RBA ACOUSTICS

60-70 SHORTS GARDENS & 14-16 BETTERTON STREET, LONDON

Plant Noise Assessment

Reference: 7431.RP01.PNA.0
Prepared: 14 June 2019
Revision Number: 0

Span Group
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Revision	Comment	Date	Prepared By	Approved By
0	First issue of report	14 June 2019	Pritham D'Souza	Andrew Heath

Terms of contract:

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The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and again will need to be developed in to full working drawings by the lead designer to incorporate all other design disciplines.

In line with our Environmental Policy, up to two hard copies of the report will be provided upon request. Additional copies of the report, or further hard copies of revised reports, would be subject to an administrative cost of £20.00 (+VAT) per copy.

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1.0 INTRODUCTION

As part of the re-development of 60-70 Shorts Garden and 14-16 Betterton Street, it is proposed to locate new items of plant on the roof of 60-70 Shorts Gardens. As part of the planning application, the London Borough of Camden requires consideration be given to atmospheric noise emissions from the proposed equipment at the nearest noise-sensitive properties.

Following measurements of the prevailing noise conditions at the site, an initial review of preliminary plant noise selections was undertaken by RBA Acoustics. Details of this assessment have been provided in our report (ref: 7431re29032017.pds.PNA-rev1 dated 29th March 2017).

Following further design development and items of plant being revised and finalised, RBA Acoustics have been commissioned to determine the atmospheric noise emissions in accordance with requirements of the London Borough of Camden. This report presents the results of the noise measurements, associated criteria and provides the required assessment.

2.0 ENVIRONMENTAL NOISE SURVEY

2.1 General

Continuous noise monitoring was undertaken at the re-development site between Wednesday 16th November and Monday 21st November 2016 in order to determine the corresponding noise levels over typical day and night-time periods. Some rain was noted to have occurred on a number of occasions though the effect of such occurrences appears to have had a negligible impact on the results and therefore conclusions and recommendations presented herein.

2.2 Measurement Locations

Measurement Position 1 – East elevation (Transformer Yard)

A microphone was positioned on an A-frame 1m outside of a first floor window overlooking the transformer yard to the east of 14-16 Betterton Street. The results at this measurement location are considered to be subject to façade reflection effects. As the measurements were unattended, it is not possible to comment upon the noise climate at each measurement position over the entire monitoring period with absolute certainty, however during our time on site it was noted that the noise climate at this measurement position was dominated by noise from the items of plant in the nearby Transformer Yard.

Measurement Position 2 – Betterton Street

A microphone was positioned on an A-frame 1m from the southern façade of the building at second floor level, overlooking Betterton Street. The results at this measurement location are also considered to be subject to façade reflection effects. From our time on site, it was noted that the noise climate at this position was predominantly affected by road traffic and pedestrian movements along Betterton Street.

The measurement positions are considered to be representative of noise levels incident on the proposed residential aspects of the re-development.

The measurement positions are also illustrated on the site plan in Figure 2 in Appendix D.

2.3 Instrumentation

Details of the instrumentation used to undertake the survey are provided in Appendix B.

The sound level meters were calibrated both prior to and on completion of the survey with no significant calibration drifts observed.

3.0 RESULTS

The noise levels at the measurement positions are shown as time-histories on the attached Graphs 7431/G1-4.

In order to ensure a worst case assessment the lowest background L_{A90} noise levels measured have been used in our analyses. The lowest L_{A90} and the period averaged L_{Aeq} dB noise levels measured are summarised below.

Table 1 – Measured Noise Levels

Measurement Period	Measurement Position 1 – Transformer Yard		Measurement Position 2 – Betterton Street	
	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)
Daytime (07:00 – 19:00)	49	65	46	64
Night-time (23:00 – 07:00)	49	64	44	59

4.0 CRITERIA

The items of plant proposed for the development include 'regular' operational items of plant and emergency/life safety items of plant. The criteria applicable to these 'regular' items of plant has been detailed in Section 4.1. As the emergency items of plant only operate under emergency conditions and during testing for very short durations, these have been assessed separately from the 'regular' items of plant with different criteria proposed for these as well, which has been detailed in Section 4.2.

4.1 Relevant Planning Conditions

The requirements of the London Borough of Camden with regards to plant noise emissions are outlined in Condition 21 of the Decision Notice (Application ref: 2017/2204/P) for the development.

Noise levels at a point 1 metre external to sensitive facades shall be at least 5dB(A) less than the existing background measurement (LA90), expressed in dB(A) when all plan/equipment (or any part of it) is in operation unless the plant/equipment hereby permitted will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps), then the noise levels from that piece of plant/equipment at any sensitive façade shall be at least 10dB(A) below the LA90, expressed in dB(A).

Table 2 – Plant Noise Emission Limits – 'Regular' Items of Plant

Measurement Position	L_{Aeq} Noise Level limit of all operating plant (dB) at 1m from the nearest noise sensitive façade	
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Position 1 – Transformer Yard	44	44
Position 2 – Betterton Street	41	39

In line with the requirements of Condition 21, should the proposed plant be identified as having intermittent or tonal characteristics, a further penalty should be subtracted from any of the above proposed noise emission limits.

It should be noted that the above requirements are applied at the nearest residential adjacencies and alternative criteria should be incorporated if there are also commercial properties affected by the proposed plant installations

4.2 Emergency/Life Safety Equipment Criteria

We are not aware of any specific requirements that the London Borough of Camden imposes on atmospheric noise emissions from emergency plant. However, based on our experience with other Local Authorities we suggest that a criterion of 10dB above the existing background noise levels is targeted for emergency/fire plant when tested. It is recommended that testing takes place only during daytime periods on weekdays (excluding evening hours). The following table presents the design target limits for emergency plant operation.

Table 3 – Plant Noise Emission Limits – Emergency Items of Plant

Measurement Position	L_{Aeq} Noise Level limit of all operating plant (dB) at 1m from the nearest noise sensitive façade	
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Position 1 – Transformer Yard	59	59
Position 2 – Betterton Street	56	54

5.0 ASSESSMENT

5.1 Proposed Plant Items

Table 4 – Plant Information

Plant Description	Ref.	Manufacturer/Model	Total Number of Units	Plant Type
Regular Operational Items of Plant	02 VRV	Daikin REYQ12T	11Nos.	Condenser Unit
	03 VRV	Daikin REYQ14T	1No.	Condenser Unit
	05VRV	Daikin RXYSCQ4TV1	5Nos.	Condenser Unit
	AHU 01	Flakt Group CAIRplus SX188.096AVBV	1No.	Air Handling Unit
Emergency/ Safety Kit	DG 01	FG Wilson P550-3 with CAE Modular Acoustic Enclosure	1No.	Diesel Generator (Emergency Safety Kit)
	EF 01	Flakt Woods HT80JMv/25/4/6/26	1No.	Basement Extract Fan (Emergency Safety Kit)

5.2 Position of Units

The items of plant detailed above are to be located on the roof of 60-70 Shorts Gardens. Following a review of the existing proposals, we understand that it is proposed to install a 2.3m high acoustic louvred screen around the items of plant. The equipment layout has been indicated on the site plan in Figure 1 and Figure 2 in Appendix D.

5.3 Noise Levels

Information regarding the noise levels of the proposed items of plant have been provided by the manufacturers of the units. The associated plant noise levels are detailed as follows:

Table 5 – Plant Noise Levels

Plant Description	Unit Ref	Parameter	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			63	125	250	500	1k	2k	4k	8k
Regular Operational Items of Plant	02 VRV	L_p at 1m	59	66	60	62	54	50	44	37
	03 VRV	L_p at 1m	65	68	64	59	54	50	48	39
	05VRV	L_p at 1m	49	53	49	51	46	40	33	25
	AHU01 – Fresh Air Intake	L_w	63	80	72	67	61	61	62	60
	AHU01 – Exhaust	L_w	72	82	81	84	83	78	77	72
	AHU01 – Fresh Air Intake/Supply Casing Breakout	L_w	51	64	57	57	59	55	45	38
	AHU01 – Exhaust side Casing Breakout	L_w	52	62	57	56	58	55	45	38
Emergency/ Safety Kit	DG 01 – 100% load at 'Stand-by' mode (worst case scenario) - (Emergency Safety Kit)	L_p at 1m	80.7 dBA							
	EF 01 – Outlet (Emergency Safety Kit)	L_w	86	88	88	87	84	80	77	75
	EF 01 – Casing Breakout (Emergency Safety Kit)	L_w	77	71	67	66	63	57	60	56

Review of the octave band data provides no indication of any tonal characteristics associated with the proposed plant.

5.4 Proposed Mitigation Measures

Following correspondence with the Design Team and as detailed in Section 5.2, we understand that it is proposed to install a 2.3m high louvred screen around the items of plant on the roof of 60-70 Shorts Garden. We understand that the louvred screen is to be acoustically rated, achieving the following minimum insertion loss values as detailed in Table 6.

Table 6 – Acoustic Louvred Screen around Rooftop Plant

Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
3	4	6	10	12	13	13	14

We also understand that the condensers units (02VRV, 03 VRV and 05 VRV) will be installed with circular attenuators to the discharge terminations. These attenuators are to achieve the following minimum insertion loss values as detailed in Table 7.

Table 7 – Daikin Condenser – Circular Attenuators to the Condenser Discharge

Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
1	2	4	9	10	10	7	3

In addition to the above, it is also understood that the AHU 01 Fresh Air Intake and Exhaust outlets will contain in-built attenuators achieving the insertion loss values as detailed in Tables 8 & 9 below.

Table 8 – AHU 01 – Fresh Air Intake – Attenuator

Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
4	6	15	16	18	15	14	14

Table 9 – AHU 01 – Exhaust – Attenuator

Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
4	6	15	16	18	15	14	14

5.5 Location of Nearest Residential Windows

Receptor 1 – Fifth floor windows belonging to 14-16 Betterton Street (East-facing)

The closest residential windows to the rooftop items of plant were advised as being the east-facing fifth floor residential windows belonging to 14-16 Betterton Street.

Receptor 2 - Fifth floor windows belonging to 14-16 Betterton Street (West-facing)

Other residential windows that are noted to be near to the rooftop plant are noted as being the west-facing fifth floor residential windows belonging to 14-16 Betterton Street.

Receptor 3 – Windows belonging to 59 Shorts Gardens

Other windows that are noted to be near to the rooftop plant are the south-facing windows belonging to 59 Shorts Gardens.

All receptor locations can be seen on Figure 2.

5.6 Calculation of Noise Levels at Nearest Residential Window

Our calculation method for predicting noise levels from the proposed plant at the nearest residential windows, based on the information stated above, is summarised below.

- Source Term SPL / SWL
- 20LogR Distance Attenuation
- Directivity
- Reflections

Calculation sheets are attached for further information in Appendix C.

The results of the calculations indicate the following noise levels from the 'regular' operational items of plant at the nearest affected residential windows:

Table 10 – Predicted Noise Levels – 'Regular' Operational Items of Plant

Operating Period	Receptor 1		Receptor 2		Receptor 3	
	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion
Daytime (07:00 – 19:00)	40	44	29	44	43	44
Night-time (23:00 –	40	44	29	44	43	44

With regards to the emergency items of plant, our calculations indicate the following noise levels from these units.

Table 11 – Predicted Noise Levels – Emergency Items of Plant

Operating Period	Receptor 1		Receptor 2		Receptor 3	
	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion
Daytime (07:00 – 19:00)	51	56	52	56	54	56
Night-time (23:00 –	51	54	52	54	54	54

Subject to the proposed mitigation measures as detailed in Section 5.4 being incorporated, atmospheric noise emissions from the proposed items of plant located on the roof of 60-70 Shorts Gardens are within the target criteria, with no additional attenuation measures required.

6.0 VIBRATION CONTROL

In addition to the control of airborne noise transfer, it is also important to consider the transfer of noise as vibration to adjacent properties (as well as to any sensitive areas of the same building).

We would typically advise that condensing units and AHUs be isolated from the supporting structure by means of either steel spring isolators or rubber footings. For particularly sensitive locations, or when on lightweight structures the mounts should ideally be caged and be of the restrained type.

It is important the isolation is not "short-circuited" by associated pipework or conduits. To this end, any conduits should be looped and flexible connectors should be introduced between the condenser and any associated pipework. Pipework should be supported by brackets containing neoprene inserts.

7.0 CONCLUSION

Measurements of the existing background noise levels at 60-70 Shorts Garden and 14-16 Betterton Street have been undertaken. The results of the measurements have been used in order to determine the required criteria for atmospheric noise emissions from the future plant installations.

The results of the assessment indicate atmospheric noise emissions from the plant are within the criteria required by London Borough of Camden providing the proposed mitigation measures are employed. As such, the proposed plant installations should be considered acceptable.

Appendix A - Acoustic Terminology

dB	Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.
dB(A)	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level. Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.
L_{eq}	L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (1 hour).
L_{Aeq}	The level of notional steady sound which, over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measured over that period.
L_{An} (e.g L_{A10}, L_{A90})	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise.
$L_{max,T}$	The instantaneous maximum sound pressure level which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the L_{eq} value.

Appendix B - Instrumentation

The following equipment was used for the measurements

Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Expiry Date
Norsonic Type 1 Sound Level Meter	Nor140	1405945	U21194	3 April 2018
Norsonic Pre Amplifier	1209	15800		
Norsonic ½" Microphone	1225	208218	21193	
Norsonic Sound Calibrator	1251	34057	U21192	
Norsonic Type 1 Sound Level Meter	Nor140	1406007	U21856	13 June 2018
Norsonic Pre Amplifier	1209	20043		
Norsonic ½" Microphone	1225	208146	21855	
Norsonic Sound Calibrator	1251	34127	U21854	

Please note that the equipment detailed above was within calibration during the period of the original survey, i.e. between 16th November and 21st November 2016.

Appendix C – Plant calculations

A summary of the noise levels at each receiver from each proposed 'regular' operational item of plant is provided below, together with the overall predicted level.

Unit	Predicted Receive Levels At Receptor 1 (dBA)	Predicted Receive Levels at Receptor 2 (dBA)	Predicted Receive Levels at Receptor 3 (dBA)
02 VRV (11Nos.)	34	18	42
03VRV (1No.)	26	0	17
05VRV (5Nos.)	14	28	26
AHU 01 – Fresh Air Intake	30	9	20
AHU 01 – Exhaust	37	15	27
AHU 01 – FAI Casing Breakout	29	7	19
AHU 01 – Exhaust/Extract Casing Breakout	29	8	19
Total Received Level (dBA)	40	29	43

An example calculation is provided for a typical unit below.

Unit	Lp @ 1m (dBA)	Attenuator to Discharge (dB)	Distance Loss (20m) (dB)	Directivity & Louvre Attenuation (dB)	Received Level (dBA)
03 VRV to Receptor 1	62	-6	-24	-6	26

Appendix D – CDM Considerations

The likelihood the harm will occur can be assessed by applying an indicative score (from 1 to 5) as follows:

1 – Remote (almost never)
2 – Unlikely (occurs rarely)
3 – Possible (could occur, but uncommon)
4 – Likely (recurrent but not frequent)
5 – Very likely (occurs frequently)

The severity of harm can be assessed by applying an indicative score (from 1 to 5) as follows:

1 – Trivial (e.g. discomfort, slight bruising, self-help recovery)
2 – Minor (e.g. small cut, abrasion, basic first aid need)
3 – Moderate (e.g. strain, sprain, incapacitation > 3 days)
4 – Serious (e.g. fracture, hospitalisation > 24 hrs, incapacitation > 4 weeks)
5 – Fatal (single or multiple)

The rating value is obtained by multiply the two scores and is then used to determine the course of action.

Rating Bands (Severity x Likelihood)		
Low Risk (1 – 8)	Medium Risk (9 -12)	High Risk (15 – 25)
May be ignored but ensure controls remain effective	Continue, but implement additional reasonable practicable controls where possible	Avoidance action is required; therefore alternative design solutions must be examined. Activity must not proceed until risks are reduced to a low or medium level

The following hazards pertinent to our design input have been identified and control measures suggested:

Hazard	Risk Of	At Risk	Rating			Control Measures	Controlled		
			L	S	R		L	S	R
Vibration Isolators	Injury to hands	Contractors	3	3	9	Care needs to be taken during adjustment. Follow manufacturers guidance	1	3	3
Attenuators/ Acoustic Lagging	Strain of neck, limbs or back.	Contractors	3	4	12	Provide sufficient manpower/ lifting gear	1	4	4
Attenuators/ Acoustic Lagging	Skin & respiratory irritation	Contractors	4	3	12	Wear gloves and mask	1	3	3

L: Likelihood S: Severity R: Rating

Appendix E – Graphs and Site Plans

14-16 Betterton Street
Position 1 -First Floor Overlooking Transformer Yard
L_{Aeq} Time History
Wednesday 16 November to Monday 21 November 2016

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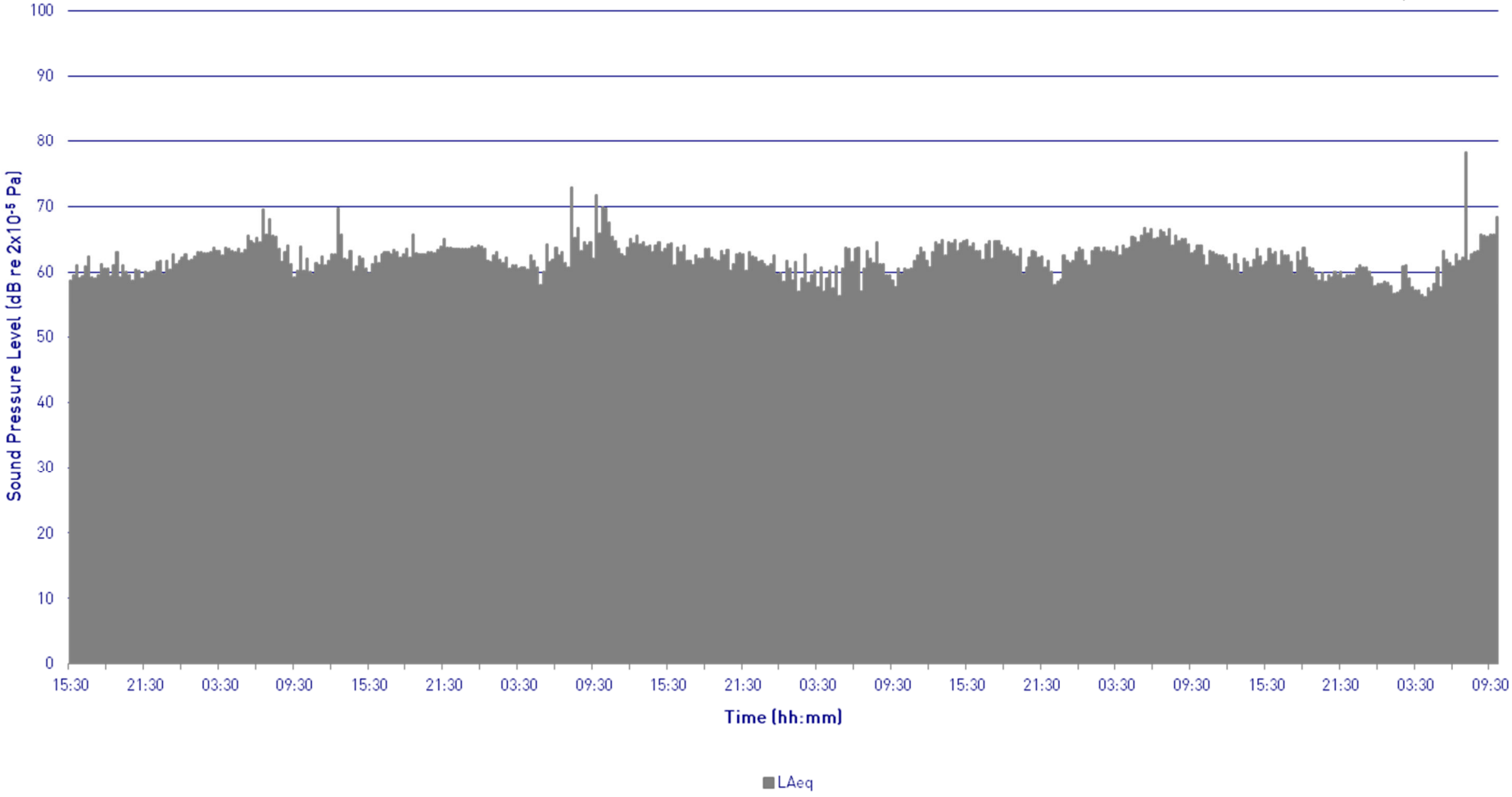
Graph 7431/G1



14-16 Betterton Street
Position 1 -First Floor Overlooking Transformer Yard
L_{A90} and L_{Amax} Time History
Wednesday 16 November to Monday 21 November 2016

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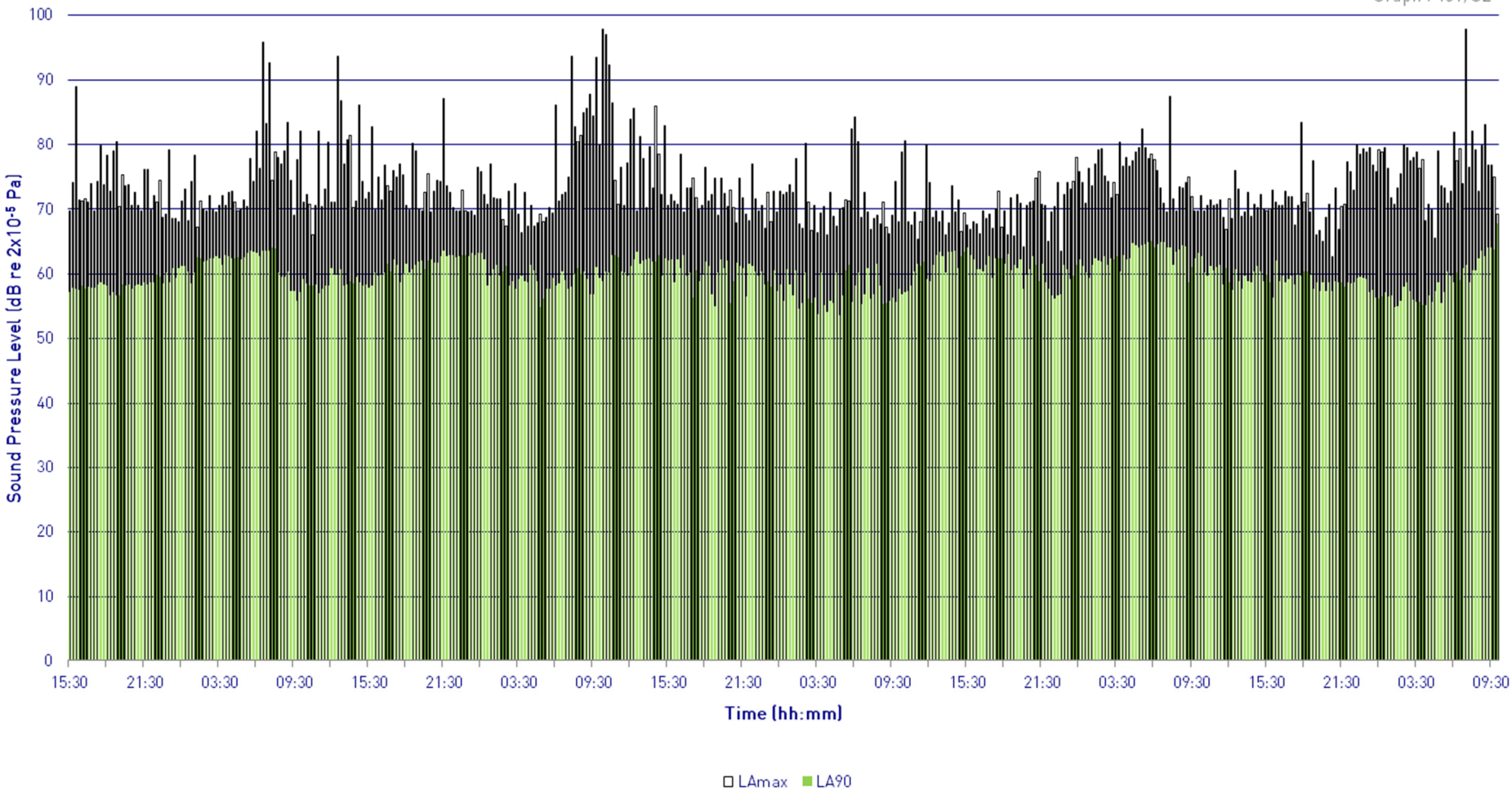
Graph 7431/G2



14-16 Betterton Street
Position 2 - Second Floor Overlooking Betterton Street
L_{Aeq} Time History
Wednesday 16 November to Monday 21 November 2016

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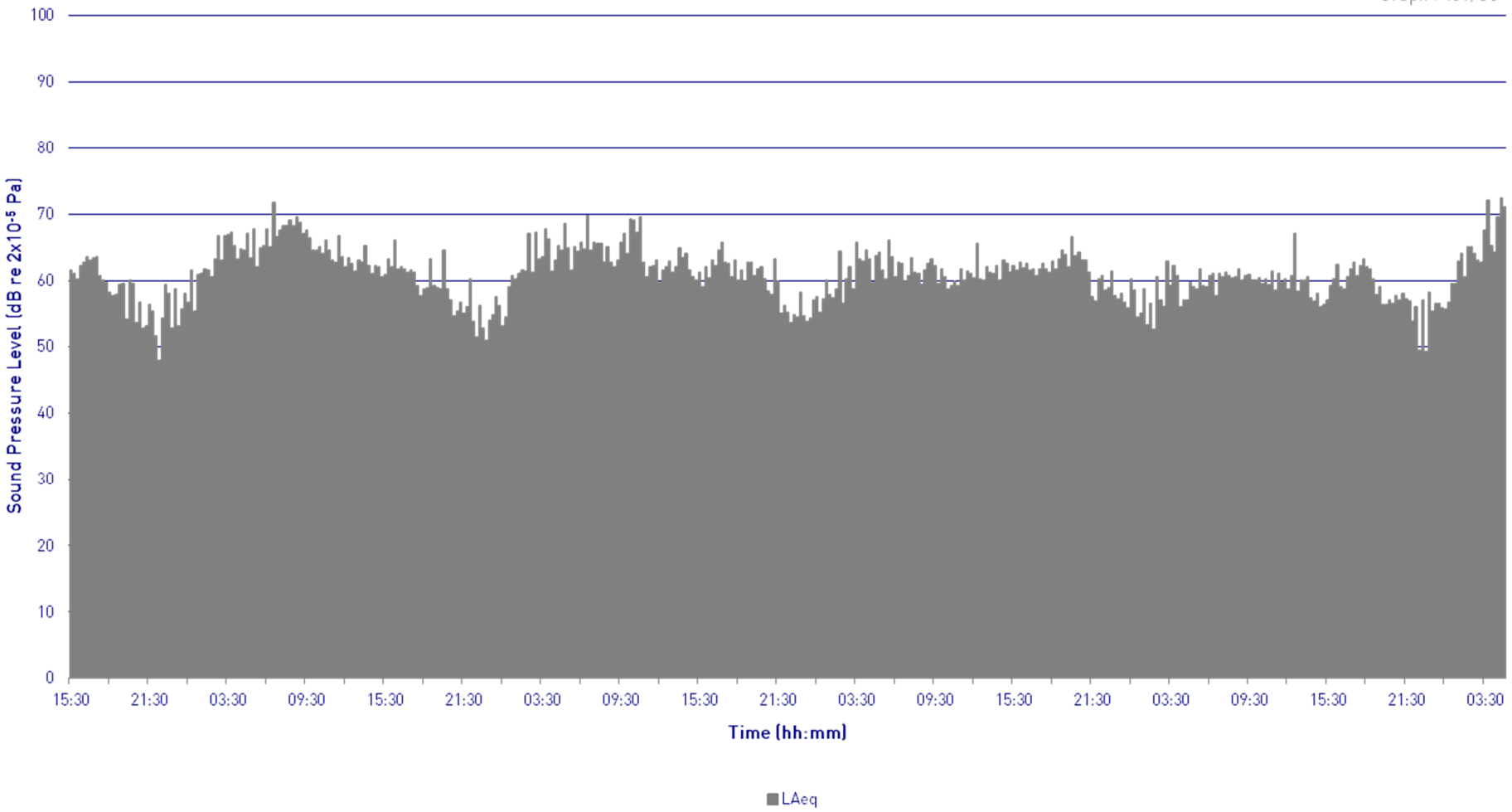
Graph 7431/G3



14-16 Betterton Street
Position 2 - Second Floor Overlooking Betterton Street
L_{A90} and L_{Amax} Time History
Wednesday 16 November to Monday 21 November 2016

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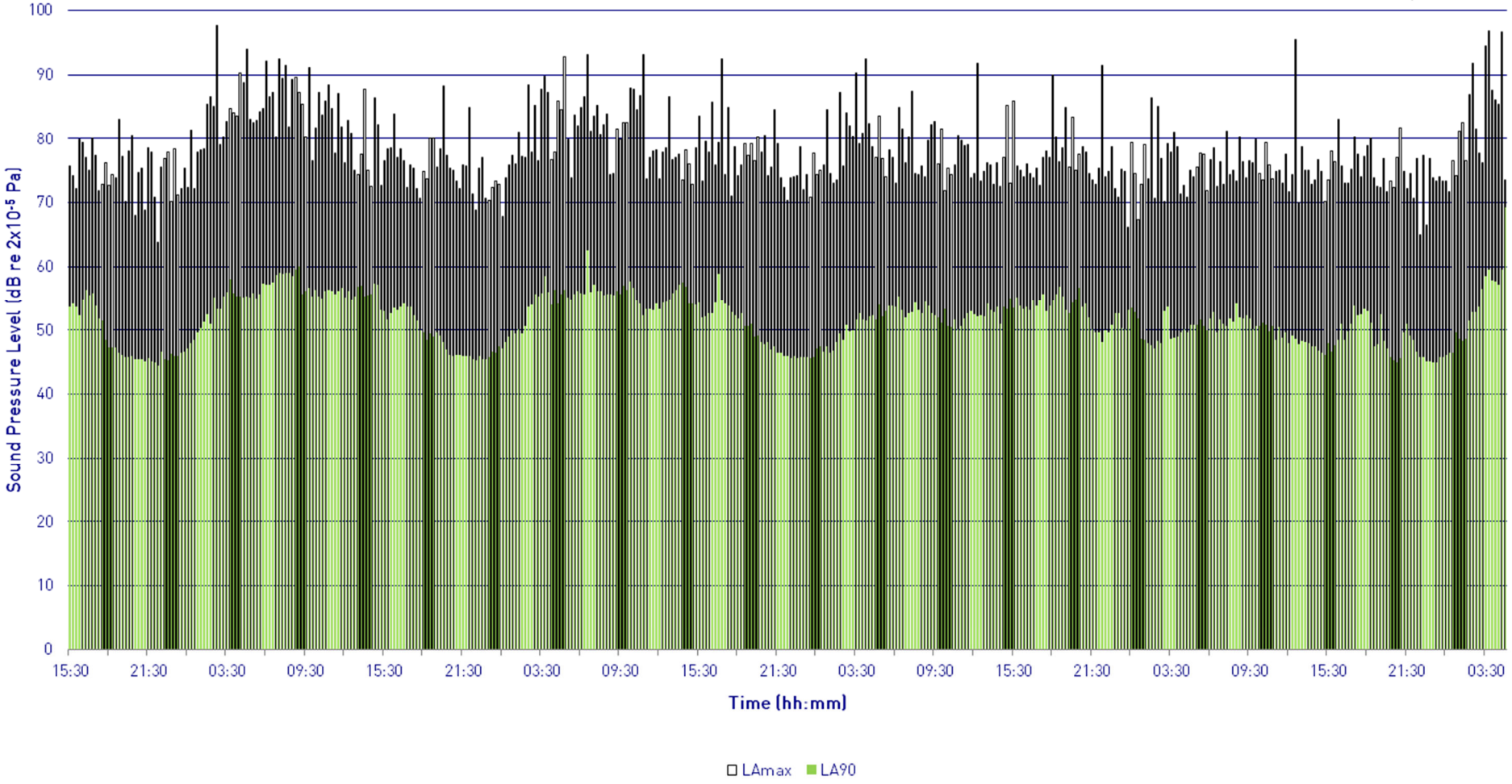
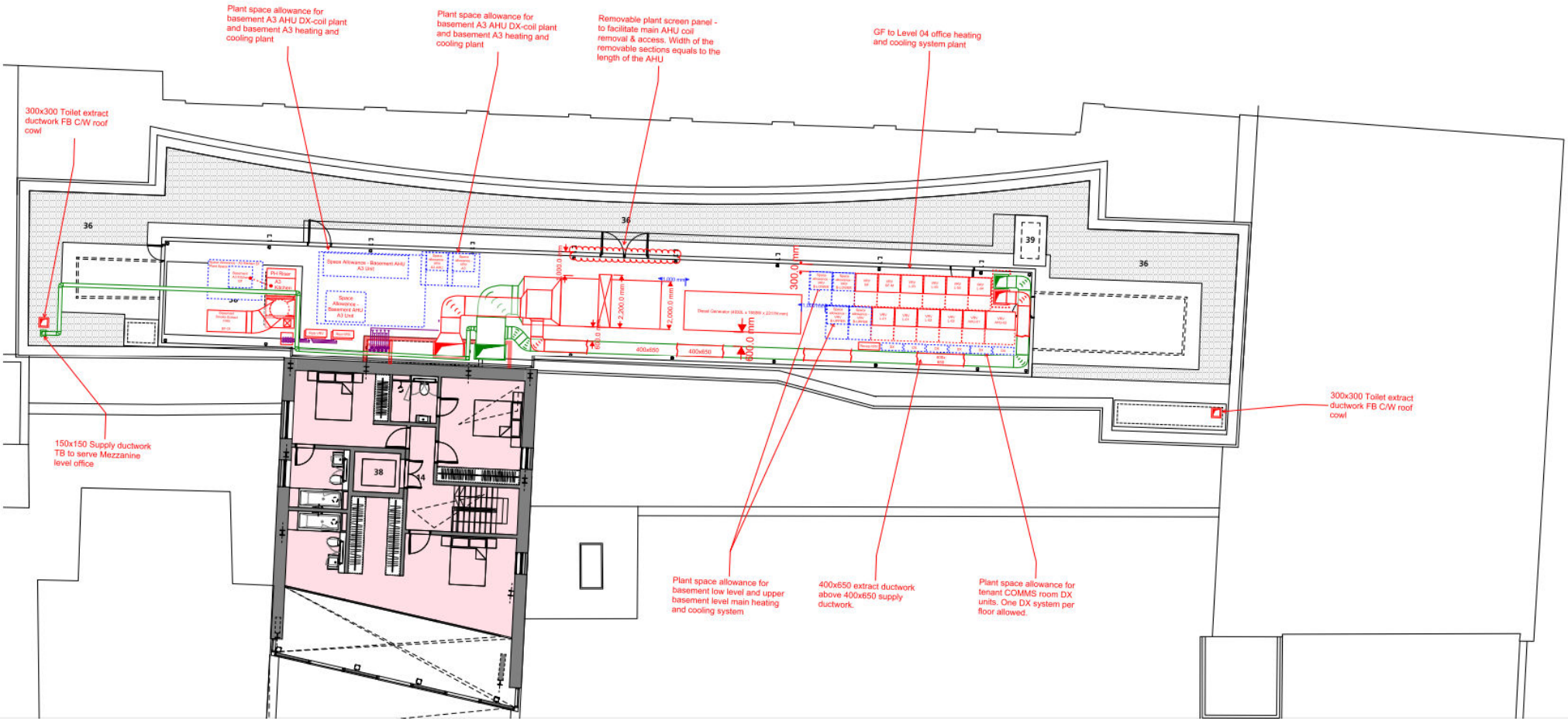
Graph 7431/G4





60-70 Shorts Gardens & 14-16 Betterton Street, London
Proposed Rooftop Plant Layout
(ref: 1087_SK-190604-001 May 2019 – DRAFT)
Project 7431

Figure 1

14 June 2019

Not to Scale

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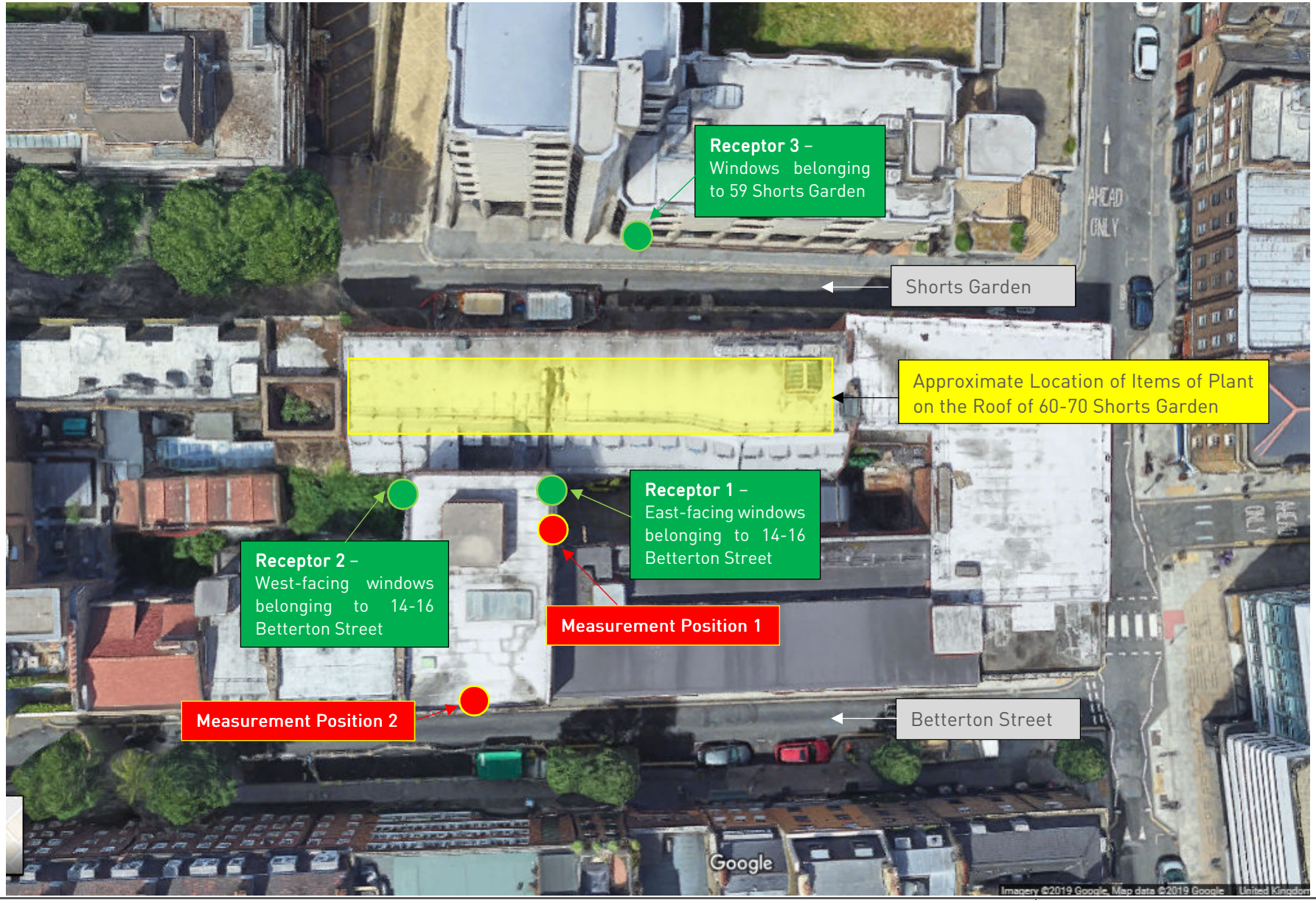

60-70 Shorts Gardens & 14-16 Betterton Street, London
Aerial Image showing Assessment Locations
Project 7431

Figure 2
14 June 2019
Not to Scale

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