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REPORT AS7909.141017.NIA

THE ROTUNDA BOROUGH OF CAMDEN

NOISE IMPACT ASSESSMENT

Prepared: 17 October 2014

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1. INTRODUCTION

Planning approval is being sought for the existing plant at the Rotunda, 42-43 Gloucester Crescent. It is understood that a planning consent exists for plant in this area, but the applicability of the consent to the current plant installation and its precise location is unclear and concerns have been raised that it may be too noisy.

To regularise the situation, therefore, the plant is to be amalgamated into a more contained footprint, around and over which an acoustic enclosure is to be constructed. The micro-siting of the plant and specification of the enclosure have been developed with the sole purpose of optimising the noise control measures which can be applied to the installation.

It will also provide an opportunity to service and overhaul the units, and address any audible features, such as rattles.

Clarke Saunders Associates has been commissioned by Workman LLP to undertake an environmental noise survey in order to measure the prevailing background noise climate at the site. The background noise levels measured will be used to determine daytime and night-time noise emission limits for the plant in accordance with the planning requirements of Camden Council.

2. SURVEY PROCEDURE & EQUIPMENT

A survey of the existing background noise levels was undertaken at a height of approximately 2m above ground level at the location shown in site plan AS7909/SP1. Measurements of consecutive 5-minute L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were taken between 15:20 hours on Friday 20th June and 11:05 hours on Tuesday 24th June 2014.

These measurements will allow suitable noise criteria to be set for the relocated building services plant.

The following equipment was used during the course of the survey:

- Rion data logging sound level meter type NA52;
- Rion sound level calibrator type NC-74.

The calibration of the sound level meter was verified before and after use. No calibration drift was detected.

The weather during the survey was dry with light winds, which made the conditions suitable for the measurement of environmental noise. There were brief periods of rain recorded on the evening of Monday 23rd June. These events are not believed to have altered the recorded minimum background noise levels.

Measurements were made generally in accordance with ISO 1996-2:2007 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels*.

An additional survey was undertaken to measure the noise level incident on a second floor window overlooking the existing plant during working hours on Friday 18th July 2014. As this was considered to be an atypically hot day, it is expected that the existing plant was operating close to its maximum expected duty.

Please refer to Appendix A for details of the acoustic terminology used throughout this report.

3. RESULTS

Figures AS7909/TH1-TH4 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at the environmental measurement position.

4. DISCUSSION

The background noise climate is determined by road traffic noise in the surrounding streets and some plant serving neighbouring buildings.

No tonal features, such as whistles or hums, were identified from the measurements and direct observations, but in one case a slight rattle could be discerned from the condenser housing, details of which have been passed on to the equipment service engineer.

Results of measurements taken by the window of the nearest office window (not serviced by the plant) showed current ambient levels between $L_{Aeq,15mins}$ 58dB and L_{Aeq} 65dB with a minimum $L_{Amin,15mins}$ of 54dB. These levels are determined by a combination of both road traffic and permanent existing plant.

Typical lowest background levels measured are shown in Table 4.1 below.

Monitoring period	Typical Lowest Background Level ($L_{A90,5mins}$)	Average Noise Level ($L_{Aeq,5mins}$)
07:00 - 23:00 hours	44 dB	55 dB
23:00 - 07:00 hours	42 dB	52 dB
Typical Office Hours (08:00-20:00)	46 dB	57 dB

Table 4.1 - Minimum measured background and average noise levels [dB ref. 20µPa]

5. DESIGN CRITERIA

Table E of the Camden Development Policies 2010-2025, DP28, state that the requirement for planning permission to be granted is that noise levels from plant and machinery at 1metre external to a sensitive façade do not exceed a level 5dB below the background level, or 10 dB below background level if the noise has any distinguishable character (bangs, clicks, clatters, thumps, whine, hiss, screech or hum).

The only feature of this nature which could be discerned from the existing plant was a slight rattle evident against the casing of one of the units. This information has been passed on to the equipment service engineer for rectification during the course of the amalgamation project.

Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)	24 hours
L_{Aeq} 39 dB	L_{Aeq} 37 dB	L_{Aeq} 37 dB

Table 5.1 - Proposed design noise criteria [dB ref. 20µPa]

5.2 BS8233:2014 Sound insulation and noise reduction for buildings

The guidance in this document indicates desirable noise levels for various activities within residential and commercial buildings.

The relevant sections of this standard are shown in the following tables:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,\ 16\ hour}$	-
Dining	Dining Room	40 dB $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$

Table 5.2 - Excerpt from BS8233: 2014 Indoor ambient noise levels for dwellings [dB ref. 20µPa]

Activity	Location	Design Range (dB $L_{Aeq,T}$)
Study and Work Requiring Concentration	Staff/meeting room, training room	35 - 45
	Executive office	35 - 40

Table 5.3 - Excerpt from BS8233: 2014 Non-domestic buildings [dB ref. 20µPa]

6. PREDICTED NOISE IMPACT

6.1 Proposed plant

The plant to be repositioned has been confirmed as:

- 2 no. Daikin Condensing Units Type PURY-P250YJM-A
- 2 no. Daikin wall mounted units Type ARX35J2V1B
- 1 no. Daikin wall mounted unit Type RZQSG71L2V1B
- 1 no. Daikin wall mounted unit Type 5MXS90E2V3B
- 1 no. Daikin wall mounted unit Type RXS50GZV1B
- 1 no. Daikin wall mounted unit Type RZQS100D7V1B
- 1 no. Mitsubishi wall mounted unit Type MUZ-SF35VE
- 1 no. Mitsubishi wall mounted unit Type MUZ-SF50VE

The approximate location of the plant to be installed is shown in site plan AS7909/SP1.

It is proposed to enclose the plant in an acoustic enclosure consisting of Allaway acoustic panels incorporating sound absorptive finishes and Allaway acoustic louvres across the lower half of the eastern boundary. The enclosure is to be roofed over with imperforate Allaway acoustic panels.

Noise levels generated by the plant to be attenuated have been confirmed by the manufacturers as follows, consistent with the levels measured during the site surveys:

Model	Freq (Hz)	63	125	250	500	1000	2000	4000	8000
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40
RZQSG71L2V1B	Lp @ 1m	52	50	52	48	47	41	38	31
5MXS90E2V3B	Lp @ 1m	57	54	53	50	48	42	38	31
ARX35J2V1B	Lp @ 1m	48	49	49	46	43	38	32	26
RXS50GZV1B	Lp @ 1m	42	47	45	39	38	33	26	15

RZQS100D7V1B	Lp @ 1m	59	59	52	52	51	45	44	34
MUZ-SF35VE	Lp @ 1m	50	54	51	47	45	41	35	29
MUZ-SF50VE	Lp @ 1m	56	55	51	49	48	44	37	32

Table 6.1 - Source noise data for the external plant to be relocated [dB ref. 20µPa]

6.2 Predicted noise levels

Following an inspection of the site, the most affected residential receivers are situated directly across the car park from the plant location, as shown on the indicative site plan AS7909/SP1, at least 20 metres away from the proposed plant location. Other surrounding residential premises are well screened from the plant location by surrounding buildings and are expected to be less affected. The most affected commercial facade is the window to the offices on the second floor of the Rotunda Building directly above the proposed plant location.

The cumulative noise level at the nearest dwelling has been assessed according to the guidelines set out in BS4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas* as guidance, using the noise data above.

The composite insertion loss of the enclosure has been calculated using the sound reduction indices of the Allaway Acoustic Panels and Acoustic Louvres, provided by the manufacture and quoted in the following table:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Allaway Panel (EP50/UF)	17	19	26	33	38	42	45	44
Allaway Louvre (AL1515)	4	4	5	8	12	16	15	13

Table 6.2 - Sound Reduction Indices of Acoustic Enclosure Components

The proposed enclosure is understood to be finished with solid panels forming the top of the enclosure over the plant. The contribution from the combined direct and reverberant field in the enclosure has been calculated separately and the cumulative resulting noise level at the assessment locations for all plant items running is summarised as follows:

	dB(A)
Criterion	**37**
Predicted level at 1m from residential receiver	**30**

Table 6.3 - Predicted noise level and criteria at nearest dwelling [dB ref. 20 µPa]

	dB(A)
Predicted level at 1m from office Window	**41**

Table 6.4 - Predicted noise level and criteria at nearest office [dB ref. 20 µPa]

A summary of the calculations are shown in Appendix B.

The results of the calculation indicate that the cumulative noise achieve the design criterion at the residential receiver.

6.3 Comparison to BS8233:2014 Criteria

BS8233 assumes a loss of approximately 15dB for a partially open window. The external noise level shown in Table 6.3 and Table 6.4 would result in an internal noise levels that would be lower than the levels shown in Table 5.2 and Table 5.3.

6.4 Discussion

6.4.1 Residential receiver

The assessment shows that the planning conditions are achieved at the most affected residential receiver with a robust assessment undertaken by a considerable margin.

It should be noted that the above assessment assumes all plant operating at full duty during the period when the minimum background noise levels occur. This is unlikely, especially during night-time periods when cooling loads are reduced. It can therefore be considered that the noise level at the assessment location would most likely be lower than that indicated in the above calculations.

6.4.2 Commercial Buildings

It is also necessary to assess cumulative noise levels from the amalgamated plant at the windows of the nearest office not serviced by the plant. Although the standard Camden condition is based on BS4142, which applies to dwellings as sensitive receptors, it is nevertheless appropriate to consider the noise climate to which the commercial neighbours are exposed, albeit with a more suitable form of comparison.

The expected specific noise level due to all plant operating at the nearest windows is L_{Aeq} 41dB, which represents a reduction of 13dB from the level observed for the current case under like for like conditions (roughly a half as loud in subjective terms).

The resultant noise level within the offices, with windows open, due to the enclosed plant is expected to be comfortably below the desirable levels outlined in BS8233. Existing average L_{Aeq} noise levels in the locality are already 16dB higher than these predicted levels. The proposed installation would not, therefore, be expected to result in unreasonable internal noise levels in the adjacent offices. At this level, the plant noise would not be likely to cause any disruption to the office use, even when windows are open.

7. CONCLUSION

An environmental noise survey has been undertaken at The Rotunda, 42-43 Gloucester Crescent, London by Clarke Saunders Associates between Friday 20th June and Tuesday 24th June 2014.

Measurements have been made to establish the current background noise climate. This has enabled a 24-hour design criterion to be set for the control of plant noise emissions to noise sensitive properties, in accordance with Camden Council's requirements.

Data for the existing external cooling units has been used to predict the noise impact of the plant, relocated into an acoustic enclosure, on neighbouring residential properties. The impact on nearby office uses has also been considered.

Compliance with the noise emission design criterion has been demonstrated for residential neighbours. It has also been shown that the noise impact on the surrounding offices will be dramatically reduced by the proposed measures, to a level below that which would be expected to cause any disturbance. The proposed mitigation measures are therefore considered entirely appropriate for control of external noise emissions.

Steven Liddell MIOA
CLARKE SAUNDERS ASSOCIATES

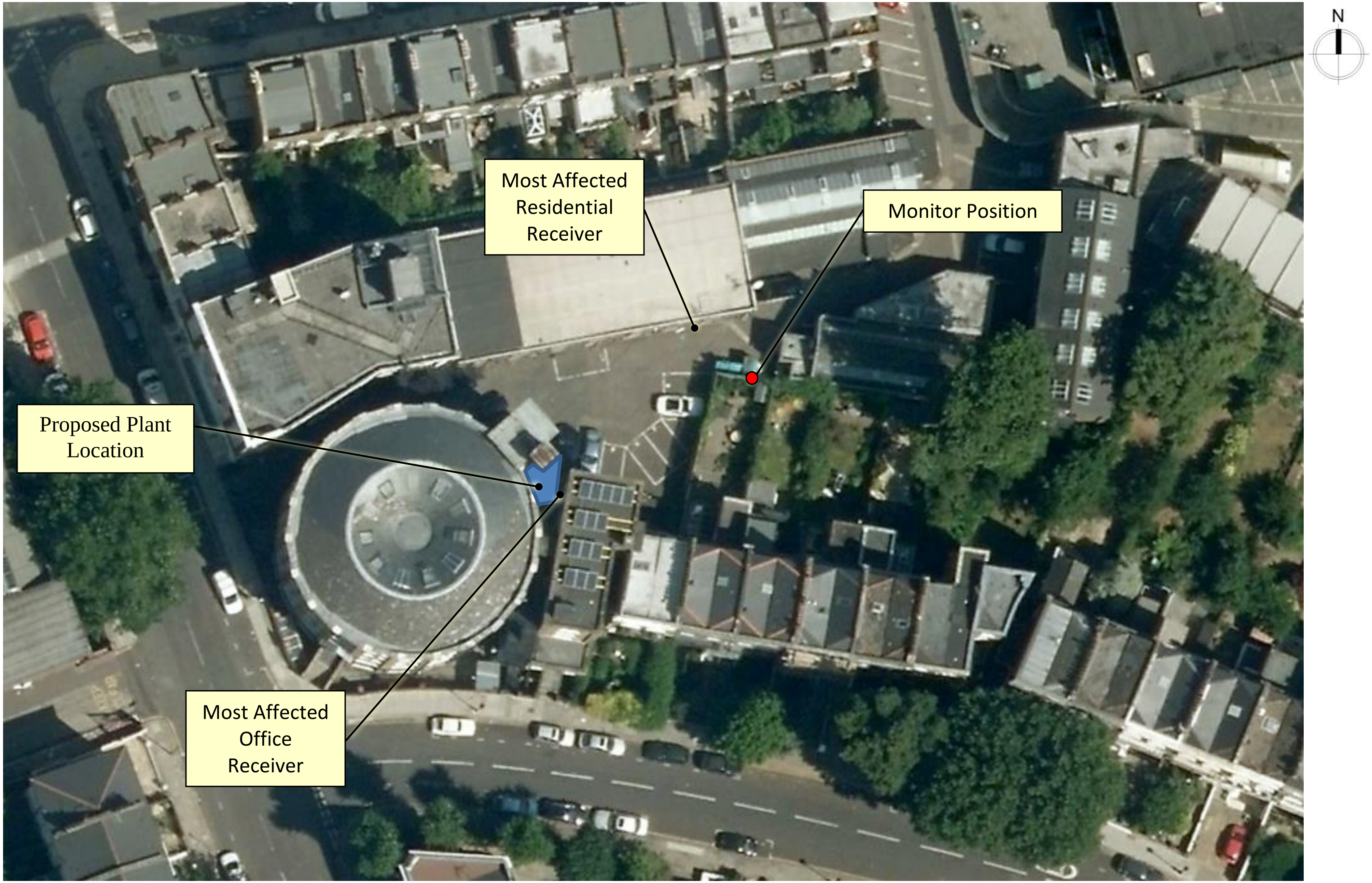
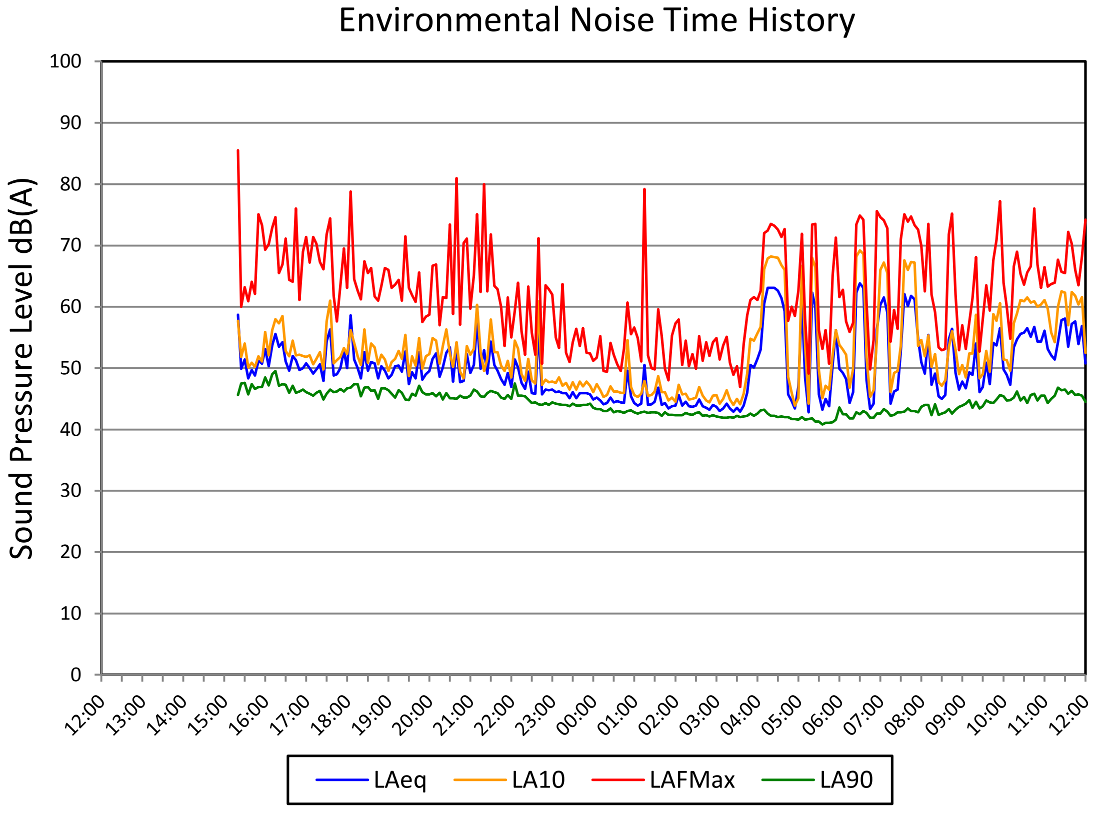


Figure AS7909/SP1

The Rotunda, 42-43 Gloucester Crescent, London

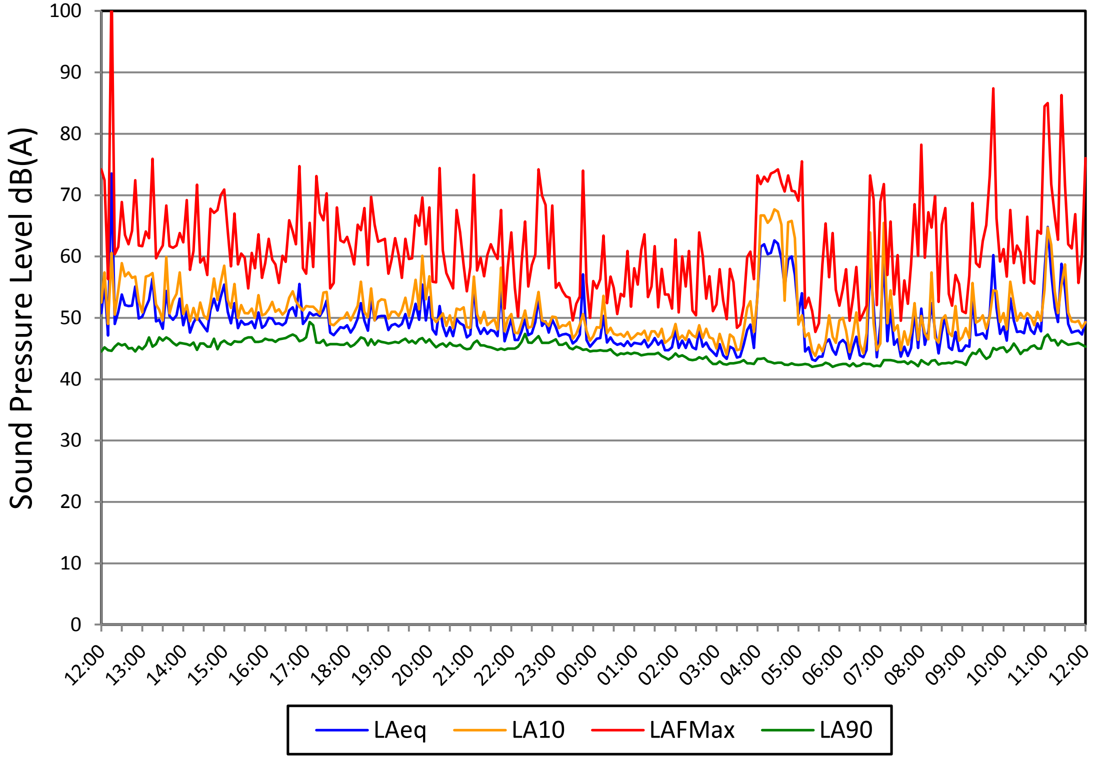


Friday 20 June to Saturday 21 June 2014

Figure AS7909/TH1

The Rotunda, 42-43 Gloucester Crescent, London

Environmental Noise Time History

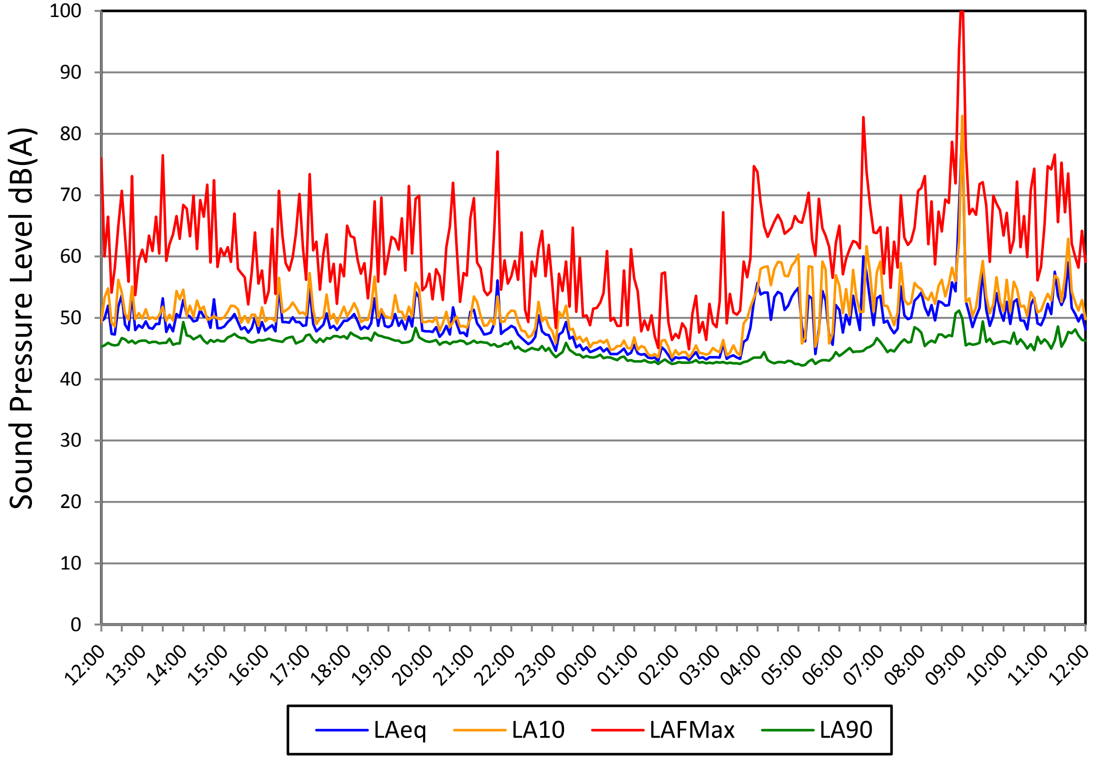


Saturday 21 June to Sunday 22 June 2014

Figure AS7909/TH2

The Rotunda, 42-43 Gloucester Crescent, London

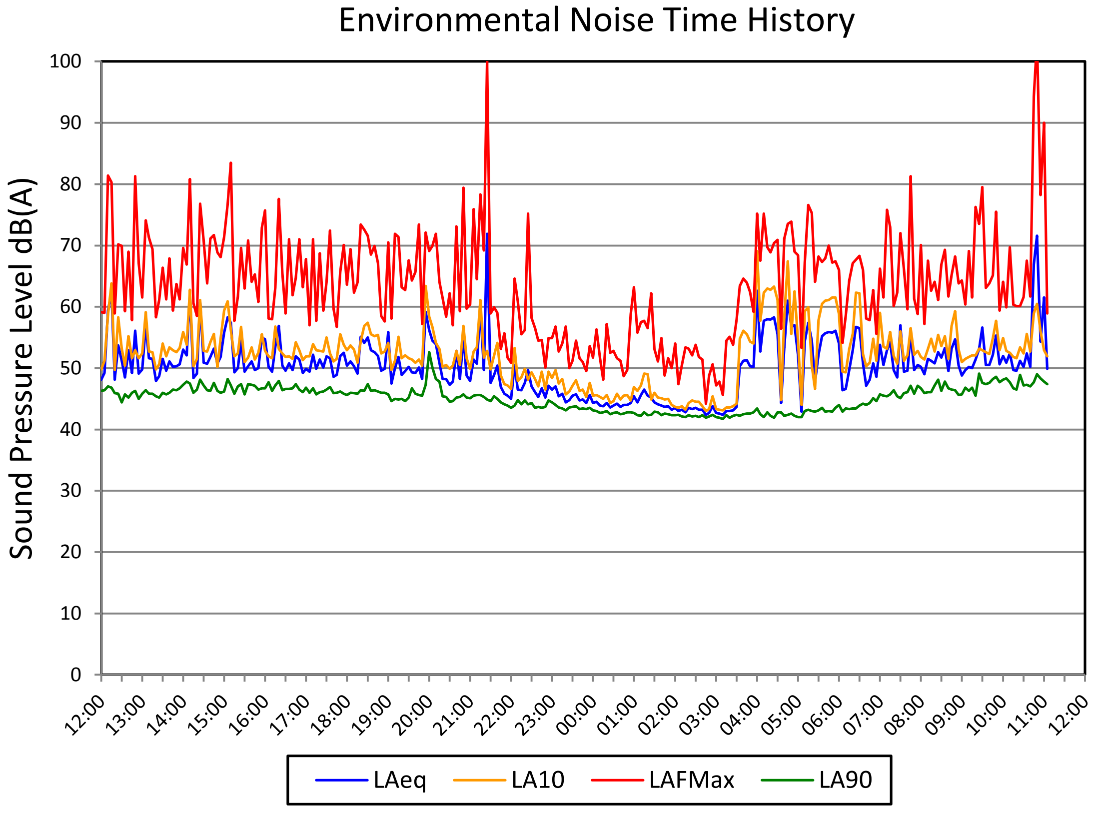
Environmental Noise Time History



Sunday 22 June to Monday 23 June 2014

Figure AS7909/TH3

The Rotunda, 42-43 Gloucester Crescent, London



Monday 23 June to Tuesday 24 June 2014

Figure AS7909/TH4

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

1.0 ACOUSTIC TERMINOLOGY

The annoyance produced by noise is dependent upon many complex interrelated factors such as ‘loudness’, its frequency (or pitch) and any variations in its level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

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.

L_{10} & L_{90} : 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.

It is common practice to use the L_{10} index to describe traffic noise, as being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic noise.

L_{eq} : The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

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 (e.g. 8 hour, 1 hour, etc).

The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward.

Because L_{eq} is effectively a summation of a number of noise events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute noise limit.

L_{max} : L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

D The sound insulation performance of a construction is a function of the difference in noise level either side of the construction in the presence of a loud noise source in one of the pair of rooms under test. *D*, is therefore simply the *level difference* in decibels between the two rooms in different frequency bands.

D_w D_w is the *Weighted Level Difference* The level difference is determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1.

$D_{nT,w}$ $D_{nT,w}$ is the *Weighted Standardised Level Difference* as defined in BS EN ISO 717-1 and represents the *weighted level difference*, as described above, corrected for room reverberant characteristics.

C_{tr} C_{tr} is a spectrum adaptation term to be added to a single number quantity such as $D_{nT,w}$, to take account of characteristics of a particular sound.

$L'_{nT,w}$ $L'_{nT,w}$ is the *Weighted Standardised Impact Sound Pressure Level* as defined in BS EN ISO 717-2 and represents the level of sound pressure when measured within room where the floor above is under excitation from a calibrated tapping machine, corrected for the receive room reverberant characteristics.

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

2.0 OCTAVE BAND FREQUENCIES

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation have agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, eg. 250 Hz octave band runs from 176 Hz to 353 Hz. The most commonly used bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

3.0 HUMAN PERCEPTION OF BROADBAND NOISE

Because of the logarithmic nature of the decibel scale, it should be borne in mind that noise levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) is not twice as loud as 50 dB(A) sound level. It has been found experimentally that changes in the average level of fluctuating sound, such as traffic noise, need to be of the order of 3 dB(A) before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10 dB(A) is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in traffic noise level can be given.

INTERPRETATION

Change in Sound Level dB(A)	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

4.0 EARTH BUNDS AND BARRIERS - EFFECTIVE SCREEN HEIGHT

When considering the reduction in noise level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a 3 metre high barrier exists between a noise source and a listener, with the barrier close to the listener, the listener will perceive the noise source is louder, if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the noise source would seem quieter than it was if he were standing. This may be explained by the fact that the "effective screen height" is changing with the three cases above, the greater the effective screen height, in general, the greater the reduction in noise level.

Where the noise sources are various roads, the attenuation provided by a fixed barrier at a specific property will be greater for roads close to the barrier than for roads further away.

APPENDIX B
AS7909: The Rotunda, Borough of Camden
Plant Noise Assessment To Residential Recievers

Direct Sound Transmission (Condensing Units)		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40	**60**
Two units	2 No.	3	3	3	3	3	3	3	3	
Reflection off backing wall	Q=2	3	3	3	3	3	3	3	3	
Enclosure (Composite Calc)		-7	-7	-8	-11	-15	-19	-18	-16	
Distance Loss	To 20m	-26	-26	-26	-26	-26	-26	-26	-26	
Level at receiver		45	38	33	26	18	11	9	4	**29**
Reverberant - Direct (All Units)										
MUZ-SF35VE	Lp @ 1m	50	54	51	47	45	41	35	29	
MUZ-SF50VE	Lp @ 1m	56	55	51	49	48	44	37	32	
RZQSG71L2V1B	Lp @ 1m	52	50	52	48	47	41	38	31	
5MXS90E2V3B	Lp @ 1m	57	54	53	50	48	42	38	31	
ARX35J2V1B	Lp @ 1m	48	49	49	46	43	38	32	26	
ARX35J2V1B	Lp @ 1m	48	49	49	46	43	38	32	26	
RXS50GZV1B	Lp @ 1m	42	47	45	39	38	33	26	15	
RZQS100D7V1B	Lp @ 1m	59	59	52	52	51	45	44	34	
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40	
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40	
Total SLP	**Lp @ 1m**	**75**	**69**	**65**	**62**	**59**	**55**	**52**	**45**	
Total SWL		83	77	73	70	67	63	60	53	
Krev of enclosure		-2	-2	-7	-10	-10	-10	-9	-9	
SRI of enclosure (composite of louvre and panel)		-7	-7	-8	-11	-15	-19	-18	-16	
Rev - Direct correction factor		-6	-6	-6	-6	-6	-6	-6	-6	
Rathe Distance Propagation	To 20m	-26	-26	-26	-26	-26	-26	-26	-26	
Level at receiver		43	36	26	17	10	2	0	0	**24**
Specific Noise Level	$L_{eq\ 1hr}$	**47**	**40**	**34**	**27**	**19**	**12**	**10**	**6**	**30**

Rating level	**30 dB(A)**
Background Noise Level	**42 dB(A)**
Assessment Level	**-12**

APPENDIX B
AS7909: The Rotunda, Borough of Camden
Plant Noise Assessment To Offices

		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
Reverberant - Direct (All Units)										
MUZ-SF35VE	Lp @ 1m	50	54	51	47	45	41	35	29	
MUZ-SF50VE	Lp @ 1m	56	55	51	49	48	44	37	32	
RZQSG71L2V1B	Lp @ 1m	52	50	52	48	47	41	38	31	
5MXS90E2V3B	Lp @ 1m	57	54	53	50	48	42	38	31	
ARX35J2V1B	Lp @ 1m	48	49	49	46	43	38	32	26	
ARX35J2V1B	Lp @ 1m	48	49	49	46	43	38	32	26	
RXS50GZV1B	Lp @ 1m	42	47	45	39	38	33	26	15	
RZQS100D7V1B	Lp @ 1m	59	59	52	52	51	45	44	34	
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40	
PURY-P250YJM-A	Lp @ 1m	72	65	61	57	53	50	47	40	
Total SLP	**Lp @ 1m**	**75**	**69**	**65**	**62**	**59**	**55**	**52**	**45**	
Total SWL		83	77	73	70	67	63	60	53	
Krev of enclosure		-2	-2	-7	-10	-10	-10	-9	-9	
SRI of enclosure (composite of louvre and panel)		-7	-7	-8	-11	-15	-19	-18	-16	
Rev - Direct correction factor		-6	-6	-6	-6	-6	-6	-6	-6	
Rathe Distance Propagation	To 6m	-16	-16	-16	-16	-16	-16	-16	-16	
Q=4 (reverberation in lightwell)		6	6	6	6	6	6	6	6	
Level at receiver		59	53	43	34	27	19	17	11	**41**
Specific Noise Level	**$L_{eq\ 1hr}$**	**59**	**53**	**43**	**34**	**27**	**19**	**17**	**11**	**41**

** Screening Limited to 18dB*

BS8233 reduction through open window	**-15 dB**
Internal noise level	**26 dB(A)**
BS8233 recommended internal levels for offices	**35-45**