Noise Climate

Road traffic travelling on nearby Upper Woburn Place and Endsleigh Place/Tavistock Square could be heard during the manned periods at the start and the end of the survey, so the noise levels measured will include contributions from road vehicles.

Commercial jet aircraft were observed at medium and high altitude during the manned periods at the start and the end of the survey, so it is possible that the noise levels measured could include contributions from medium altitude jet aircraft.

There are no overland railways nearby, so the noise levels measured will not include contributions from rail noise.

There were no other noticeable noise sources heard during the 24-hour noise survey period i.e. construction work.

We judged that road traffic noise to be the dominant source of noise affecting ambient noise levels.

4.0. TEST PROCEDURE

The survey was conducted during a continuous 24-hour period from 09:18am on Thursday the 12th of May 2016 to 09:03am on Friday the 13th of May 2016.

Data was continuously acquired throughout the measurement period with the individual averaging time for statistical noise data set to 15 minutes. The following 'A' weighted statistical measurements were recorded concurrently: -

LA_1 - The Sound Pressure Level exceeded for 1 of the measurement period.

LA_{10} - The Sound Pressure Level exceeded for 10 of the measurement period.

LA_{50} - The Sound Pressure Level exceeded for 50 of the measurement period.

LA_{90} - The Sound Pressure Level exceeded for 90 of the measurement period. LA90 is considered to represent the "background noise level" during the measurement period and is used for the assessment of noise to determine the likelihood of complaints (See BS 4142:2014).

LA_{99} - The Sound Pressure Level exceeded for 99 of the measurement period.

LA_{eq} - The continuous steady state Sound Pressure Level that has the same acoustic energy as the real fluctuating level.

4.1. Measurement Positions

Noise levels were measured on the roof of the building towards the back of the roof overlooking the parapet to the rear. The photos B and C show the location of the microphone which was fixed onto a tripod.

The microphone was pointing vertically and was approximately 1.2 metres above the roof level. The rest of the measurement equipment was located in a weatherproof enclosure with a low impedance cable running from the microphone to the instrumentation.

4.2. Weather Conditions

The weather conditions prevailing during the measurement period were generally in line with those recommended in BS 4142:2014: -

Weather daytime: -	Bright and Sunny	Weather night time: -	Clear
Wind daytime: -	Calm	Wind night time: -	Calm

The microphone was protected throughout the tests by an acoustically transparent wind balloon.

5.0. RESULTS AND EVALUATION OF NOISE CRITERIA

The raw test data, gathered during the noise survey, is given in Appendix 'A 'of this report.

The 'A' Weighted Leq levels measured over each 15 minute interval throughout the 24-hour period (denoted by LA_{eq}, (15 mins)) are displayed as a line graph on the attached Sketch No QF/8684/T1 at the back of this report.

The 'A' Weighted percentile levels measured over each 15 minute interval denoted by LA_{10} (15 mins), LA_{50} (15 mins) and LA_{90} (15 mins) are displayed as line graphs on the attached Sketch No QF/8684/T2 at the back of this report.

5.1. Summary of Results

The table QF/8684/D1 below summarises the noise levels taken over the 24-hour period in terms of the maximum and minimum Sound Pressure Levels recorded.

Table QF/8684/D1 – Summary of Maximum and Minimum Noise Levels

	LA_{eq}	LA_{1}	LA_{10}	LA_{50}	LA_{90}	LA_{99}
Minimum	49dBA	52.2dBA	50.4dBA	48.7dBA	46.7dBA	46.3dBA
Maximum	58.7dBA	70.1dBA	62.5dBA	58.1dBA	56.8dBA	56.5dBA

5.2. Summary of the Local Authority's planning requirements regarding noise for noise sensitive properties

Table E of Camden's current replacement Unitary Development Plan states that noise from external plant and machinery must be at least 5dB less than the lowest measured LA90 when measured at 1 metre external to the nearest sensitive façade.

Where the noise has a distinguishable discrete continuous note (whine, hiss, screech, hum) the Development Plan states that noise from external plant and machinery must be at least 10dB less than the lowest measured LA90 when measured at 1 metre external to the nearest sensitive façade.

Where the noise has distinct impulses (bangs, clicks, clatters, thumps) the Development Plan states that noise from external plant and machinery must be at least 10dB less than the lowest measured LA90 when measured at 1 metre external to the nearest sensitive façade.

Where the lowest background noise level exceeds 60dBA, then noise from external plant and machinery must be at least 55dBA when measured at 1 metre external to the nearest sensitive façade.

5.3. Determination of noise sensitive property design criteria

The new plant will not be intermittent or contain tones. Based on the local authority's planning requirements outlined above, the new plant should be designed to be 5dBA below the minimum existing LA_{90} background noise level during the relevant operational period.

It is proposed to operate the plant on an extended office hour basis (ie 8am to 10pm) with certain items of plant possibly operating over the full 24 hour period.

The lowest recorded LA_{90} level measured during the 8am to 10pm period was 50.1dBA and over the 24 hour period was 46.7dBA.

The new plant should therefore be designed to achieve 45.1dBA at 1 metre from the nearest noise sensitive properties' windows if the externally located equipment is to be operated between 8am and 10pm and 41.7dBA if operated on a 24-hour basis.

5.4. Determination of commercial design criteria

The uses of the commercial premises that surround the development site generally consist of offices. It is therefore proposed that the recommendations given in BS8233:1999, Section 7.6 be considered.

	Good	Reasonable
Open plan office: $L_{Aeq,T}$	45dBA	50dBA

We propose that the lower of these rating levels is adopted, i.e. 45dBA.

Assuming a 10dB noise reduction due to a partially open window, as per the lower limit of the range given in BS8233:1999 section 8.4.7, the rating level at 1 metre external to the nearest affected office windows would be 45dBA + 10dB = 55dBA.

5.5. Summary of external noise criteria

Based upon the results of the survey and the above design criteria we summarise the actual design rating levels to be adopted for this project in table QF/8684/D2: -

Table QF/8684/D2 – recommended design rating levels $L_{Ar,T}$

Type of premises	**$L_{Ar,T}$ (8am to 10pm)**	**$L_{Ar,T}$ (24-hour)**
Noise sensitive	45.1dBA	41.7dBA
Commercial	55 dBA	-

6.0. DISCUSSION OF RESULTS

It is proposed to locate three new air cooled condensers onto the roof of the building next to the existing condensers that can be seen in Photo C. The exact location of the new condensers is shown on the attached 360 Engineering drawing No.360-R-AC04.

The three condensers are Daikin units as listed in the table QF/8684/D3 together with their Sound Pressure levels at 1 metre in free field conditions: -

Table QF/8684/D3 – Noise Levels of Air Cooled Condensers.

Type of Condenser	No. Off	Sound Pressure Level (dB ref 2 x 10^{-5} N/m^2) 63	125	250	500	1k	2k	4k	8k	dBA
Daikin REYQ20T – 1 metre free field	1	65	65	67	65	60	57	52	45	66
Daikin REYQ18T – 1 metre free field	1	66	65	67	64	59	55	50	44	65
Daikin REYQ12T – 1 metre free field	1	59	66	60	62	53	49	44	37	61
Combined SPL at 1 metre free field		69	70	70	68	63	59	54	47	69

Note: - The above data was taken from Daikin's data book on the REYQT series of condensers.

The nearest residential window to the new condensers is located, as shown on the attached 360 Engineering drawing No.360-R-AC04, some 22 metres away at the rear of the Endsleigh Court flats.

The nearest office window is at the front of Woburn House, some 4 metres away from the condenser, again as indicated on the attached 360 Engineering drawing.

The tables QF/8684/D4 and QF/8684/D5 below show the noise levels that can be expected at 1 metre from the nearest residential and office windows:

Table QF/8684/D4 – Noise Level at 1 Metre from Nearest Residential Window

Source/Attenuation	Sound Pressure Level (dB ref 2 x 10^{-5} N/m^2) 63	125	250	500	1k	2k	4k	8k	dBA
Combined Free Field SPL of condensers	69	70	70	68	63	59	54	47	69
Reverberation of environment	+3	+3	+3	+3	+3	+3	+3	+3	
Distance Correction 10 log A_{21}/A_1	-21	-21	-21	-21	-21	-21	-21	-21	
Barrier Effect of edge of building (100mm)	-4	-6	-8	-10	-10	-10	-10	-10	
Noise Level at 1 metre from nearest residential window	47	46	44	40	35	31	26	19	41.6

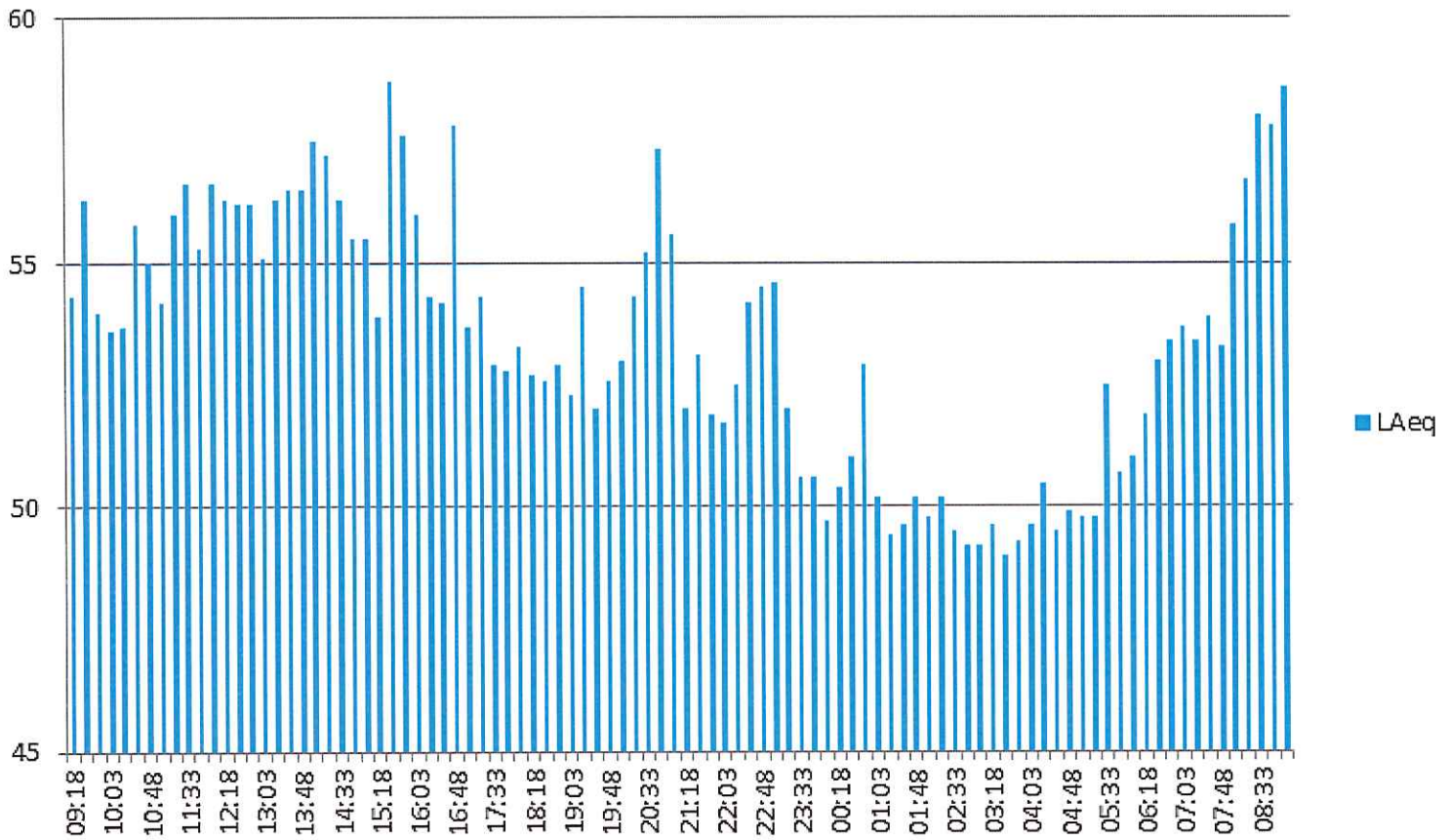
Table QF/8684/D5 – Noise Level at 1 Metre from Nearest Office Windows

Source/Attenuation	Sound Pressure Level (dB ref 2 x 10^{-5} N/m^2) 63	125	250	500	1k	2k	4k	8k	dBA
Combined Free Field SPL of condensers	69	70	70	68	63	59	54	47	69
Reverberation of environment	+3	+3	+3	+3	+3	+3	+3	+3	
Distance Correction 10 log A_4/A_1	-8	-8	-8	-8	-8	-8	-8	-8	
Barrier Effect of edge of building (500mm)	-8	-10	-12	-14	-16	-18	-18	-18	
Noise Level at 1 metre from nearest office window	56	55	53	49	42	36	31	24	49.8

Based upon the calculations in tables QF/8684/D4 and QF/8684/D5 the resultant noise levels at 1 metre from the nearest residential and the nearest office windows will fall below the recommended design rating noise levels for both daytime and 24 hour operation of the plant.

We would therefore conclude that no acoustic treatment will be required to the proposed new roof mounted air cooled condensers in order for them to satisfy the planning requirements of Camden Council.

EMTEC PRODUCTS LTD
26th May 2016



TITLE: *LAeq Levels*	*ISSUE DATE:* 16/05/2016			*DRAWN BY:* *MGR*	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
CLIENT: 360 Engineering Ltd	*PF No: 5724*			*APPROVED BY:* *MGR*	*REVISION*							
PROJECT: 20 Tavistock Square, London WC1	*Q*	*A*	*M*	*I*	*DESIGN AUTH:* *MGR*	*SKETCH No. QF/8684/T1*						

EMTEC
Unit L, Turnpike Way, High Wycombe
Bucks HP12 3TF
Tel: 020 8848 3031 Fax: 020 8573 3605

TITLE: *LA10; LA50 & LA90 Levels*	*ISSUE DATE:* 16/05/2016				*DRAWN BY:* *MGR*	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
CLIENT: 360 Engineering Ltd	*PF No: 5724*				*APPROVED BY:* *MGR*	*REVISION*							
PROJECT: 20 Tavistock Square, London WC1	*Q*	*A*	*M*	*I*	*DESIGN AUTH:* *MGR*	*SKETCH No. QF/8684/T2*							

EMTEC
Unit L, Turnpike Way, High Wycombe
Bucks HP12 3TF
Tel: 020 8848 3031 Fax: 020 8573 3605

APPENDIX 'A'

Raw Data – Noise Survey

12th to 13th of May 2016

RAW NOISE DATA - 20 Tavistock Square, London WC1

Ref: QF8684/PF5724/RP1
Client: 360 Engineering Ltd
Date: 12th to 13th of May 2016

Address	Start Time	LAeq	LE	Lmax	Lmin	LA1	LA10	LA50	LA90	LA99
1	09:18	54.3	83.9	68	51.5	58.5	55.3	53.9	52.9	52.7
2	09:33	56.3	85.9	83.8	51.4	61.6	56.3	54.7	53.2	52.8
3	09:48	54	83.6	62.1	50.9	57.6	55.3	53.8	52.6	52.3
4	10:03	53.6	83.2	61.6	50.3	58.2	55.5	53	51.8	51.5
5	10:18	53.7	83.3	68.4	50.2	60.7	54.6	52.9	51.8	51.6
6	10:33	55.8	85.4	71.8	50.7	65.7	57.4	53.6	52.2	51.9
7	10:48	55	84.6	67.7	51.3	60.7	56.9	54.1	52.8	52.5
8	11:03	54.2	83.8	70.8	51.2	57.9	55.8	53.7	52.5	52.2
9	11:18	56	85.6	71.1	51	63.8	57.7	54.5	52.4	52.1
10	11:33	56.6	86.2	69.4	51.8	61.9	58.6	56.1	53.3	53
11	11:48	55.3	84.9	63.6	51.4	58.5	57.1	55.1	52.8	52.5
12	12:03	56.6	86.2	73.1	51.1	65.5	58.2	54.7	52.8	52.5
13	12:18	56.3	85.9	63.8	51.5	60.1	58.3	56.1	53.4	52.9
14	12:33	56.2	85.8	65.5	51.9	59.2	57.6	56.1	54.6	54.2
15	12:48	56.2	85.8	75.7	50.8	61.8	58.7	55.6	52.6	52.3
16	13:03	55.1	84.7	68.2	51.9	60.9	56.8	54.4	53.2	52.9
17	13:18	56.3	85.9	64	52.3	61.4	58.5	55.4	53.7	53.5
18	13:33	56.5	86.1	63.6	50.6	61.3	57.7	56.2	55	54.4
19	13:48	56.5	86.1	65.6	51.2	63.1	57.4	56.1	53.7	53.1
20	14:03	57.5	87.1	75.5	51.4	70	56.1	54	52.8	52.5
21	14:18	57.2	86.8	68.1	50.8	62.4	59.4	56.7	53.7	52.5
22	14:33	56.3	85.9	63.7	51	59.5	58	56.6	52.9	52.5
23	14:48	55.5	85.1	69.7	51.5	61	58.5	54.1	53	52.8
24	15:03	55.5	85.1	67.4	50.9	59.3	57.1	55	53.4	52.9
25	15:18	53.9	83.5	65.7	50.4	59.3	55.7	53.2	51.8	51.6
26	15:33	58.7	88.3	73.7	51	68.7	62.5	53.8	52.3	52
27	15:48	57.6	87.2	71.2	52.4	66.6	60.3	55.1	53.8	53.5
28	16:03	56	85.6	67.8	51.1	64.4	58.4	54.3	52.7	52.3
29	16:18	54.3	83.9	72.3	50.7	57.5	55.7	54.1	52.8	52.4
30	16:33	54.2	83.8	62.9	50.1	59.4	56	53.7	51.8	51.4
31	16:48	57.8	87.4	76.2	50.8	68	61.5	53.2	52	51.8
32	17:03	53.7	83.3	61.9	49.8	57.4	55.5	53.3	52.1	51.8
33	17:18	54.3	83.9	69.8	49.7	65.3	54.5	52.7	51.4	51
34	17:33	52.9	82.5	61.9	50.1	55.9	54.1	52.6	51.6	51.3
35	17:48	52.8	82.4	60.6	50.4	55.8	53.9	52.6	51.8	51.5
36	18:03	53.3	82.9	60	50.3	56.4	54.5	53.1	51.9	51.6
37	18:18	52.7	82.3	71.4	49.5	56.6	54.1	52.3	50.9	50.6
38	18:33	52.6	82.2	62.9	49.3	56.5	54.2	52.1	50.9	50.4
39	18:48	52.9	82.5	63.6	49.5	59.6	54.5	52.1	51	50.7
40	19:03	52.3	81.9	61	49.4	56.8	53.7	51.8	50.8	50.5
41	19:18	54.5	84.1	66.9	49.6	63.1	57	52.8	51.1	50.7
42	19:33	52	81.6	63.6	48.7	57.9	53	51.4	50.3	50
43	19:48	52.6	82.2	64.6	49	58.4	54.8	51.6	50.4	50.2
44	20:03	53	82.6	61.1	48.4	58.2	55.3	52.2	50.6	50.2
45	20:18	54.3	83.9	68.6	49.7	61.4	56.4	52.6	51.3	51
46	20:33	55.2	84.8	69.9	49	64.9	57.9	52.5	50.7	50.4
47	20:48	57.3	86.9	74.8	48.9	70.1	56.2	52.1	50.8	50.5
48	21:03	55.6	85.2	70	49	65.1	58.4	52.6	50.8	50.5
49	21:18	52	81.6	66	48.4	57.6	53.3	51.4	50.2	49.9
50	21:33	53.1	82.7	64.5	48.7	58.8	56	51.7	50.2	49.9

51	21:48	51.9	81.5	66.4	48.4	57.3	53.4	51.3	50.1	49.8
52	22:03	51.7	81.3	62.7	48.6	57.8	52.5	51.2	50.1	49.8
53	22:18	52.5	82.1	60.7	48.9	56.7	54.1	52	50.7	50.4
54	22:33	54.2	83.8	69.2	48.8	62.8	56.6	52.2	50.3	49.9
55	22:48	54.5	84.1	68.1	48.8	63.9	57.9	51.3	50.1	49.8
56	23:03	54.6	84.2	69.9	48.5	62.9	57.7	52.4	50.4	50
57	23:18	52	81.6	62.6	47.4	58.1	54.1	51.2	49.3	49
58	23:33	50.6	80.2	57	47.4	54.1	52	50.5	48.9	48.6
59	23:48	50.6	80.2	60	47	56.7	51.7	50.1	48.6	48.2
60	00:03	49.7	79.3	62.7	46.8	52.4	51	49.5	48.2	47.9
61	00:18	50.4	80	62.2	46.4	57.2	51.8	49.8	48.7	48.4
62	00:33	51	80.6	62.2	47	57.5	52.6	50.1	48.9	48.6
63	00:48	52.9	82.5	66.2	46.9	61.5	56	50.6	49.2	48.9
64	01:03	50.2	79.8	62.6	46.7	55.9	51.3	49.7	48.3	47.9
65	01:18	49.4	79	61	45.5	53.4	50.7	49.3	47.6	47.2
66	01:33	49.6	79.2	57.9	46.5	52.8	51	49.4	48	47.7
67	01:48	50.2	79.8	64.6	45.3	59.9	50.9	49	47.5	47.1
68	02:03	49.8	79.4	59.4	45.6	56.4	51.6	49	47.5	47.1
69	02:18	50.2	79.8	62.3	46.1	59.3	51.2	49	47.5	47.3
70	02:33	49.5	79.1	62.7	45.6	56.1	51.2	48.7	47.4	47.1
71	02:48	49.2	78.8	60.8	45.6	53.9	50.4	48.9	47.4	47.1
72	03:03	49.2	78.8	58.7	44.6	54.1	50.9	48.8	46.8	46.3
73	03:18	49.6	79.2	60.4	45.5	56.1	51.2	48.8	47.3	47
74	03:33	49	78.6	56.6	45.5	53	50.5	48.7	47	46.6
75	03:48	49.3	78.9	57.8	44.8	53.9	51.3	48.7	46.7	46.3
76	04:03	49.6	79.2	61.9	45.4	55.5	51.8	48.8	46.9	46.6
77	04:18	50.5	80.1	60.6	46	56.4	52.7	49.7	47.9	47.5
78	04:33	49.5	79.1	64.3	44.9	55.6	50.7	48.9	47.3	46.9
79	04:48	49.9	79.5	62.1	45.5	58.2	50.9	49.2	47.6	47
80	05:03	49.8	79.4	57.4	45.9	53	51.2	49.7	47.9	47.4
81	05:18	49.8	79.4	56.1	46.5	52.2	51.2	49.7	48.1	47.7
82	05:33	52.5	82.1	58.7	47.5	56.8	55.2	51.4	49.5	49.1
83	05:48	50.7	80.3	59	47.3	55.2	52.1	50.4	49	48.7
84	06:03	51	80.6	64.2	47.7	53.9	52.3	50.9	49.3	49
85	06:18	51.9	81.5	60.6	48	55.1	53.3	51.7	50.2	49.7
86	06:33	53	82.6	66.2	49.5	61.3	54	52	50.9	50.6
87	06:48	53.4	83	65.9	49.7	58.8	54.8	52.8	51.4	51.1
88	07:03	53.7	83.3	64.9	48.3	58.6	55.4	53.3	51.2	50.6
89	07:18	53.4	83	64.6	49.8	58.5	54.8	52.9	51.7	51.4
90	07:33	53.9	83.5	63.3	49.7	59.6	55.7	53.1	51.9	51.5
91	07:48	53.3	82.9	61.6	50.2	57.2	54.8	52.9	51.7	51.4
92	08:03	55.8	85.4	70.8	50.1	65.2	57.4	53.9	52.7	52.4
93	08:18	56.7	86.3	70	52.1	62.5	58.6	55.7	54.1	53.7
94	08:33	58	87.6	72.1	53.9	64.4	58.9	57.4	56.1	55.8
95	08:48	57.8	87.4	71	55.2	62	58.9	57.4	56.5	56.3
96	09:03	58.6	88.2	67.8	53.3	64.1	60.2	58.1	56.8	56.5

APPENDIX 'B'

Photos and sketches

Woburn House

Photo A – Front of Woburn House Looking from Tavistock Square Down Upper Woburn Place

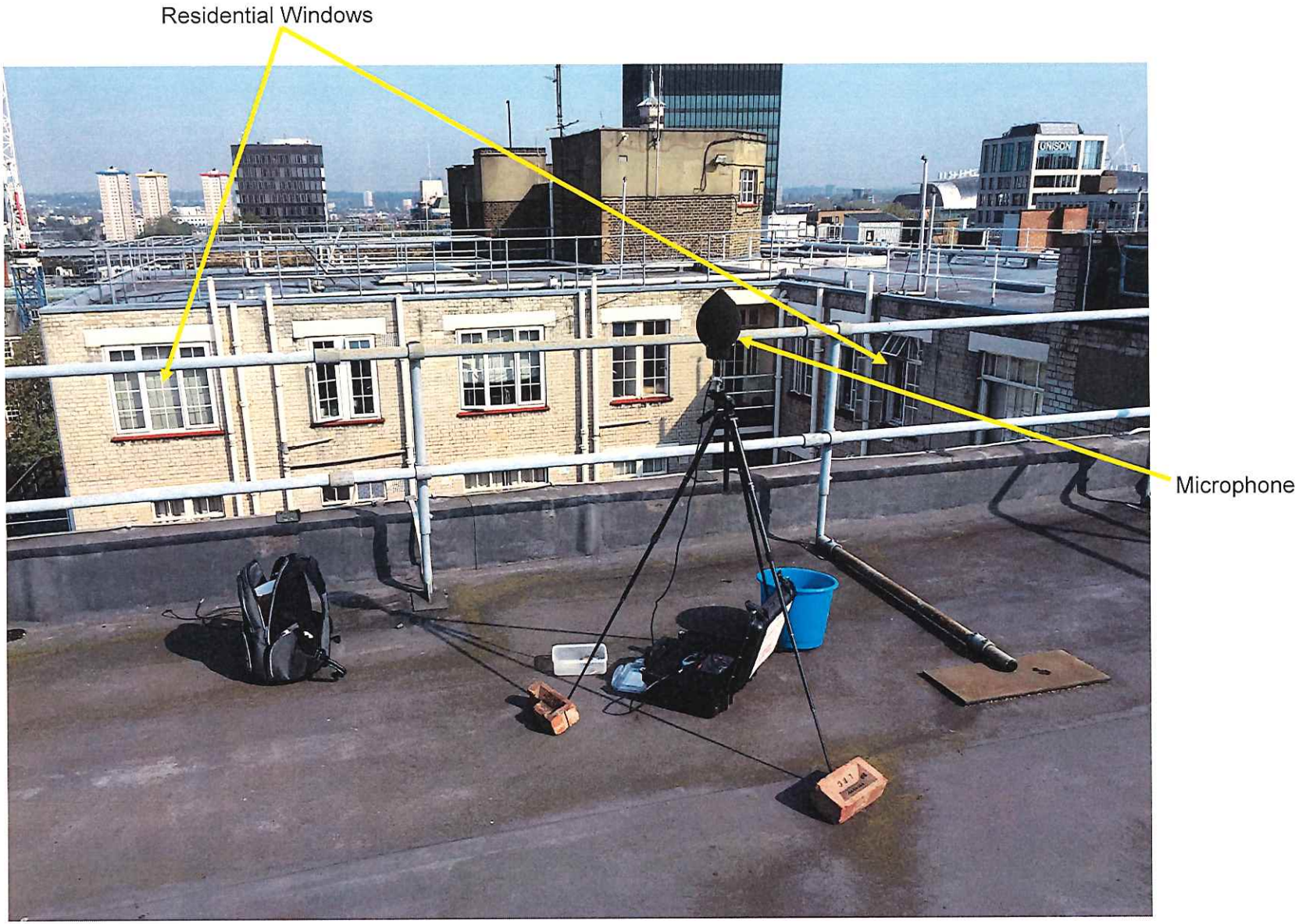


Photo B – Location of Microphone at Rear of Flat Roof Next to Light Well Overlooked by Residential Flats in Endsleigh Court

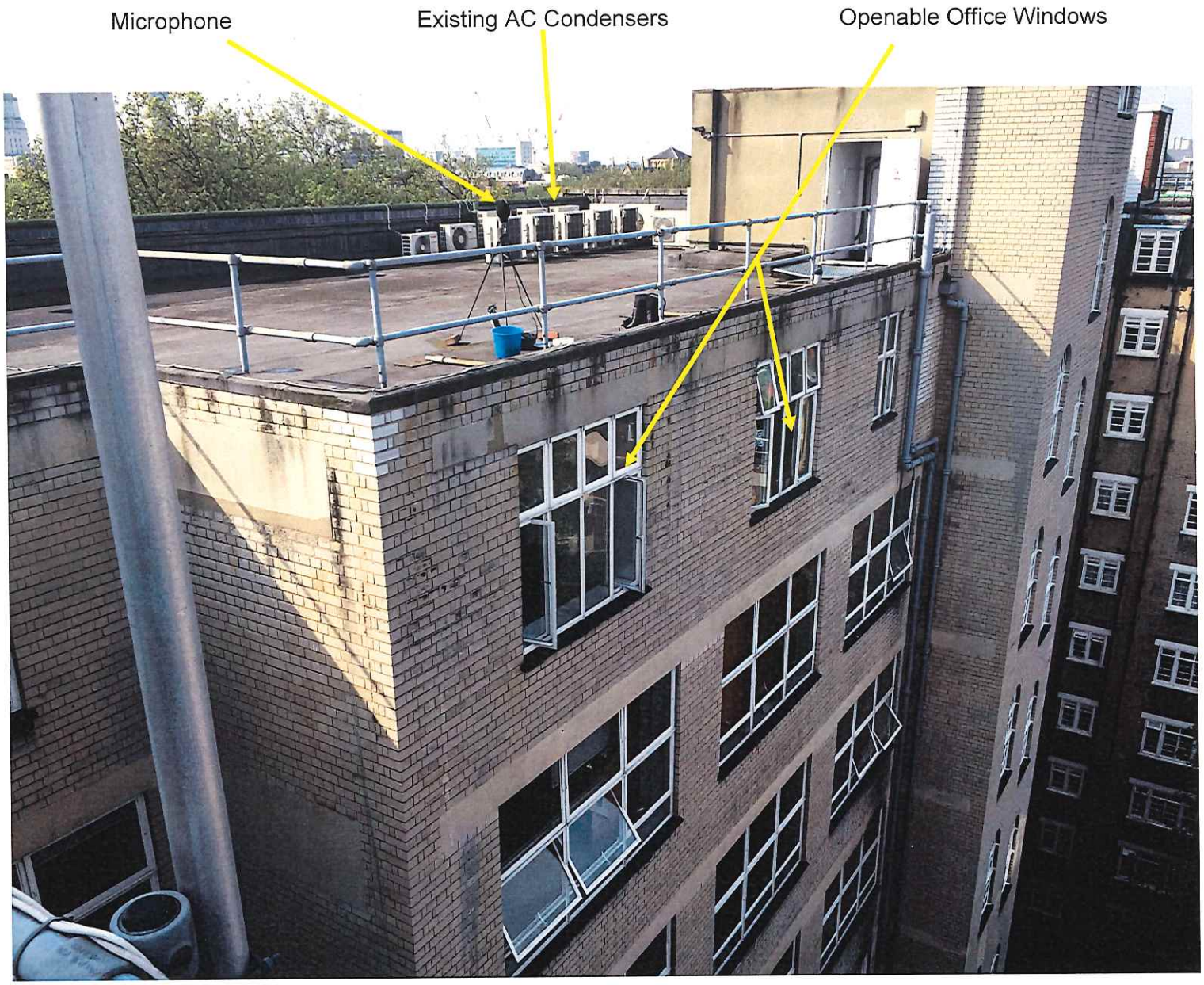


Photo C – Rear Façade of Woburn House with Microphone on Roof

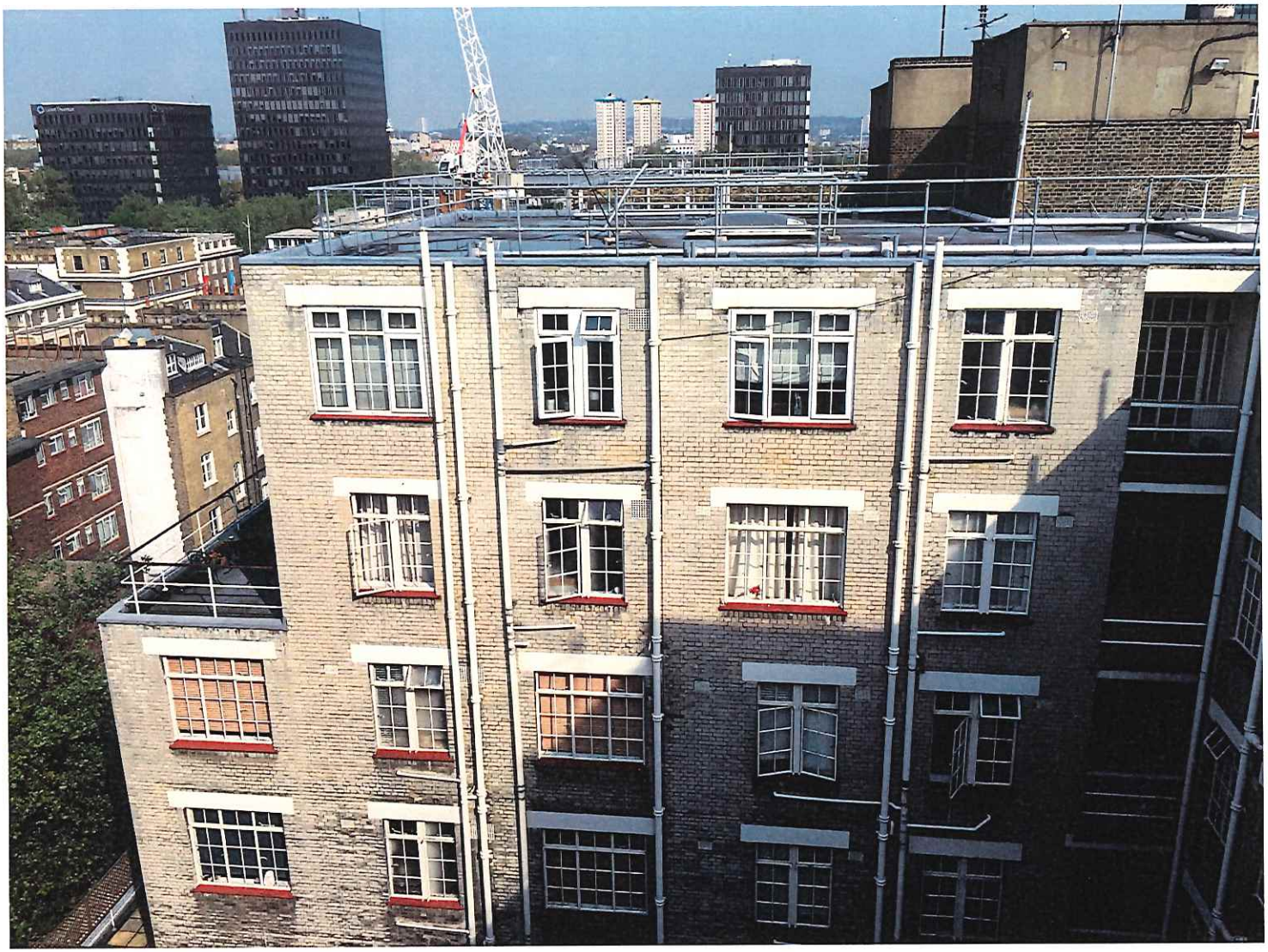


Photo D – Residential Windows of Flats in Endsleigh Court on Other Side of Rear Lightwell

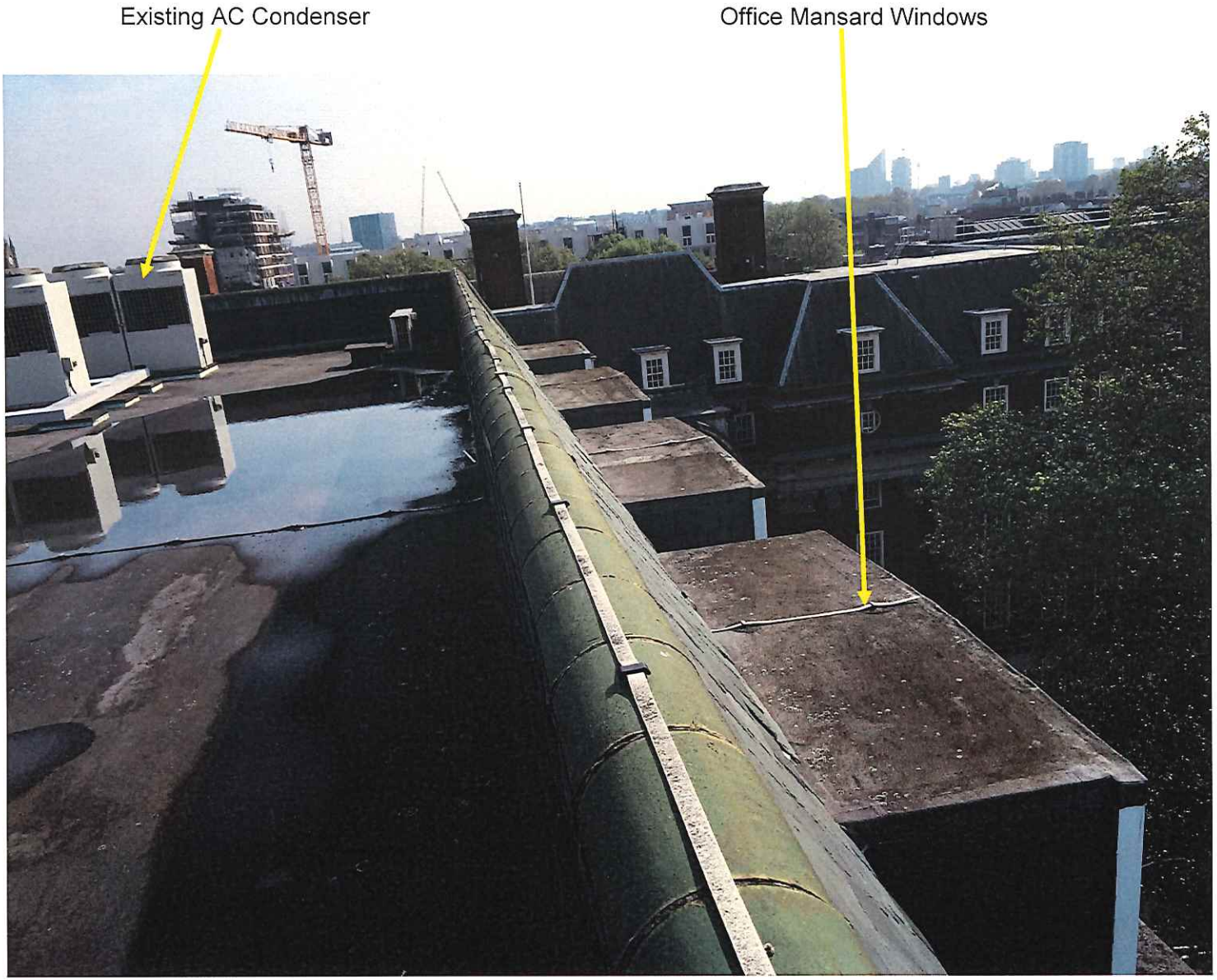


Photo E – Front of Building Overlooking Tavistock Square with Mansard Office Windows & Existing AC Condensers

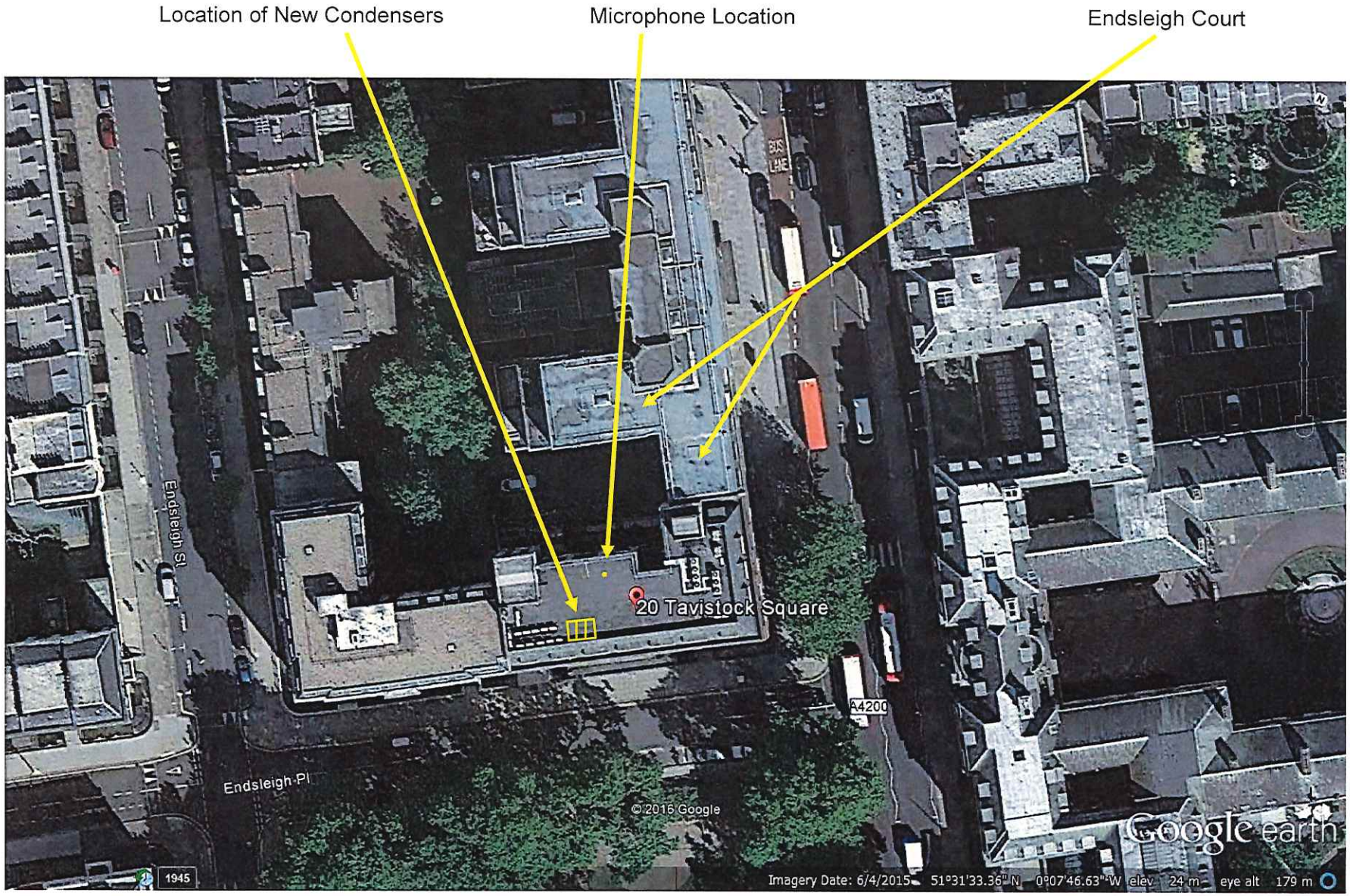
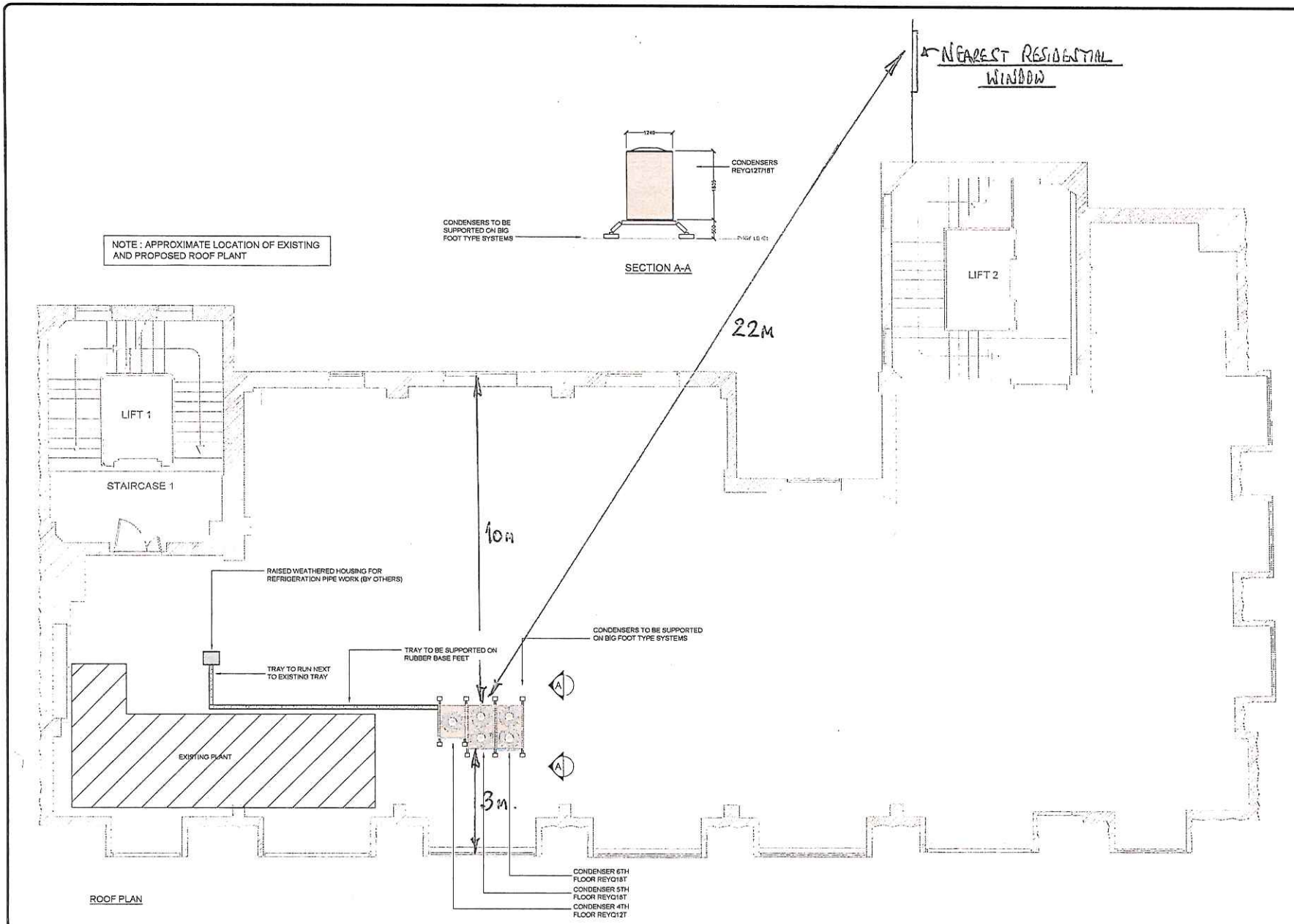


Photo F – Aerial View of Building with Microphone Location and Location of Proposed New Plant



LEGEND AND NOTES

Please do not scale from this drawing

Rev	Description	Init	Date

ACU

SPACEWORKPLACE	Proposed Roof Plant Layout. Condensers Serving 4th, 5th & 6th Floors.

Drawn	Date	Scale	Drawing No:	Rev
SB	FEB16	1:50	360-R-AC04	-

360 Engineering Ltd

Air Conditioning Specialists
Admiral House, 117 High Street
Berkhamsted, HP4 2DJ
Tel: 01442 863604 Fax: 01442 871180
e-mail: sales@360engineering.co.uk www.360engineering.com