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Project:

Fitzroy Yard, Fitzroy Road

Title:

Plant Noise Impact Assessment

quietly moving forward

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Revision	Date	Author	Checked
0			

CONTENTS:

1 INTRODUCTION

1.01 Environmental Equipment Corporation Ltd has been commissioned by Werninck Building Services to undertake a noise assessment of the proposed fixed mechanical services plant to serve an indoor swimming pool to be located in a residential property of Fitzroy Yard, Fitzroy Road, London, United Kingdom.

1.02 The assessment has been conducted in accordance with the relevant standards, policies and requirements of Camden Council and is based on a noise survey carried out at the site over a typical representative 43-hour period.

1.03 This assessment includes:

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

1.04 This report is prepared solely for Werninck Building Services. Environmental Equipment Corporation Ltd 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 Fitzroy Yard is a two-storey residential house located in a residential area of London.

2.02 The property is bound by the following:

- North-East – back gardens of residential houses of Chalcot Road;
- North-West – back gardens of residential houses of Fitzroy Road;
- South-West – residential properties of Primrose Hill Studios; and
- South-East – back gardens of residential houses of Manley Street.

The location of the property is indicated on the site plan in Appendix B.

2.03 This application is for a Recotherm AERIS 50 air handling unit (AHU) to serve the proposed indoor swimming pool. The unit is to be located on the first-floor level terrace in the north-eastern corner of the property, as indicated on the site plan in Appendix B. The unit and the immediate ductwork are to be installed within a full enclosure built to meet the building regulations, with the fresh air inlet and discharge duct terminations located outside near the north-western and the south-eastern enclosure elevations respectively. Portions of the supply and return air ductwork are also to be located externally on the terrace.

2.04 The closest noise sensitive receptors to the proposed plant items are the rear 1st floor windows of the residential houses of 4 and 6 Manley Street, located approximately 8 m to southeast from the closest proposed atmosphere-side duct termination.

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 Guidance on noise management, control and rating pertinent to this application is provided by the planning policy for Camden Council, National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE), and British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound'. The relevant parts of these documents are presented in Appendix C.

3.02 Typically Camden Council require that noise from the mechanical services is designed to a level of 5 dB below the existing L_{A90} noise level, as assessed outside of any noise sensitive facades. A criterion of 10 dB below the existing L_{A90} noise level is required if the plant generates noise that has distinguishable tonal components, or includes distinct impulsive sounds.

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a representative period, commencing approximately 1335 hours on Tuesday 12th January 2016 and concluding approximately 0905 hours on Thursday 14th January 2016, to obtain the existing noise levels at the site. The survey methodology and results are set out below.

4.02 The weather during the survey was suitable for noise measurement – it was generally dry with little wind for the duration of the survey. Some light rain and stronger wind gusts occurred during the afternoon and evening of 12th January. However, this rainfall and wind is not

considered to have affected parameters and periods relevant to the outcomes of this assessment.

4.03 The measurements have been carried out at the following location:

- Position 1: located approximately 1.5 metres above the first floor level terrace in the north-eastern corner of the Fitzroy Yard property. The measurement was located more than 3.5 m from any other significant reflective surface.

The measurement position is indicated on the site plan in Appendix B.

4.04 The predominant source of noise on site was local and distant road traffic. No other significant noise sources were identified on site.

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	27th July 2015
	Cal. Certificate No.	U19312

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

6.02 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.

Location	Period	Average $L_{Aeq,T}$ – dB	Minimum L_{A90} – dB
Position 1	Day time 0700-1900 hrs (T=12h)	49	41
	Evening 1900-2300 hrs (T=4h)	47	39
	Night-time 2300-0700 hrs (T=8h)	43	33

Table 6.1: Free-field measured ambient and lowest background noise levels.

7 PLANT ASSESSMENT

7.01 In the following, the impact of noise from the proposed AHU on the most sensitive noise receptors is assessed.

7.02 The results of the noise measurements on site were used to establish the noise rating level limits that the plant will need to meet at the most sensitive noise receptors described in Section 2.04. Following the standard recommendations of Camden Council, it is proposed that the noise at 1 metre from the sensitive residential windows should not exceed 5 dB below the lowest measured $L_{A90,5min}$, as shown in Table 7.1 below.

7.03 With respect to the NPPF, setting the rating level between 5 dB below the existing L_{A90} background level should result in the noise approaching the NOEL (No Observed Effect Level).

7.04 Note that the limits suggested in Table 7.1 are rating levels and as such any design should take into account the acoustic characteristics of the plant, as outlined in Appendix C. In this instance the proposed unit is understood to display none of the characteristics whereby the acoustic correction should be applied.

Position	Period	Measured Existing $L_{A90,5min}$ (dB)	Proposed Noise Limit L_{Ar} (dB)
1	Day (0700-1900 hrs)	41	36
	Evening (1900-2300 hrs)	39	34
	Night-time(2300-0700 hrs)	33	28

Table 7.1: Proposed plant noise emission limits at the most affected residential receptors based on lowest measured $L_{A90,5min}$, free-field.

7.05 The proposed AHU is Recotherm AERIS 50, and has the manufacturer's published in-duct sound power levels (SWLs) as shown in Table 7.2 (nominal duty).

Sound Power Level (dB)	Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
	Supply Fan	77	83	71	69	65	61	58	51
	Return Fan	67	73	62	63	60	54	50	43

Table 7.2: Fan Sound power level Recotherm AERIS 50 AHU.

7.06 The actual noise levels are likely to be lower than presented in Table 7.2 in practice, as the unit will be operating at a lower than nominal duty. The following assessment is based on the nominal levels, and as such represents the worst case scenario.

7.07 Predicted noise levels have been calculated at the most noise sensitive receptors. Tables 7.3-7.4 below present the worst-case noise predictions for these receptors.

7.08 Other residential receptors will be subject to lower noise levels than those predicted at the above locations.

7.09 To ensure that the proposed noise limits are met, a noise control scheme has been designed. The design includes high-performance supply and discharge in-duct attenuators to provide between 17-18 dB of noise attenuation (together with other duct system losses). The design has taken account of airflow and pressure requirements to ensure the efficiency of the unit is maintained.

7.10 The noise break-out from the external air supply and return ductwork will be controlled by means of room-side in-duct attenuators, so that it does not contribute to the noise levels predicted above.

7.11 It can be seen that even in the worst case of the AHU operating non-stop at the nominal duty, the predicted cumulative noise levels will meet the adopted criteria during all periods of plant operation at the most affected noise sensitive receptors.

Item	Noise Level	Notes
Exhaust fan	65 dB(A)	Nominal in-duct SWL
System losses and EEC noise control scheme	-17 dB	Duct system losses, including the end reflection and a sound attenuator
Distance losses over 8 m	-29 dB	Distance from the duct termination to the most noise sensitive residential windows
Directivity	+5 dB	Sound pressure increase due to beaming effect (30° off-axis propagation)
Noise level at receptor	24 dB(A)	SPL at the most noise sensitive windows
Supply fan	72 dB(A)	Nominal in-duct SWL
System losses and EEC noise control scheme	-18 dB	Duct system losses, including the end reflection and a sound attenuator
Distance losses over 11 m	-32 dB	Distance from the duct termination to the most noise sensitive residential windows
Directivity	0 dB	Sound pressure change due to propagation 150° off-axis
Noise level at receptor	22 dB(A)	SPL at the most noise sensitive windows
Total noise level at receptor	26 dB(A)	Cumulative SPL at the most noise sensitive windows

Table 7.3: Worst-case plant noise calculations for the most noise sensitive receptors.

Property	Period	Proposed Noise Limit L_{Ar} (dB)	Predicted $L_{Aeq,T}$ (dB) Receptors A and B	Exceedance of noise limit (dB)
Most noise sensitive receptors	Day	36	26	-10
	Evening	34	26	-8
	Night	28	26	-2

Table 7.4: Assessment of predicted noise levels based on proposed noise limits.

8 CONCLUSIONS

8.01 Environmental Equipment Corporation Limited has been commissioned by Werninck Building Services to undertake a noise assessment of the proposed ventilation plant to serve an indoor swimming pool to be located in a residential property of Fitzroy Yard, Fitzroy Road, London, United Kingdom.

8.02 The assessment has been carried out in accordance with relevant standards, national planning guidance and the requirements of Camden Council, and was based on an environmental noise survey conducted at the site over a representative 43-hour period.

8.03 The potential noise impact of the proposed plant has been evaluated at the most noise sensitive residential receptors. Predictions have shown that the proposed noise criteria are met at the assessment locations during all periods of plant operation, provided that in-duct attenuators are installed within the fresh air inlet and discharge ducts to provide up to 18 dB of sound attenuation (including other duct system losses).

8.04 Assessing the site in accordance with the principles of the NPPF has shown that the noise levels predicted outside the most affected noise sensitive residential windows will be approaching the level at which no effects are observed to occur, the NOEL.

8.05 On the basis of this assessment it is considered that noise should not pose a material constraint to the operation of the proposed plant.

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:-

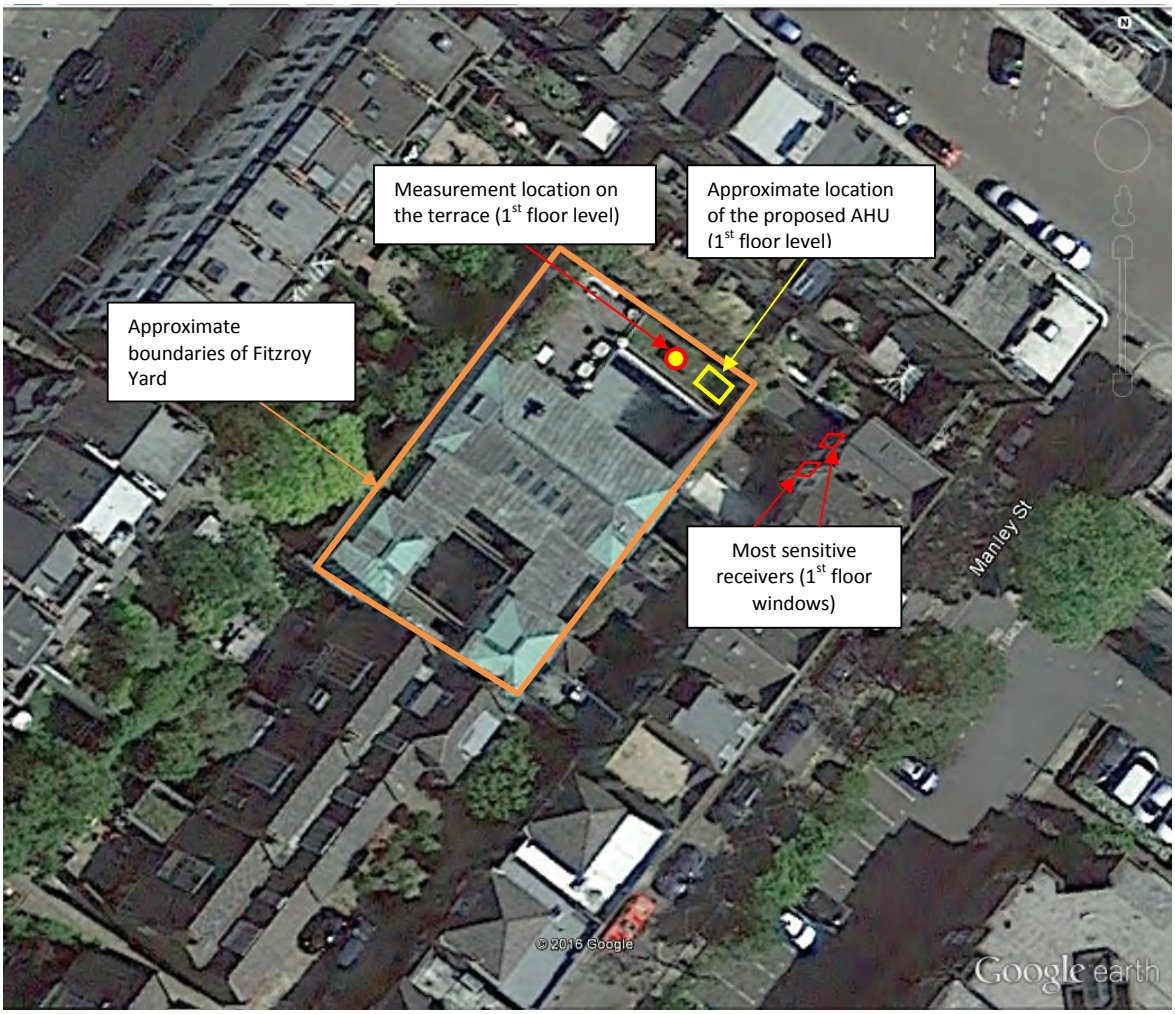
L_{90} This is the sound pressure level exceeded for 90% of the measurement period. It is widely used to measure background noise levels.

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

DP POLICY

DP28 – Noise and vibration

The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:

a) development likely to generate noise pollution; or

b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.

The Council will seek to minimise the impact on local amenity from the demolition and construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact.

With relation to plant noise emissions, DP28 provides the following table which sets maximum noise criterion limits above which planning permission will not be granted. The policy explains that noise sensitive development includes housing, schools and hospitals as well as offices.

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB$L_{Aeq'}$

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 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
13:35	48	60	46
13:40	50	63	46
13:45	48	58	45
13:50	48	61	46
13:55	48	65	46
14:00	47	59	45
14:05	47	59	45
14:10	48	70	45
14:15	49	75	46
14:20	46	52	45
14:25	47	54	45
14:30	46	52	44
14:35	47	62	45
14:40	47	54	45
14:45	46	51	45
14:50	46	57	44
14:55	49	63	45
15:00	48	60	46
15:05	47	59	45
15:10	47	56	45
15:15	47	61	46
15:20	47	60	46
15:25	48	62	46
15:30	47	57	45
15:35	48	64	46
15:40	50	66	47
15:45	49	64	46
15:50	50	66	46
15:55	51	74	45
16:00	48	68	46
16:05	52	70	46
16:10	54	73	46
16:15	50	67	47
16:20	51	68	46
16:25	53	75	46
16:30	52	74	46
16:35	52	68	47
16:40	52	70	46
16:45	54	74	46
16:50	52	72	47
16:55	52	69	46
17:00	50	66	46
17:05	52	76	46
17:10	50	65	46
17:15	50	67	46
17:20	50	62	47
17:25	53	67	46
17:30	48	60	46

Time	L_{Aeq}	L_{AMax}	L_{A90}
17:35	46	50	45
17:40	47	56	46
17:45	47	52	46
17:50	48	55	46
17:55	47	51	46
18:00	47	52	46
18:05	46	51	45
18:10	47	51	46
18:15	47	52	46
18:20	48	60	46
18:25	47	55	45
18:30	47	53	46
18:35	49	66	46
18:40	48	56	46
18:45	48	58	46
18:50	48	57	46
18:55	49	66	46
19:00	47	55	45
19:05	49	63	46
19:10	46	52	45
19:15	47	55	44
19:20	45	50	44
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19:30	47	61	44
19:35	45	51	44
19:40	44	48	43
19:45	44	51	43
19:50	45	55	43
19:55	45	55	43
20:00	46	56	43
20:05	44	64	42
20:10	45	59	42
20:15	44	50	42
20:20	45	57	42
20:25	45	53	43
20:30	44	57	42
20:35	43	51	41
20:40	43	53	40
20:45	43	59	41
20:50	44	55	42
20:55	43	54	40
21:00	42	56	41
21:05	41	48	39
21:10	43	51	40
21:15	43	57	40
21:20	48	64	41
21:25	44	50	41
21:30	49	68	40

EC 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
21:35	41	47	40
21:40	42	51	40
21:45	42	57	40
21:50	42	57	40
21:55	41	49	39
22:00	42	49	41
22:05	42	52	40
22:10	50	67	40
22:15	42	48	40
22:20	42	48	40
22:25	42	48	40
22:30	43	57	40
22:35	43	51	41
22:40	43	55	40
22:45	42	50	40
22:50	42	50	39
22:55	41	46	40
23:00	43	59	39
23:05	46	62	40
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23:20	40	51	38
23:25	40	46	39
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23:35	41	54	38
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23:45	40	48	37
23:50	40	49	37
23:55	38	42	37
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00:30	39	49	37
00:35	40	52	37
00:40	37	47	36
00:45	38	47	36
00:50	38	41	36
00:55	37	45	36
01:00	38	45	36
01:05	38	50	36
01:10	38	45	36
01:15	38	46	36
01:20	41	53	35
01:25	37	45	35
01:30	35	43	34

Time	L_{Aeq}	L_{AMax}	L_{A90}
01:35	36	49	34
01:40	36	47	35
01:45	36	48	35
01:50	35	41	34
01:55	36	42	35
02:00	36	41	34
02:05	39	49	34
02:10	37	50	34
02:15	36	43	34
02:20	35	44	34
02:25	36	47	34
02:30	35	46	33
02:35	35	46	33
02:40	35	39	34
02:45	35	44	34
02:50	37	49	33
02:55	37	47	34
03:00	36	42	34
03:05	37	48	34
03:10	36	47	34
03:15	36	46	33
03:20	36	48	33
03:25	36	47	33
03:30	36	45	33
03:35	44	58	35
03:40	41	58	34
03:45	36	41	34
03:50	36	42	34
03:55	36	41	35
04:00	37	45	36
04:05	38	45	35
04:10	42	56	35
04:15	38	45	37
04:20	37	42	35
04:25	37	44	35
04:30	38	43	37
04:35	38	50	36
04:40	42	55	37
04:45	39	47	37
04:50	38	42	37
04:55	38	44	36
05:00	40	51	37
05:05	41	51	38
05:10	39	43	37
05:15	39	45	37
05:20	40	43	38
05:25	41	52	38
05:30	42	52	38

EC 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
05:35	39	45	38
05:40	40	47	38
05:45	41	56	39
05:50	41	49	40
05:55	42	50	40
06:00	42	47	41
06:05	43	50	40
06:10	46	59	40
06:15	43	53	41
06:20	42	47	41
06:25	42	47	41
06:30	47	64	41
06:35	43	63	42
06:40	42	47	42
06:45	43	47	42
06:50	45	53	43
06:55	45	50	43
07:00	45	52	43
07:05	44	48	43
07:10	44	48	43
07:15	45	48	44
07:20	45	52	44
07:25	45	51	43
07:30	48	60	43
07:35	45	50	44
07:40	46	58	44
07:45	45	58	44
07:50	46	52	43
07:55	46	53	44
08:00	46	58	45
08:05	46	62	44
08:10	47	61	44
08:15	47	60	44
08:20	47	56	45
08:25	47	54	45
08:30	47	58	45
08:35	48	62	45
08:40	49	69	46
08:45	48	67	45
08:50	48	57	46
08:55	49	71	45
09:00	52	71	45
09:05	50	65	45
09:10	50	65	45
09:15	47	62	44
09:20	48	59	45
09:25	46	62	43
09:30	55	71	44

Time	L_{Aeq}	L_{AMax}	L_{A90}
09:35	47	62	44
09:40	47	64	44
09:45	47	64	45
09:50	48	64	45
09:55	46	59	44
10:00	48	61	46
10:05	48	69	45
10:10	45	59	43
10:15	47	64	44
10:20	48	65	45
10:25	48	62	45
10:30	47	57	44
10:35	47	57	45
10:40	46	59	45
10:45	48	59	45
10:50	50	67	44
10:55	50	67	44
11:00	47	63	44
11:05	47	57	44
11:10	47	57	43
11:15	46	56	44
11:20	47	57	44
11:25	47	58	44
11:30	47	60	45
11:35	46	56	43
11:40	47	54	44
11:45	47	58	44
11:50	47	59	44
11:55	50	63	45
12:00	49	60	44
12:05	50	62	44
12:10	48	62	44
12:15	48	60	43
12:20	48	59	43
12:25	46	56	43
12:30	49	58	44
12:35	49	60	44
12:40	48	57	43
12:45	49	58	46
12:50	49	60	46
12:55	48	55	45
13:00	46	54	43
13:05	45	54	42
13:10	46	53	42
13:15	45	54	42
13:20	46	63	43
13:25	45	52	43
13:30	45	55	42

EC 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
13:35	45	58	42
13:40	44	54	41
13:45	45	52	43
13:50	45	58	43
13:55	46	51	44
14:00	47	54	44
14:05	48	61	45
14:10	48	57	45
14:15	49	61	44
14:20	50	61	46
14:25	50	60	45
14:30	49	64	46
14:35	50	63	46
14:40	50	65	46
14:45	49	62	45
14:50	46	56	44
14:55	47	59	45
15:00	50	64	45
15:05	48	62	44
15:10	50	61	45
15:15	50	65	44
15:20	48	64	44
15:25	47	58	44
15:30	48	59	44
15:35	48	59	44
15:40	47	58	44
15:45	46	55	43
15:50	46	61	44
15:55	46	56	44
16:00	47	64	45
16:05	54	70	45
16:10	46	58	45
16:15	46	53	45
16:20	48	56	46
16:25	54	70	46
16:30	49	66	46
16:35	46	52	45
16:40	47	55	46
16:45	46	51	46
16:50	48	59	47
16:55	49	58	47
17:00	49	55	47
17:05	49	58	47
17:10	50	62	48
17:15	49	55	47
17:20	50	62	48
17:25	49	54	48
17:30	49	54	47

Time	L_{Aeq}	L_{AMax}	L_{A90}
17:35	49	54	47
17:40	48	62	47
17:45	48	53	47
17:50	48	55	47
17:55	49	53	47
18:00	48	54	47
18:05	48	55	47
18:10	48	58	47
18:15	48	50	47
18:20	49	57	47
18:25	49	53	47
18:30	49	57	47
18:35	49	53	48
18:40	49	55	48
18:45	49	61	47
18:50	49	55	47
18:55	48	55	47
19:00	48	57	47
19:05	51	62	48
19:10	50	59	48
19:15	48	63	47
19:20	48	61	47
19:25	48	60	46
19:30	48	57	46
19:35	48	52	47
19:40	48	52	47
19:45	47	51	46
19:50	47	56	46
19:55	47	56	46
20:00	47	52	46
20:05	47	52	46
20:10	47	54	46
20:15	48	62	46
20:20	48	61	46
20:25	48	61	46
20:30	47	56	46
20:35	47	51	46
20:40	47	51	46
20:45	51	66	47
20:50	47	51	46
20:55	47	58	45
21:00	47	54	45
21:05	48	54	46
21:10	47	51	46
21:15	49	62	46
21:20	47	53	45
21:25	46	50	44
21:30	46	62	44

EC 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
21:35	59	78	44
21:40	46	49	45
21:45	46	60	44
21:50	46	56	45
21:55	52	68	45
22:00	47	53	46
22:05	48	53	47
22:10	55	72	46
22:15	46	51	45
22:20	47	53	46
22:25	47	52	45
22:30	47	52	45
22:35	46	52	45
22:40	46	55	45
22:45	46	51	45
22:50	47	54	45
22:55	47	53	46
23:00	47	53	44
23:05	46	54	44
23:10	46	51	45
23:15	46	51	44
23:20	57	77	44
23:25	46	54	44
23:30	52	55	51
23:35	45	57	43
23:40	49	55	44
23:45	51	55	46
23:50	53	58	51
23:55	46	51	45
00:00	46	53	43
00:05	45	51	43
00:10	44	54	43
00:15	44	49	43
00:20	44	53	42
00:25	43	49	42
00:30	44	50	42
00:35	44	49	42
00:40	44	48	43
00:45	46	55	44
00:50	46	51	43
00:55	44	52	42
01:00	45	51	43
01:05	43	51	41
01:10	43	50	40
01:15	42	47	40
01:20	45	59	41
01:25	42	55	38
01:30	40	48	38

Time	L_{Aeq}	L_{AMax}	L_{A90}
01:35	40	47	38
01:40	39	48	38
01:45	38	45	36
01:50	39	47	37
01:55	42	51	40
02:00	38	46	35
02:05	37	46	34
02:10	37	46	35
02:15	35	38	33
02:20	37	48	35
02:25	38	46	35
02:30	36	40	34
02:35	36	39	34
02:40	36	39	35
02:45	38	45	37
02:50	38	45	37
02:55	39	46	37
03:00	41	50	38
03:05	39	45	37
03:10	39	46	36
03:15	37	43	36
03:20	39	49	37
03:25	38	45	36
03:30	40	53	37
03:35	39	50	37
03:40	39	44	37
03:45	40	52	38
03:50	39	48	37
03:55	40	47	38
04:00	39	45	38
04:05	39	47	37
04:10	39	45	37
04:15	39	50	37
04:20	41	54	37
04:25	39	49	37
04:30	40	48	38
04:35	40	46	38
04:40	40	50	38
04:45	43	59	39
04:50	41	50	39
04:55	42	54	39
05:00	41	53	39
05:05	41	47	40
05:10	40	51	39
05:15	41	48	39
05:20	41	48	39
05:25	40	46	39
05:30	42	47	40

EC 14544 - Chalcot Yard

Werninck Building Services

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
05:35	42	47	41
05:40	43	49	42
05:45	43	46	42
05:50	43	49	42
05:55	43	47	42
06:00	43	55	42
06:05	44	49	43
06:10	44	48	43
06:15	45	51	43
06:20	45	50	44
06:25	45	49	44
06:30	45	54	44
06:35	46	49	45
06:40	46	53	45
06:45	46	61	44
06:50	46	49	44
06:55	46	49	45
07:00	47	52	46
07:05	47	63	45
07:10	47	54	45
07:15	47	54	46
07:20	47	52	46
07:25	49	57	47
07:30	47	51	46
07:35	47	53	46
07:40	48	55	47
07:45	48	53	46
07:50	48	56	47
07:55	50	65	47
08:00	50	59	48
08:05	49	56	47
08:10	50	62	46
08:15	49	62	47
08:20	49	55	47
08:25	50	61	47
08:30	48	58	47
08:35	51	62	48
08:40	50	59	48
08:45	51	69	48
08:50	49	60	47
08:55	48	63	46
09:00	49	57	47
09:05	49	58	47
09:10	52	67	47

Time	L_{Aeq}	L_{AMax}	L_{A90}

APPENDIX E

SURVEY RESULTS
(GRAPHICAL)

Noise Level Time History at Chalcot Yard