SHARPS REDMORE

ACOUSTIC CONSULTANTS • Established 1990

Report

New London Theatre, Drury Lane, London

Environmental Noise Survey and Assessment of Noise Emissions from Proposed New Condensers

Prepared by

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Contents

Appendices

1.0 Introduction

1.1 Sharps Redmore (SR) has been instructed to undertake a revised assessment of the noise emissions due to the proposed installation of cooling plant on the roof of the New London Theatre. The revised assessment being necessary due to a revised scheme whereby the three air cooled chillers proposed in 2015 are to be omitted and the current chillers in the basement retained and the cooling to be provided by three condenser units located on the roof.

1.2 The original assessment was reported in Sharps Redmore report dated 8th January 2015. This report is a revision of the 2015 report with the assessment being based on the new plant proposed.

1.3 A noise survey to establish the existing noise climate at the New London Theatre, Drury Lane, London, WC2 was undertaken in December 2014 and the details are shown in this report as it is considered that the noise levels measured at that time should not have changed and was the basis of the planning permission in 2015. The assessment evaluates the noise data of the proposed fixed plant as calculated to the nearest existing noise sensitive receivers with that of Camden Borough Council's Policy DP28 *(Noise and vibration)*.

1.4 The site is a seven storey theatre building located on Drury Lane. The area is typically made up of offices, retail units, residential dwellings and some theatres. The area is dominated by noise from pedestrians, road traffic, aircraft pass-by and mechanical services plant.

1.5 It is proposed to install two new condensers from Coolers and Condensers Ltd, one KFHC1.2-234 model with six fans, and one KFHC1.2-134 model with three fans on the rooftop of the New London Theatre in the position shown in Appendix C, which is an existing high level flat roof.

1.6 The noise sensitive receivers most likely to be affected by noise from plant are:

- To the North East a residential tower block "Winter Garden House" attached to the rear of the theatre, accessed via Macklin Street.
- To the north, adjacent 5 storey flats also on Macklin Street. This property has one balcony overlooking Parker Mews to the east of the plant area, in close horizontal proximity, but some 9 metres below.
- To the South East 5 storey residential flats on Parker Street overlooking Parker Mews to the rear.

1.7 A guide to the assessment methodology and criteria used within this report is included in section 2.0. Details of the noise survey to establish the existing noise climate and to determine suitable design criteria at the closest residences are presented in section 3.0. Survey results are shown in Appendix B.

1.8 An assessment of the noise impact from the new plant, based on manufacturer's data and drawings provided is included in section 4.0.

1.9 A guide to the acoustic terminology used in this report is contained in Appendix A.

1.10 Calculations for the noise emissions are shown in Appendix D.

2.0 Assessment Methodology

National Policy

2.1 The National Planning Policy Framework (NPPF), March 2012, sets out the Government's planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 123 of the NPPF states the following:

"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."*

2.2 The NPPF refers to the March 2010 DEFRA publication. "Noise Policy Statement for England" (NPSE), which reinforces and supplements the NPPF. The NPSE states three policy aims, as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on 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."*

2.3 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect (LOAEL) and a level which represents a significant observed adverse effect (SOAEL), then according to the explanatory notes in the statement:

"...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

Local Policy

2.4 The site lies within Camden Borough Council's (CBC) jurisdiction. CBC's Policy document DP28 requires a comparison of noise from proposed new plant to existing noise levels. The noise levels above which planning permission will not be granted are set out in Table E as follows:

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	5 dB(A) < L_{A90}
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	10 dB(A) < L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade	Day, Evening and night	0000 – 2400	10 dB(A) < L_{A90}
Noise at 1 metre external to sensitive façade where L_{A90} > 60 dB	Day, Evening and night	0000 - 2400	55 dBL_{Aeq}

2.5 The lowest measured background noise levels at the position on the 5th floor roof overlooking Parker Mews were:

Daytime (0700 – 1900) 43 dB $L_{A90,15\ mins}$

Evening (1900 – 2300) 50 dB $L_{A90,15\ mins}$

Night time (2300 – 0700) 43 dB $L_{A90,15\ Mins}$

2.6 The lowest measured background noise levels at the position on the 6th floor roof overlooking the flats on Macklin Street were:

Daytime (0700 – 1900) 48 dB $L_{A90,15\ mins}$

Evening (1900 – 2300) 49 dB $L_{A90,15\ mins}$

Night time (2300 – 0700) 47 dB $L_{A90,15\ Mins}$

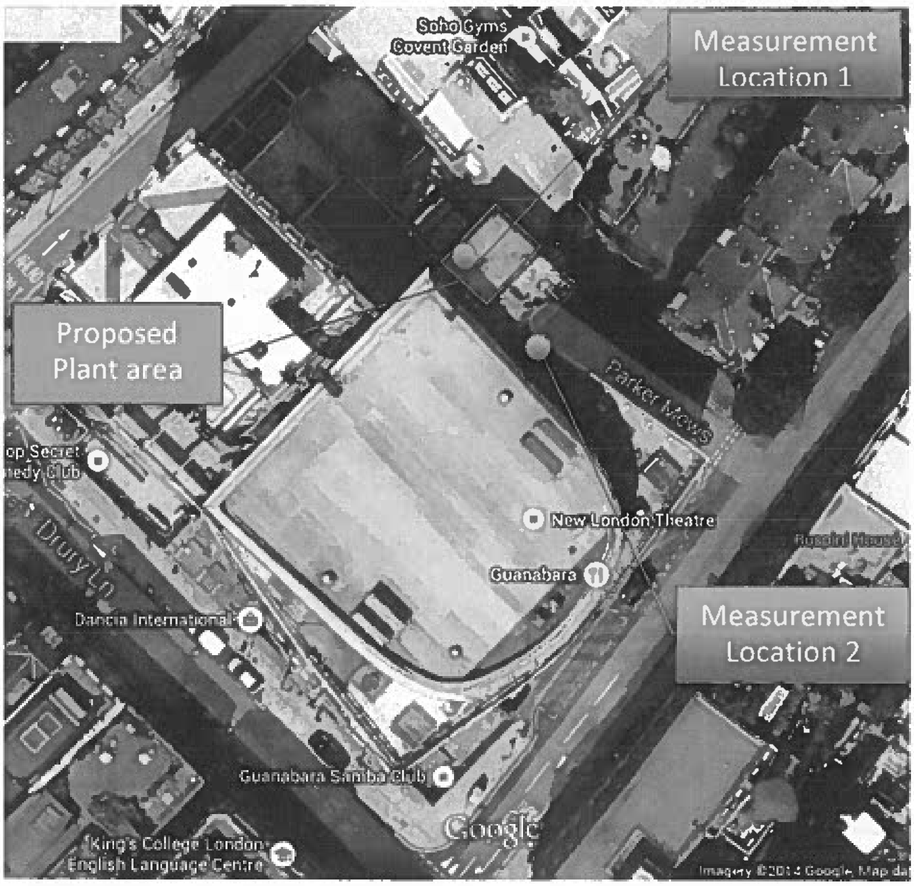
2.7 A comparison of the measured noise levels against the upper criterion of 60 dB L_{A90} indicates that the 4th criterion in the local authority's policy does not apply as background noise levels are rarely above this level.

2.8 Assuming the new plant will not have impulsive or tonal characteristics as described above, the criteria for new plant should therefore be to not exceed 5 dBA below the lowest measured background noise level for each noise sensitive location, as predicted to 1m from the nearest noise sensitive.

3.0 Survey Details

3.1 A survey of existing noise levels was carried out between Friday 28th November and Tuesday 2nd December 2014 at two locations at the New London Theatre and as depicted in Fig 1; Location 1 - on a small lower roof above the 6th floor level, overlooking the flat roof to the rear of the theatre between the tower block and other flats on Macklin St. (at approximately 10 metres from the adjacent residential dwelling façade) and Location 2 – on the roof above 5th floor level overlooking Parker Mews. The monitoring positions were chosen to be representative of the ambient and background noise levels at the nearest noise sensitive dwellings (also shown in Fig 1) to the existing plant area.

Fig 1: Monitoring locations



3.2 The weather during the survey was mostly dry but with around 1mm of rain on the final day of the survey. Wind direction varied during the survey. Wind speeds were mostly low to moderate, with average speeds of 13Km/h on the Friday, Monday and Tuesday, but 8Km/h and 6Km/h on the Saturday and Sunday respectively. Stronger gusts of up to 27 Km/h were present on the first and last day of the survey. Temperatures were mild and ranged between 6 – 13°C. The measurement positions were part shielded from wind conditions, particularly measurement location 2. Whilst the short period of rain on the final day and gusts of wind on the first and final day would not be considered fully suitable for such noise measurements it is considered that the weather conditions during the weekend were suitable for carrying out sound level measurements, as would the conditions when there was no rain or no gusts of wind on the other days.

3.3 The measurements were taken using two Norsonic 118 Class 1 precision sound level meters. The correct operation of the sound level meters was verified at the start and end of the survey by the application of an associated acoustic calibrator and showed no significant drift, and have full traceable calibration histories. Sound level measurements were taken automatically at fifteen minute samples over the duration of the survey. All measurements at location 1 were taken in approximately free field conditions, 1.5m above the roof, and approximately 3 – 4 metres from the vertical façade of the auditorium. Measurement location 2 was in a façade location, 1 metre from the nearest façade 1.5m above the roof, and approximately 3m from another façade.

3.4 The average ambient noise levels dB $L_{Aeq(15min)}$ and background noise levels dB, $L_{A90(15min)}$ were recorded during the survey and are summarised in Fig 2 and Fig 3. Full details of the survey are included in Appendix B and include additionally recorded noise levels; dB $L_{Amax(15min)}$

Fig 2: Survey Results – Measurement Location 1

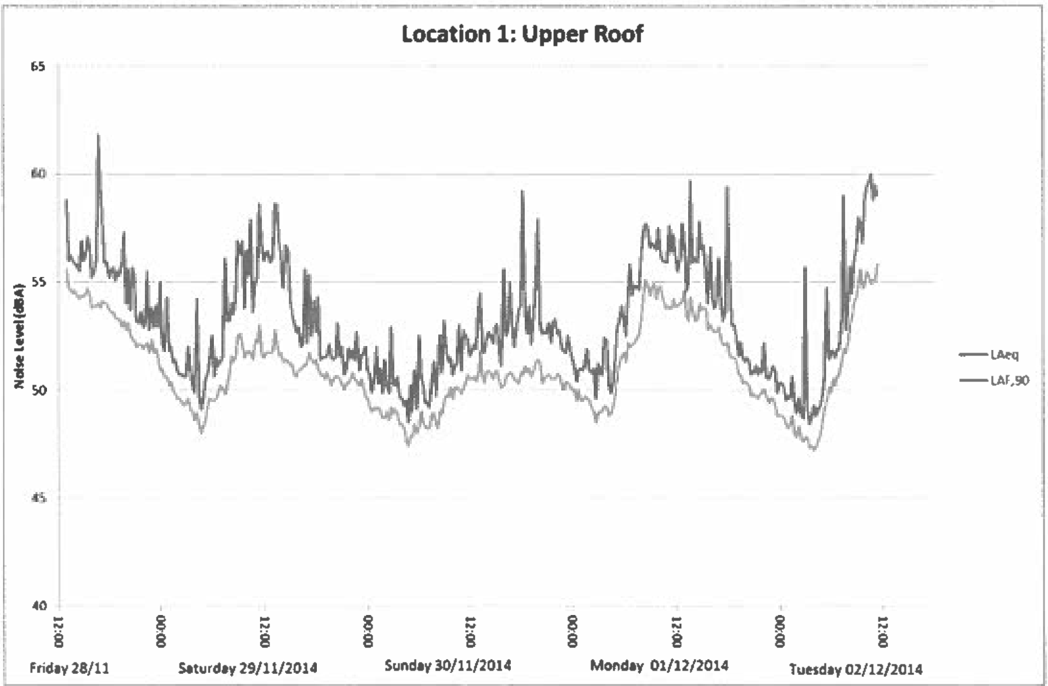
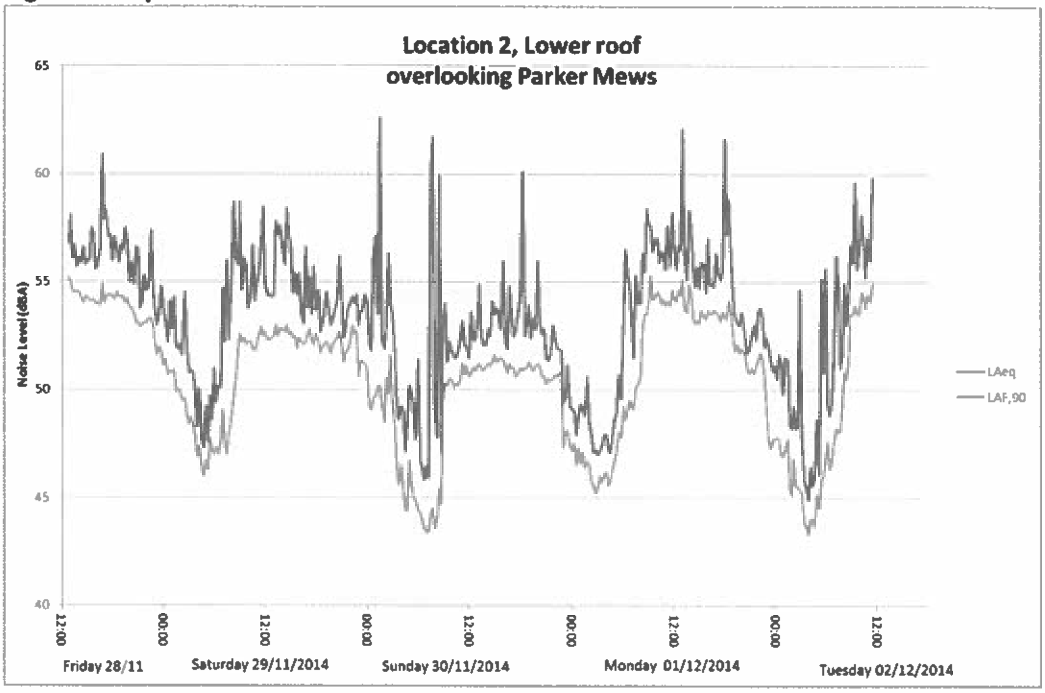


Fig 3: Survey Results – Measurement Location 2



3.5 The noise climate at measurement Location 1 was dominated by noise from traffic in the surrounding area, with no particular noise sources drawing attention.

3.6 The noise climate at measurement Location 2 was affected by extracts on the sloping roof between the measurement location and Parker Street. General traffic noise was also significant. Background noise levels at Location 2 were lower than at Location 1 due to this location being more screened from surrounding general environmental noise than Location 1.

4.0 Plant Noise Assessment and Mitigation

4.1 Sharps Redmore have been advised that the new condensers may operate 24 hours a day, Monday to Sunday. The lowest background noise levels shown during the noise survey during these hours can be established by inspecting the survey results. The lowest background noise levels overlooking Parker Mews, Location 2, of 43 dB L_{A90} were observed on Sunday morning between 7 am – 9am and between 4 – 5 am on the Tuesday morning. Generally the L_{A90} levels were above 45 dB. Note these are considered façade levels.

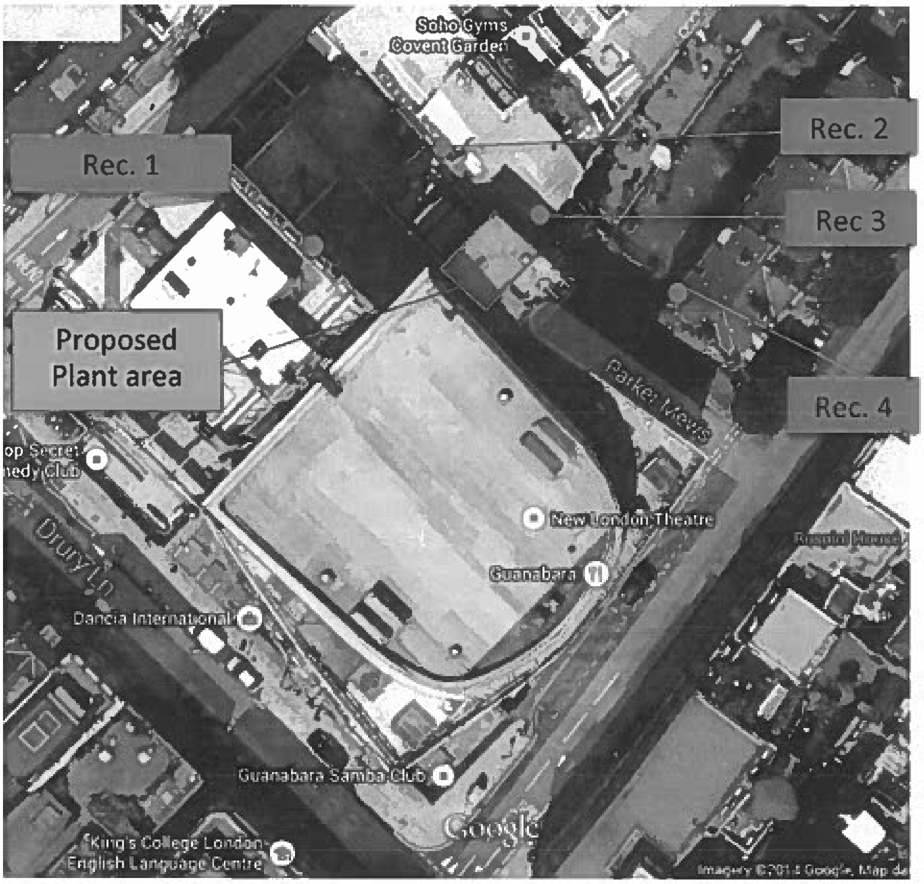
4.2 Therefore in accordance with CBC's plant noise criteria and allowing for the worst case of operating any day of the week and at the quietest time, the noise level due to the new plant should not exceed $L_{Aeq,15mins}$ 38 dB when calculated at the nearest noise sensitive properties overlooking Parker Mews.

4.3 The façade of the tower block and the flats opposite it were exposed to slightly higher background noise levels with a lowest measured free field level of 47 dB $L_{Aeq\ 15\ min}$. This is equivalent to a façade level of 50 dB $L_{Aeq\ 15\ min}$. For these façades the noise due to the new plant should not exceed a façade level 45 dB $L_{Aeq\ 15\ min}$.

4.4 It can, therefore, be seen that to meet the requirement of CBC's DP28, the noise from the plant must be controlled to:

- a maximum level of 45 dB $L_{Aeq,15mins}$ at the nearest noise sensitive receiver(s) to Location 1, namely receiver locations 1 and 2 on figure 4.
- a maximum level of 38 dB $L_{Aeq,15mins}$ at the nearest noise sensitive receivers to Location 2, namely receiver locations 3 and 4 on figure 4 (below).

Figure 4 – Nearest Noise Sensitive Receptors



Key:

Rec.1: Windows on the NE Façade of Winter Garden House up to 14 floors. Windows above the direct line of sight over screen 14m above top of condensers. Horizontal distance 13m from nearest condenser.

Rec. 2: Windows on SW Façade of property on Macklin Street. Vertical distance 11m below top of condensers. Horizontal distance 8m from nearest condenser.

Rec. 3: Balcony garden of rear flat in property on Macklin Street. Overlooking Parker Mews. 11m below top of condensers. Horizontal distance 3.8m from nearest condenser. No window or door visible from proposed condenser location.

Rec 4: Windows on rear of flats on Parker Street. Overlooking Parker Mews. Top flats at 5th floor level. Vertical distance 11 – 14m below top of condensers. Horizontal distance 12.5m from nearest condenser.

4.5 In order to determine any noise mitigation requirements an assessment has been undertaken based on two Coolers and Condensers Ltd condensers, one with six fans and one with three fans. A. The manufacturer has supplied the following noise data for each fan at full duty.

	Octave Band Centre Frequency							
	125	250	500	1k	2k	4k	8k	Hz	dBA
Sound Power	69.3	62.6	66.1	63.4	57.6	51.3	46.8	dB	67.4

Note the octave band sound power levels are linear with no weighting whilst the overall level is A-weighted.

4.6 There is currently an 800mm high brick parapet around the roof where the condensers are to be situated. The condensers will be located on channels directly on top of the roof. The fans will be located on the top of the condensers. The source height for the fans is taken to be 1902mm above the roof. A louvred screen is to be constructed around the perimeter of the roof together with vertical baffles across the top of the plant area. The louvres and baffles will act as both a visual and acoustic screen. The screen and baffles are to be, at minimum, 2557mm above the top of the roof. To achieve suitable acoustic performance the louvred screen is to be acoustic louvres that should provide the following acoustic specification:

'Single bank acoustic louvres shall be installed to a height at least 2557mm above the level of the roof along all three open sides of the roof area. These acoustic louvres shall provide, at minimum, the following octave band sound reduction, R, as tested to BS EN ISO 140:3:

	Octave Band Centre Frequency								
	63	125	250	500	1k	2k	4k	8k	Hz
Sound Reduction R	4	5	8	11	16	18	14	12	dB'

4.7 The vertical baffles will be installed between the louvres across the plant area. These baffles will provide additional screening for the highest level windows in the tower-block which overlook the plant area. These baffles should have a sound absorptive facing towards the fans being, typically, 25mm mineral wool with perforated metal facing of minimum open area 30%.

4.8 Based on the condenser noise data stated in 4.5 together with the screens stated in 4.6 and 4.7 the plant noise level at the façades of the residential dwellings surrounding the plant area have been calculated as in Appendix D. With regard to these calculations:

- The sound power levels provided by the manufacturer have been used in the calculations. To obtain the sound pressure level at the receiver locations hemi spherical radiation has been assumed, although as the plant is located on a roof top some spherical radiation may occur.
- The calculation is based on both condensers operating simultaneously at full load.
- The screening effect depends on the height of the noise source, which is taken as being on the top of the condensers. As the screening would be greater for a lower source height these calculations can be considered a 'worst case' calculation.

- For calculations for noise emissions to the windows on the upper level on the tower block in particular, the screen is taken as the vertical baffle that is located above the units. As such this is closer to the noise source and more effective than the acoustic louvres screen. Where appropriate the noise transmitting through the louvres is also added for these calculations.

- The calculated screening predictions are shown in Appendix D.

4.9 The calculations in Appendix D together with the criteria at each of the receiver locations can be summarised as:

Receiver location	Predicted plant noise level	Lowest measured L_{A90} dB	Plant noise criteria (L_{A90}-5 dB)
R1, Tower Block Windows above screen line Windows below screen line	43 dBA 44 dBA	50 dBA	45 dBA
R2, SW façade of building on Macklin Street	35 dBA	50 dBA	45 dBA
R3, Terrace overlooking Parker Mews	35 dBA	43 dBA	38 dBA
R4, Flats on Parker Street, windows overlooking Parker Mews	35 dBA	43 dBA	38 dBA

These are 1-2 dBA within the criteria at R1, 10 dBA within criteria at R2, 3 dBA within criteria at R3 and R4.

4.10 This shows compliance with the normal planning condition for this area, but with no margin for some locations should a tonal component exist. It is, however the case that the noise data for the fans does not show any tonal component, nor does the overall octave band noise levels calculated at the receiver positions.

4.11 It is, therefore, proposed that the specification for the condensers includes the following:

'Each condenser shall be selected such that at maximum design duty, or at any other time, no tonal or impulsive components should be caused and the following noise levels are not exceeded:

	Octave Band Centre Frequency								
	125	250	500	1k	2k	4k	8k	Hz	dBA
Sound Power Level (linear) KFHC1.2-234 model with six fans	77.1	70.4	73.9	71.2	65.4	59.1	54.6	dB	75.2
Sound Power Level (linear) KFHC1.2-134 model with three fans	74.1	67.4	70.9	68.2	62.4	56.1	51.6	dB	72.2

Sound Power as measured in accordance with BS EN ISO 9614-2. These noise levels should be proved by a test at the factory prior to despatch to site to the satisfaction of the Project Acoustic Consultant.

In addition the condensers shall be located on anti-vibration mounts consisting of steel springs of minimum static deflection 25mm together with neoprene noise stop pads of, at minimum, 10mm ribbed neoprene.'

5.0 Conclusions

5.1 A plant noise assessment has been to demonstrate compliance of the proposed plant with Camden Borough Councils Policy DP28.

5.2 The proposed condensers may operate 24 hours a day. Based on Section 4, worst case calculations show that the predicted noise levels based on all condensers operating at maximum duty for operation complies with the CBC criteria when operating 7 days per week.

5.3 Sharps Redmore is therefore of the opinion that there should be no significant environmental impact when the new plant is installed.

APPENDIX A

ACOUSTIC TERMINOLOGY

Acoustic Terminology

A1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible

3 dB increase - just noticeable

10 dB increase - perceived as twice as loud

A2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

A3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

A4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

A5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

A6 The main noise indices in use in the UK are:

L_{A90}: The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{AMAX}: The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

`A8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = 20 Log (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \text{ Log } {}^{160}/_{10} = 60 - 24 = 36 \text{ dB.}$$

APPENDIX B

SURVEY RESULTS

Table B1: Survey Results Lower Roof, Location 2

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}	Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
28/11/2014 12:45	56.8	55.2	65.0	28/11/2014 23:00	53.6	52.1	62.2
28/11/2014 13:00	58.1	55.0	83.7	28/11/2014 23:15	53.0	51.6	63.3
28/11/2014 13:15	56.1	54.6	70.5	28/11/2014 23:30	53.5	52.0	66.5
28/11/2014 13:30	56.7	54.5	73.5	28/11/2014 23:45	54.8	51.8	71.0
28/11/2014 13:45	55.7	54.5	73.7	29/11/2014 00:00	53.8	51.1	67.9
28/11/2014 14:00	56.1	54.5	70.9	29/11/2014 00:15	53.2	51.4	68.6
28/11/2014 14:15	55.9	54.3	67.9	29/11/2014 00:30	52.2	50.7	62.2
28/11/2014 14:30	56.6	54.0	75.0	29/11/2014 00:45	54.1	50.9	66.8
28/11/2014 14:45	55.8	54.3	65.2	29/11/2014 01:00	52.8	50.8	60.6
28/11/2014 15:00	56.0	54.3	71.9	29/11/2014 01:15	54.3	50.9	70.0
28/11/2014 15:15	56.0	54.1	72.0	29/11/2014 01:30	52.0	49.9	64.9
28/11/2014 15:30	57.5	54.1	75.5	29/11/2014 01:45	51.9	50.0	61.4
28/11/2014 15:45	57.3	54.2	71.5	29/11/2014 02:00	52.1	49.9	62.6
28/11/2014 16:00	55.6	54.0	71.0	29/11/2014 02:15	51.6	49.5	64.4
28/11/2014 16:15	55.7	54.0	68.0	29/11/2014 02:30	54.5	49.6	79.2
28/11/2014 16:30	56.5	53.9	75.1	29/11/2014 02:45	51.9	48.8	76.1
28/11/2014 16:45	60.9	54.9	80.2	29/11/2014 03:00	50.8	48.4	70.3
28/11/2014 17:00	57.9	54.0	78.1	29/11/2014 03:15	50.9	48.7	64.1
28/11/2014 17:15	58.3	54.3	79.7	29/11/2014 03:30	50.8	48.5	66.5
28/11/2014 17:30	57.1	54.4	76.9	29/11/2014 03:45	50.1	47.9	60.5
28/11/2014 17:45	57.2	54.4	70.7	29/11/2014 04:00	48.3	46.9	56.9
28/11/2014 18:00	56.0	54.3	65.6	29/11/2014 04:15	50.0	47.4	58.7
28/11/2014 18:15	57.1	54.2	78.2	29/11/2014 04:30	47.6	46.3	56.3
28/11/2014 18:30	56.4	54.5	69.9	29/11/2014 04:45	47.3	46.0	55.2
28/11/2014 18:45	55.9	54.3	69.7	29/11/2014 05:00	49.2	46.7	62.8
28/11/2014 19:00	56.7	54.3	71.2	29/11/2014 05:15	47.6	46.3	62.7
28/11/2014 19:15	56.5	54.3	67.4	29/11/2014 05:30	49.7	47.7	59.8
28/11/2014 19:30	57.5	54.0	75.3	29/11/2014 05:45	48.6	47.2	59.9
28/11/2014 19:45	56.8	54.2	70.8	29/11/2014 06:00	51.0	47.0	72.9
28/11/2014 20:00	55.0	53.8	68.4	29/11/2014 06:15	49.4	47.3	63.2
28/11/2014 20:15	55.9	53.8	69.4	29/11/2014 06:30	50.2	47.0	68.2
28/11/2014 20:30	54.9	53.5	63.6	29/11/2014 06:45	50.1	47.6	64.2
28/11/2014 20:45	56.6	53.1	70.9	29/11/2014 07:00	54.7	49.1	59.3
28/11/2014 21:00	56.5	53.1	75.2	29/11/2014 07:15	52.2	47.4	63.5
28/11/2014 21:15	53.8	52.9	66.8	29/11/2014 07:30	56.0	47.0	77.1
28/11/2014 21:30	54.0	53.0	72.6	29/11/2014 07:45	52.3	47.9	67.4
28/11/2014 21:45	55.3	53.1	72.6	29/11/2014 08:00	54.3	48.5	73.3
28/11/2014 22:00	54.6	53.1	65.3	29/11/2014 08:15	58.7	49.7	87.2
28/11/2014 22:15	54.7	53.3	67.4	29/11/2014 08:30	56.1	50.5	78.5
28/11/2014 22:30	57.4	53.3	81.3	29/11/2014 08:45	55.8	51.8	71.7
28/11/2014 22:45	54.7	53.0	64.3	29/11/2014 09:00	58.7	52.6	83.7

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
29/11/2014 09:15	54.6	52.2	69.5
29/11/2014 09:30	56.1	52.4	74.2
29/11/2014 09:45	55.8	52.1	75.8
29/11/2014 10:00	53.8	52.2	65.3
29/11/2014 10:15	54.3	52.2	66.4
29/11/2014 10:30	56.7	51.9	76.7
29/11/2014 10:45	54.1	51.8	65.3
29/11/2014 11:00	55.0	52.1	70.5
29/11/2014 11:15	55.5	52.6	69.7
29/11/2014 11:30	56.9	52.9	71.3
29/11/2014 11:45	58.5	52.5	81.2
29/11/2014 12:00	54.9	52.7	69.7
29/11/2014 12:15	54.4	52.3	71.8
29/11/2014 12:30	54.4	52.3	68.1
29/11/2014 12:45	54.3	52.4	68.2
29/11/2014 13:00	54.4	52.5	72.2
29/11/2014 13:15	57.8	53.0	77.2
29/11/2014 13:30	57.2	52.5	74.3
29/11/2014 13:45	57.6	52.8	74.0
29/11/2014 14:00	56.7	52.8	75.9
29/11/2014 14:15	55.8	52.7	73.0
29/11/2014 14:30	58.4	53.0	76.2
29/11/2014 14:45	57.2	52.6	74.9
29/11/2014 15:00	56.7	52.7	71.7
29/11/2014 15:15	54.5	52.4	68.8
29/11/2014 15:30	55.4	52.5	74.4
29/11/2014 15:45	54.4	51.9	68.6
29/11/2014 16:00	55.4	52.4	68.4
29/11/2014 16:15	53.4	52.2	62.7
29/11/2014 16:30	53.1	52.1	65.4
29/11/2014 16:45	56.6	52.2	77.3
29/11/2014 17:00	53.8	52.6	63.4
29/11/2014 17:15	55.2	52.8	67.6
29/11/2014 17:30	53.5	52.3	62.6
29/11/2014 17:45	55.7	52.1	73.3
29/11/2014 18:00	53.7	52.6	61.3
29/11/2014 18:15	54.6	52.2	70.6
29/11/2014 18:30	52.7	51.7	60.0
29/11/2014 18:45	53.0	52.0	62.3
29/11/2014 19:00	53.7	52.1	77.7
29/11/2014 19:15	54.5	52.2	76.2
29/11/2014 19:30	53.7	52.0	65.5
29/11/2014 19:45	53.0	51.7	64.1
29/11/2014 20:00	53.3	52.1	65.0
29/11/2014 20:15	53.8	52.3	74.8
29/11/2014 20:30	54.2	52.4	67.9

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
29/11/2014 20:45	56.2	52.7	79.8
29/11/2014 21:00	54.3	52.1	77.5
29/11/2014 21:15	52.4	51.3	63.2
29/11/2014 21:30	52.8	51.7	67.0
29/11/2014 21:45	53.7	51.8	68.2
29/11/2014 22:00	53.9	52.1	67.0
29/11/2014 22:15	54.3	53.0	65.5
29/11/2014 22:30	54.0	52.6	64.3
29/11/2014 22:45	54.4	52.7	67.8
29/11/2014 23:00	53.0	50.6	66.4
29/11/2014 23:15	53.6	51.3	68.8
29/11/2014 23:30	53.7	51.3	65.9
29/11/2014 23:45	54.4	51.2	73.0
30/11/2014 00:00	54.2	51.0	72.1
30/11/2014 00:15	52.1	49.2	72.4
30/11/2014 00:30	51.8	49.1	73.3
30/11/2014 00:45	56.1	49.6	78.2
30/11/2014 01:00	57.1	49.7	76.8
30/11/2014 01:15	53.5	50.1	75.4
30/11/2014 01:30	62.6	50.2	75.7
30/11/2014 01:45	52.3	49.3	74.5
30/11/2014 02:00	51.9	48.5	77.3
30/11/2014 02:15	53.0	50.5	69.2
30/11/2014 02:30	56.3	49.8	82.9
30/11/2014 02:45	54.0	51.6	66.8
30/11/2014 03:00	53.4	49.4	72.1
30/11/2014 03:15	52.0	48.5	71.7
30/11/2014 03:30	49.7	46.8	63.9
30/11/2014 03:45	48.6	45.6	66.3
30/11/2014 04:00	49.2	46.5	67.3
30/11/2014 04:15	49.0	45.3	68.0
30/11/2014 04:30	47.1	44.4	63.0
30/11/2014 04:45	48.4	44.4	67.3
30/11/2014 05:00	50.2	46.7	66.0
30/11/2014 05:15	49.8	45.7	68.8
30/11/2014 05:30	49.3	45.0	71.4
30/11/2014 05:45	47.7	44.9	59.4
30/11/2014 06:00	51.4	44.4	70.9
30/11/2014 06:15	46.7	44.3	59.0
30/11/2014 06:30	46.4	44.0	57.2
30/11/2014 06:45	45.8	43.6	58.2
30/11/2014 07:00	46.4	43.4	64.8
30/11/2014 07:15	45.9	43.4	60.8
30/11/2014 07:30	59.8	44.2	84.0
30/11/2014 07:45	61.7	44.5	86.6
30/11/2014 08:00	49.1	43.6	67.5

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
30/11/2014 08:15	47.8	44.0	64.7
30/11/2014 08:30	59.9	45.4	85.8
30/11/2014 08:45	47.1	44.7	65.4
30/11/2014 09:00	53.4	49.4	74.2
30/11/2014 09:15	54.0	50.3	72.0
30/11/2014 09:30	51.3	50.2	60.2
30/11/2014 09:45	52.2	50.5	64.2
30/11/2014 10:00	51.7	50.4	60.6
30/11/2014 10:15	51.5	50.1	60.7
30/11/2014 10:30	51.5	50.3	59.4
30/11/2014 10:45	51.8	50.2	62.3
30/11/2014 11:00	52.3	50.5	73.9
30/11/2014 11:15	53.2	51.2	70.5
30/11/2014 11:30	52.1	50.7	62.4
30/11/2014 11:45	52.0	51.1	60.2
30/11/2014 12:00	51.5	50.6	57.0
30/11/2014 12:15	53.6	50.8	76.1
30/11/2014 12:30	52.3	51.0	65.1
30/11/2014 12:45	52.3	50.9	59.9
30/11/2014 13:00	53.2	51.1	67.4
30/11/2014 13:15	54.9	51.2	74.6
30/11/2014 13:30	52.5	51.0	64.9
30/11/2014 13:45	52.1	50.9	63.1
30/11/2014 14:00	52.1	51.1	60.1
30/11/2014 14:15	52.8	51.2	66.0
30/11/2014 14:30	52.5	51.1	65.0
30/11/2014 14:45	54.1	51.3	75.9
30/11/2014 15:00	53.5	51.6	64.8
30/11/2014 15:15	53.8	51.3	74.5
30/11/2014 15:30	53.5	51.4	67.3
30/11/2014 15:45	52.8	51.5	62.9
30/11/2014 16:00	56.0	51.4	74.6
30/11/2014 16:15	52.3	51.1	66.7
30/11/2014 16:30	51.9	50.8	61.2
30/11/2014 16:45	54.8	51.2	73.5
30/11/2014 17:00	53.4	51.0	72.1
30/11/2014 17:15	52.5	51.0	66.5
30/11/2014 17:30	52.7	50.6	67.9
30/11/2014 17:45	53.6	50.8	69.4
30/11/2014 18:00	54.4	51.0	73.7
30/11/2014 18:15	60.1	50.9	81.3
30/11/2014 18:30	52.5	51.0	65.5
30/11/2014 18:45	53.0	51.0	68.8
30/11/2014 19:00	53.9	51.3	68.0
30/11/2014 19:15	52.4	51.1	67.6
30/11/2014 19:30	53.3	50.9	71.4

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
30/11/2014 19:45	52.8	51.1	64.7
30/11/2014 20:00	56.0	51.2	73.4
30/11/2014 20:15	53.1	51.1	75.7
30/11/2014 20:30	52.6	50.6	65.5
30/11/2014 20:45	52.8	50.6	69.2
30/11/2014 21:00	51.5	50.3	64.0
30/11/2014 21:15	51.4	50.5	59.3
30/11/2014 21:30	51.6	50.4	64.7
30/11/2014 21:45	53.0	50.5	68.4
30/11/2014 22:00	52.4	50.7	66.7
30/11/2014 22:15	51.9	50.6	63.5
30/11/2014 22:30	51.9	50.8	60.9
30/11/2014 22:45	51.8	50.7	67.6
30/11/2014 23:00	49.4	47.3	60.5
30/11/2014 23:15	49.6	48.0	63.2
30/11/2014 23:30	51.1	48.1	66.3
30/11/2014 23:45	49.2	47.4	65.1
01/12/2014 00:00	49.1	47.2	56.8
01/12/2014 00:15	49.0	47.5	58.9
01/12/2014 00:30	47.9	46.5	54.3
01/12/2014 00:45	48.7	47.3	61.8
01/12/2014 01:00	49.3	46.6	64.7
01/12/2014 01:15	49.2	47.1	59.3
01/12/2014 01:30	48.8	46.4	59.9
01/12/2014 01:45	50.6	46.7	67.2
01/12/2014 02:00	48.5	46.5	58.6
01/12/2014 02:15	47.9	45.7	62.1
01/12/2014 02:30	47.1	45.6	55.4
01/12/2014 02:45	47.2	45.2	62.4
01/12/2014 03:00	47.0	45.5	57.7
01/12/2014 03:15	47.1	46.0	57.3
01/12/2014 03:30	47.4	45.7	59.0
01/12/2014 03:45	47.9	46.1	60.1
01/12/2014 04:00	47.9	46.2	55.2
01/12/2014 04:15	47.2	45.6	61.5
01/12/2014 04:30	47.1	45.8	55.1
01/12/2014 04:45	47.9	46.3	59.1
01/12/2014 05:00	48.6	46.7	58.9
01/12/2014 05:15	48.9	47.2	61.1
01/12/2014 05:30	50.7	48.0	65.1
01/12/2014 05:45	49.6	47.8	57.1
01/12/2014 06:00	53.2	49.2	79.4
01/12/2014 06:15	56.5	48.6	79.8
01/12/2014 06:30	55.4	49.0	75.9
01/12/2014 06:45	54.8	49.5	75.4
01/12/2014 07:00	53.1	49.2	68.6

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
01/12/2014 07:15	51.5	49.1	67.3
01/12/2014 07:30	55.3	50.1	73.0
01/12/2014 07:45	54.0	50.3	74.5
01/12/2014 08:00	54.0	50.7	70.1
01/12/2014 08:15	56.3	53.0	78.4
01/12/2014 08:30	55.5	53.5	72.1
01/12/2014 08:45	58.4	53.5	85.4
01/12/2014 09:00	57.7	54.1	77.4
01/12/2014 09:15	57.6	55.3	75.3
01/12/2014 09:30	56.4	54.2	71.9
01/12/2014 09:45	57.0	54.3	74.4
01/12/2014 10:00	57.0	54.5	71.2
01/12/2014 10:15	55.9	54.4	64.0
01/12/2014 10:30	56.4	54.0	70.1
01/12/2014 10:45	56.3	54.2	66.1
01/12/2014 11:00	55.6	53.9	71.9
01/12/2014 11:15	57.6	54.1	78.6
01/12/2014 11:30	55.7	53.9	69.8
01/12/2014 11:45	58.2	54.6	77.6
01/12/2014 12:00	56.5	54.2	70.9
01/12/2014 12:15	55.6	54.1	71.3
01/12/2014 12:30	56.7	54.6	65.3
01/12/2014 12:45	56.5	54.4	65.0
01/12/2014 13:00	62.1	55.1	72.2
01/12/2014 13:15	56.3	53.8	74.8
01/12/2014 13:30	55.1	53.6	65.2
01/12/2014 13:45	58.3	54.9	73.4
01/12/2014 14:00	57.5	54.5	85.4
01/12/2014 14:15	55.6	53.3	68.4
01/12/2014 14:30	54.8	53.1	71.1
01/12/2014 14:45	55.7	53.2	71.3
01/12/2014 15:00	54.7	53.1	66.1
01/12/2014 15:15	55.9	53.7	71.5
01/12/2014 15:30	55.8	53.4	81.5
01/12/2014 15:45	54.5	53.3	66.4
01/12/2014 16:00	57.0	53.7	73.3
01/12/2014 16:15	54.9	53.5	71.5
01/12/2014 16:30	54.9	53.5	63.9
01/12/2014 16:45	54.8	53.7	65.5
01/12/2014 17:00	56.3	53.6	70.5
01/12/2014 17:15	55.4	53.5	74.1
01/12/2014 17:30	55.1	53.2	69.1
01/12/2014 17:45	55.6	53.6	65.5
01/12/2014 18:00	61.6	53.4	80.7
01/12/2014 18:15	57.2	53.3	77.8
01/12/2014 18:30	58.8	54.1	84.0

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
01/12/2014 18:45	56.5	53.8	82.4
01/12/2014 19:00	54.6	52.8	67.3
01/12/2014 19:15	53.5	51.8	69.2
01/12/2014 19:30	53.1	52.1	63.4
01/12/2014 19:45	53.0	51.7	64.7
01/12/2014 20:00	53.6	51.9	71.4
01/12/2014 20:15	53.1	51.8	64.9
01/12/2014 20:30	52.2	51.5	56.9
01/12/2014 20:45	51.7	50.9	59.3
01/12/2014 21:00	51.9	50.8	63.2
01/12/2014 21:15	52.5	51.0	65.6
01/12/2014 21:30	53.0	50.8	75.8
01/12/2014 21:45	52.3	51.1	63.7
01/12/2014 22:00	53.6	51.4	77.4
01/12/2014 22:15	53.8	51.7	71.9
01/12/2014 22:30	53.4	51.5	61.7
01/12/2014 22:45	52.0	50.6	65.8
01/12/2014 23:00	52.4	49.2	64.5
01/12/2014 23:15	52.1	47.7	67.0
01/12/2014 23:30	51.3	47.3	68.2
01/12/2014 23:45	50.9	47.7	62.4
02/12/2014 00:00	51.1	47.7	65.5
02/12/2014 00:15	50.5	47.8	64.4
02/12/2014 00:30	51.6	47.7	67.3
02/12/2014 00:45	51.3	47.0	67.9
02/12/2014 01:00	49.8	46.9	63.6
02/12/2014 01:15	51.5	47.2	68.7
02/12/2014 01:30	51.4	47.7	68.7
02/12/2014 01:45	48.4	45.4	63.8
02/12/2014 02:00	48.2	45.1	66.1
02/12/2014 02:15	49.2	46.8	64.9
02/12/2014 02:30	48.2	45.6	60.7
02/12/2014 02:45	48.3	45.5	67.7
02/12/2014 03:00	54.6	45.4	76.7
02/12/2014 03:15	47.8	45.2	58.6
02/12/2014 03:30	45.7	43.8	56.3
02/12/2014 03:45	45.5	43.7	54.9
02/12/2014 04:00	44.9	43.3	52.2
02/12/2014 04:15	46.4	44.0	54.2
02/12/2014 04:30	45.6	44.0	56.0
02/12/2014 04:45	45.9	43.7	59.2
02/12/2014 05:00	48.6	45.1	67.4
02/12/2014 05:15	46.1	44.5	53.9
02/12/2014 05:30	55.1	45.9	76.7
02/12/2014 05:45	50.8	46.0	63.7
02/12/2014 06:00	55.6	46.8	77.0

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
02/12/2014 06:15	49.3	47.6	57.7
02/12/2014 06:30	48.8	46.3	70.1
02/12/2014 06:45	49.3	46.6	62.4
02/12/2014 07:00	51.3	47.5	68.8
02/12/2014 07:15	56.2	48.2	80.9
02/12/2014 07:30	54.8	48.0	74.6
02/12/2014 07:45	51.0	48.1	61.7
02/12/2014 08:00	51.6	49.3	72.4
02/12/2014 08:15	54.9	50.8	75.3
02/12/2014 08:30	53.0	50.5	66.6
02/12/2014 08:45	54.3	51.4	68.6
02/12/2014 09:00	56.7	53.5	72.1
02/12/2014 09:15	55.9	53.5	68.7
02/12/2014 09:30	59.6	53.9	73.4
02/12/2014 09:45	55.6	53.5	67.0
02/12/2014 10:00	56.6	53.5	79.5
02/12/2014 10:15	58.1	54.5	67.9
02/12/2014 10:30	57.0	54.4	69.2
02/12/2014 10:45	55.2	53.8	68.1
02/12/2014 11:00	57.0	54.4	72.5
02/12/2014 11:15	56.0	54.1	66.8
02/12/2014 11:30	59.8	54.9	89.6

Table B2. Upper Roof Level, Location 1

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
28/11/2014 13:00	58.8	55.6	83.0
28/11/2014 13:15	56.0	54.7	69.6
28/11/2014 13:30	56.2	54.6	64.7
28/11/2014 13:45	56.0	54.5	69.1
28/11/2014 14:00	55.8	54.6	62.6
28/11/2014 14:15	55.8	54.4	66.8
28/11/2014 14:30	55.5	54.2	63.1
28/11/2014 14:45	56.9	54.4	76.0
28/11/2014 15:00	56.0	54.3	69.4
28/11/2014 15:15	56.2	54.5	68.7
28/11/2014 15:30	57.1	54.7	75.4
28/11/2014 15:45	56.7	54.4	72.7
28/11/2014 16:00	55.2	53.8	63.7
28/11/2014 16:14	55.5	53.9	67.5
28/11/2014 16:30	56.1	53.9	69.8
28/11/2014 16:45	61.8	54.0	82.6
28/11/2014 17:00	59.5	53.8	79.8
28/11/2014 17:15	57.8	54.1	77.9
28/11/2014 17:30	55.9	54.0	73.1
28/11/2014 17:45	55.9	54.0	67.9
28/11/2014 18:00	55.2	53.7	63.5
28/11/2014 18:15	55.5	53.6	75.1
28/11/2014 18:30	55.7	53.6	68.1
28/11/2014 18:45	55.1	53.4	64.8
28/11/2014 19:00	55.5	53.3	71.8
28/11/2014 19:15	55.3	53.3	66.8
28/11/2014 19:30	55.8	52.9	71.6
28/11/2014 19:45	57.3	53.2	71.9
28/11/2014 19:59	54.0	52.8	64.0
28/11/2014 20:15	55.6	53.1	67.5
28/11/2014 20:30	53.7	52.6	68.2
28/11/2014 20:45	55.7	52.3	69.6
28/11/2014 21:00	55.4	52.3	73.7
28/11/2014 21:15	53.2	52.0	62.3
28/11/2014 21:30	53.1	52.1	61.1
28/11/2014 21:45	53.6	52.1	68.5
28/11/2014 22:00	52.9	51.9	60.2
28/11/2014 22:15	53.1	52.1	60.7
28/11/2014 22:30	55.5	52.2	79.4
28/11/2014 22:45	52.8	51.7	59.2
28/11/2014 23:00	53.8	52.3	63.8
28/11/2014 23:15	52.9	51.7	63.3
28/11/2014 23:30	53.9	51.9	65.9

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
28/11/2014 23:45	52.9	51.5	60.3
29/11/2014 00:00	55.0	50.9	75.1
29/11/2014 00:15	52.3	51.0	64.5
29/11/2014 00:30	51.8	50.6	65.0
29/11/2014 00:45	54.3	50.6	68.4
29/11/2014 01:00	51.8	50.2	62.8
29/11/2014 01:15	52.0	50.4	64.5
29/11/2014 01:30	51.3	50.0	63.2
29/11/2014 01:45	51.4	49.8	58.8
29/11/2014 02:00	50.9	49.6	63.0
29/11/2014 02:15	50.7	49.6	59.0
29/11/2014 02:30	50.7	49.4	64.1
29/11/2014 02:45	50.6	49.3	61.1
29/11/2014 03:00	50.6	49.4	58.7
29/11/2014 03:15	52.0	49.6	66.3
29/11/2014 03:30	50.9	49.1	60.0
29/11/2014 03:45	50.3	49.0	57.4
29/11/2014 04:00	49.9	48.6	63.6
29/11/2014 04:15	54.2	48.9	69.2
29/11/2014 04:30	49.7	48.4	59.7
29/11/2014 04:45	49.1	48.0	56.7
29/11/2014 05:00	49.6	48.3	55.2
29/11/2014 05:15	50.5	48.6	60.9
29/11/2014 05:30	50.7	49.2	58.3
29/11/2014 05:45	51.3	49.6	59.0
29/11/2014 06:00	52.5	49.5	68.2
29/11/2014 06:15	50.6	49.5	58.5
29/11/2014 06:30	51.5	49.6	67.2
29/11/2014 06:44	51.1	49.9	58.7
29/11/2014 07:00	51.3	50.2	60.1
29/11/2014 07:15	51.5	50.1	61.4
29/11/2014 07:30	56.1	49.8	76.2
29/11/2014 07:45	53.2	50.3	67.8
29/11/2014 08:00	53.2	50.8	65.9
29/11/2014 08:15	54.0	51.6	71.9
29/11/2014 08:30	53.5	51.3	66.3
29/11/2014 08:45	54.2	51.5	68.1
29/11/2014 09:00	56.9	52.5	82.4
29/11/2014 09:15	56.3	52.6	74.2
29/11/2014 09:30	56.9	52.0	76.2
29/11/2014 09:45	53.8	51.5	76.5
29/11/2014 10:00	56.4	51.7	74.0
29/11/2014 10:15	55.3	51.8	73.2
29/11/2014 10:30	57.9	51.7	76.0
29/11/2014 10:45	53.6	51.4	76.2

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
29/11/2014 11:00	54.9	52.3	68.7
29/11/2014 11:15	55.2	52.2	71.2
29/11/2014 11:30	58.6	53.0	84.4
29/11/2014 11:45	56.8	51.6	73.4
29/11/2014 12:00	56.0	51.5	74.9
29/11/2014 12:15	56.3	51.7	75.3
29/11/2014 12:30	56.4	51.7	76.1
29/11/2014 12:45	55.9	51.7	76.3
29/11/2014 13:00	56.1	51.8	78.1
29/11/2014 13:15	58.6	52.8	76.8
29/11/2014 13:30	58.6	52.0	81.8
29/11/2014 13:45	56.9	51.6	73.4
29/11/2014 14:00	56.1	51.7	75.0
29/11/2014 14:15	54.7	51.3	71.8
29/11/2014 14:30	56.7	51.4	76.0
29/11/2014 14:45	56.5	51.3	81.3
29/11/2014 15:00	54.3	51.1	70.1
29/11/2014 15:15	53.5	51.2	70.1
29/11/2014 15:30	53.1	50.7	71.0
29/11/2014 15:45	52.7	50.6	65.6
29/11/2014 16:00	52.9	50.9	71.2
29/11/2014 16:15	52.0	51.0	60.5
29/11/2014 16:30	52.1	51.1	60.8
29/11/2014 16:45	55.6	51.1	70.8
29/11/2014 17:00	52.2	51.3	62.8
29/11/2014 17:15	55.3	51.7	68.7
29/11/2014 17:30	52.5	51.4	60.7
29/11/2014 17:45	54.1	51.2	72.2
29/11/2014 18:00	52.7	51.4	62.5
29/11/2014 18:15	54.3	51.0	79.9
29/11/2014 18:30	51.4	50.7	58.3
29/11/2014 18:45	51.5	50.7	58.6
29/11/2014 19:00	51.5	50.5	65.6
29/11/2014 19:15	51.6	50.8	58.5
29/11/2014 19:30	52.1	50.5	61.7
29/11/2014 19:45	51.5	50.2	65.4
29/11/2014 20:00	51.4	50.5	71.3
29/11/2014 20:15	51.5	50.6	59.7
29/11/2014 20:30	53.1	50.6	69.1
29/11/2014 20:45	51.6	50.5	61.0
29/11/2014 21:00	52.0	50.3	60.5
29/11/2014 21:15	50.7	50.0	59.5
29/11/2014 21:30	51.0	50.3	55.8
29/11/2014 21:45	51.9	50.3	63.7
29/11/2014 22:00	51.5	50.5	56.8

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
29/11/2014 22:15	51.8	50.8	60.1
29/11/2014 22:30	51.4	50.5	61.9
29/11/2014 22:45	52.7	50.4	66.6
29/11/2014 23:00	50.9	50.2	56.6
29/11/2014 23:15	51.6	50.5	65.5
29/11/2014 23:30	51.7	50.1	65.7
29/11/2014 23:45	52.0	49.7	63.3
30/11/2014 00:00	50.9	49.6	68.3
30/11/2014 00:15	50.7	49.2	61.3
30/11/2014 00:30	49.9	49.0	59.2
30/11/2014 00:45	50.6	49.2	61.4
30/11/2014 01:00	52.0	49.1	71.0
30/11/2014 01:15	50.3	49.2	59.4
30/11/2014 01:30	51.0	49.0	61.7
30/11/2014 01:45	49.9	48.7	63.5
30/11/2014 02:00	51.4	48.7	64.7
30/11/2014 02:15	50.2	49.0	60.5
30/11/2014 02:30	49.9	48.6	65.3
30/11/2014 02:45	52.9	49.2	72.9
30/11/2014 03:00	50.3	48.9	70.1
30/11/2014 03:15	50.2	49.1	60.5
30/11/2014 03:30	50.6	48.9	66.7
30/11/2014 03:45	49.7	48.4	62.6
30/11/2014 04:00	49.6	48.4	55.9
30/11/2014 04:15	49.3	48.2	57.1
30/11/2014 04:30	49.5	47.6	61.6
30/11/2014 04:45	48.5	47.4	56.8
30/11/2014 05:00	50.2	47.9	68.0
30/11/2014 05:15	49.0	47.8	59.7
30/11/2014 05:30	50.9	48.4	68.0
30/11/2014 05:45	49.1	48.0	55.8
30/11/2014 06:00	52.5	48.3	72.0
30/11/2014 06:15	50.6	49.0	58.2
30/11/2014 06:30	50.2	48.5	71.5
30/11/2014 06:45	49.4	48.3	55.6
30/11/2014 07:00	49.4	48.2	57.4
30/11/2014 07:15	49.2	48.2	56.9
30/11/2014 07:30	50.5	48.9	68.0
30/11/2014 07:45	51.3	48.9	68.2
30/11/2014 08:00	49.7	48.4	60.9
30/11/2014 08:15	51.0	48.2	69.0
30/11/2014 08:30	52.5	49.0	69.2
30/11/2014 08:45	50.8	48.9	66.4
30/11/2014 09:00	53.2	49.5	73.2
30/11/2014 09:15	51.7	49.8	63.6

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
30/11/2014 09:30	51.3	49.7	64.3
30/11/2014 09:45	51.5	50.1	65.4
30/11/2014 10:00	50.7	49.6	62.8
30/11/2014 10:15	51.1	50.1	57.0
30/11/2014 10:30	51.2	50.1	70.3
30/11/2014 10:45	53.0	50.0	66.6
30/11/2014 11:00	50.9	49.8	64.3
30/11/2014 11:15	52.8	50.1	67.6
30/11/2014 11:30	52.5	50.3	68.0
30/11/2014 11:45	52.3	50.7	74.7
30/11/2014 12:00	51.6	50.5	59.5
30/11/2014 12:15	51.7	50.5	65.0
30/11/2014 12:30	52.1	50.6	61.7
30/11/2014 12:45	51.9	50.4	66.0
30/11/2014 13:00	53.7	50.7	66.1
30/11/2014 13:15	54.5	51.8	73.1
30/11/2014 13:30	51.9	50.6	63.4
30/11/2014 13:45	51.7	50.3	62.4
30/11/2014 14:00	52.3	50.8	61.8
30/11/2014 14:15	52.7	50.9	67.5
30/11/2014 14:45	52.2	50.5	61.7
30/11/2014 15:00	52.9	50.9	64.6
30/11/2014 15:15	53.0	50.9	67.8
30/11/2014 15:30	51.9	50.4	62.6
30/11/2014 15:45	51.1	50.1	57.4
30/11/2014 16:00	55.6	50.2	77.0
30/11/2014 16:15	52.5	50.6	62.2
30/11/2014 16:30	52.8	50.7	69.1
30/11/2014 16:45	55.0	50.8	74.8
30/11/2014 17:00	53.0	50.7	66.6
30/11/2014 17:15	52.0	50.5	65.3
30/11/2014 17:30	52.8	50.4	67.5
30/11/2014 17:45	53.7	50.3	71.7
30/11/2014 18:00	53.9	50.8	74.3
30/11/2014 18:15	59.2	50.7	80.0
30/11/2014 18:30	53.7	51.1	66.1
30/11/2014 18:45	52.6	50.8	65.5
30/11/2014 19:00	53.9	51.0	68.3
30/11/2014 19:15	52.1	50.6	64.9
30/11/2014 19:30	53.5	50.9	69.5
30/11/2014 19:45	55.0	51.3	73.0
30/11/2014 20:00	57.9	51.4	77.9
30/11/2014 20:15	53.0	51.2	66.7
30/11/2014 20:30	52.6	50.3	67.6
30/11/2014 20:45	52.7	50.5	68.3

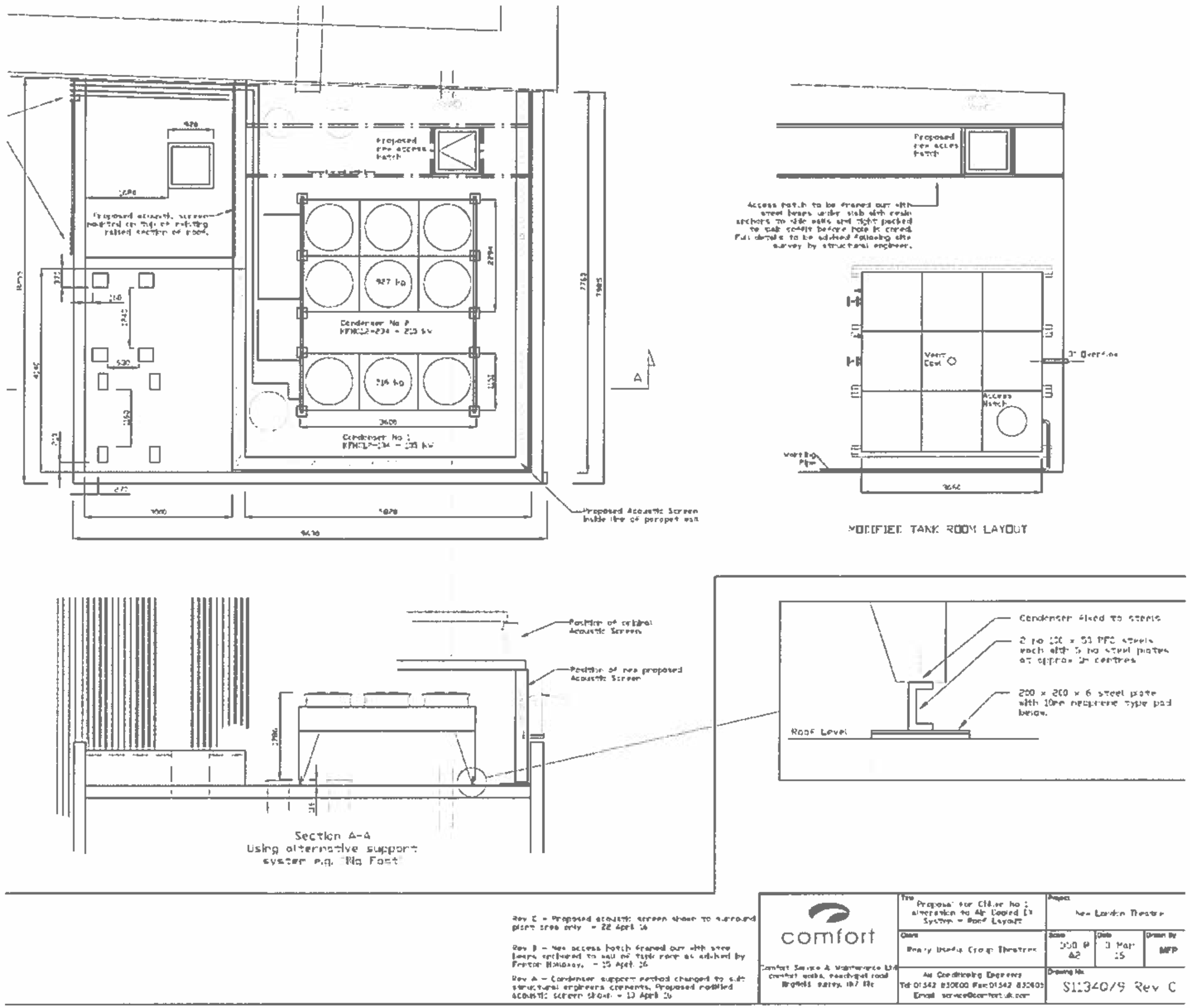
Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
30/11/2014 21:00	52.6	50.6	66.2
30/11/2014 21:15	53.1	50.7	68.0
30/11/2014 21:30	52.2	50.5	63.8
30/11/2014 21:45	53.1	50.5	68.4
30/11/2014 22:00	53.3	50.5	68.2
30/11/2014 22:15	52.6	50.7	65.9
30/11/2014 22:30	52.8	50.7	66.7
30/11/2014 22:45	51.9	50.2	69.1
30/11/2014 23:00	51.8	50.0	64.8
30/11/2014 23:15	51.7	50.4	67.8
30/11/2014 23:30	52.5	50.3	66.7
30/11/2014 23:45	52.0	50.2	65.8
30/11/2014 23:59	51.5	50.0	62.9
01/12/2014 00:15	51.1	50.0	59.7
01/12/2014 00:30	50.4	49.5	56.0
01/12/2014 00:45	51.0	50.0	60.9
01/12/2014 01:00	51.0	49.5	62.4
01/12/2014 01:15	50.9	49.5	63.2
01/12/2014 01:30	51.2	49.7	60.9
01/12/2014 01:45	51.9	49.6	74.8
01/12/2014 02:00	50.9	49.5	62.7
01/12/2014 02:15	50.8	49.1	65.2
01/12/2014 02:30	51.0	49.0	66.6
01/12/2014 02:45	49.6	48.5	60.8
01/12/2014 03:00	51.2	48.9	69.9
01/12/2014 03:15	50.9	49.0	62.9
01/12/2014 03:30	50.7	49.0	65.4
01/12/2014 03:45	52.4	49.3	68.4
01/12/2014 04:00	52.3	49.2	66.3
01/12/2014 04:15	50.3	48.8	62.1
01/12/2014 04:30	49.9	48.9	60.5
01/12/2014 04:45	50.4	49.3	57.2
01/12/2014 05:00	51.4	49.8	70.9
01/12/2014 05:15	52.9	50.6	65.8
01/12/2014 05:30	53.1	51.2	66.3
01/12/2014 05:45	53.9	51.6	72.8
01/12/2014 06:00	53.3	51.7	62.9
01/12/2014 06:15	52.5	51.3	61.5
01/12/2014 06:30	54.3	52.2	68.9
01/12/2014 06:45	55.8	52.0	74.4
01/12/2014 07:00	54.4	52.1	64.6
01/12/2014 07:15	54.8	52.2	74.7
01/12/2014 07:30	54.8	52.4	69.0
01/12/2014 07:45	54.6	52.6	67.0
01/12/2014 08:00	56.2	53.3	69.7

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}	Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
01/12/2014 08:15	57.2	54.3	70.1	01/12/2014 19:30	52.2	50.7	64.4
01/12/2014 08:30	57.7	55.1	67.5	01/12/2014 19:45	51.5	50.3	65.8
01/12/2014 08:45	57.6	54.9	70.1	01/12/2014 20:00	51.3	50.4	57.0
01/12/2014 09:00	56.6	54.4	73.1	01/12/2014 20:15	51.5	50.3	59.8
01/12/2014 09:15	56.8	54.8	69.9	01/12/2014 20:30	51.3	50.2	58.4
01/12/2014 09:30	56.7	54.9	67.7	01/12/2014 20:45	50.7	49.7	56.1
01/12/2014 09:45	56.5	54.2	71.1	01/12/2014 21:00	50.8	49.8	60.9
01/12/2014 10:00	57.5	54.7	74.0	01/12/2014 21:15	51.1	49.7	60.6
01/12/2014 10:15	56.3	54.8	66.1	01/12/2014 21:30	50.7	49.6	61.7
01/12/2014 10:30	56.0	54.3	66.0	01/12/2014 21:45	51.0	49.8	57.5
01/12/2014 10:45	55.9	53.8	71.5	01/12/2014 22:00	50.8	49.9	60.5
01/12/2014 11:00	55.9	53.9	71.1	01/12/2014 22:15	52.2	50.0	67.2
01/12/2014 11:15	57.6	53.8	76.1	01/12/2014 22:30	50.6	49.7	57.5
01/12/2014 11:30	56.4	53.8	68.4	01/12/2014 22:45	50.5	49.4	58.4
01/12/2014 11:45	57.2	54.2	74.7	01/12/2014 23:00	50.8	49.6	56.7
01/12/2014 12:00	56.2	53.9	70.5	01/12/2014 23:15	51.1	49.6	59.0
01/12/2014 12:15	55.5	53.9	64.8	01/12/2014 23:30	50.9	49.3	62.7
01/12/2014 12:30	56.1	54.0	67.8	01/12/2014 23:45	49.9	48.8	56.4
01/12/2014 12:45	57.7	54.1	70.9	01/12/2014 23:59	50.3	48.8	62.3
01/12/2014 13:00	56.7	54.6	67.6	02/12/2014 00:15	50.3	48.8	58.6
01/12/2014 13:15	54.6	53.4	62.8	02/12/2014 00:30	50.1	48.7	58.5
01/12/2014 13:30	55.0	53.2	63.2	02/12/2014 00:45	49.5	48.4	57.2
01/12/2014 13:45	59.7	54.3	77.1	02/12/2014 01:00	49.7	48.2	58.5
01/12/2014 14:00	55.9	53.7	72.8	02/12/2014 01:15	49.6	48.4	58.5
01/12/2014 14:15	56.1	53.2	71.3	02/12/2014 01:30	50.6	48.8	63.9
01/12/2014 14:30	55.9	53.3	73.2	02/12/2014 01:45	49.5	48.0	60.1
01/12/2014 14:45	57.8	54.0	75.9	02/12/2014 02:00	48.9	47.8	57.4
01/12/2014 15:00	56.5	53.7	68.5	02/12/2014 02:15	49.6	48.3	58.5
01/12/2014 15:15	56.7	53.8	69.3	02/12/2014 02:30	48.9	47.7	58.4
01/12/2014 15:30	55.5	53.8	63.5	02/12/2014 02:45	48.7	47.6	55.4
01/12/2014 15:45	54.0	52.8	65.1	02/12/2014 03:00	55.7	47.8	77.1
01/12/2014 16:00	56.6	53.0	72.6	02/12/2014 03:15	49.1	47.8	58.7
01/12/2014 16:15	54.2	52.8	64.4	02/12/2014 03:30	48.4	47.3	58.9
01/12/2014 16:30	53.8	52.7	62.2	02/12/2014 03:45	48.8	47.4	57.5
01/12/2014 16:45	54.1	52.7	68.3	02/12/2014 04:00	49.3	47.2	62.2
01/12/2014 17:00	56.1	52.9	71.1	02/12/2014 04:15	48.8	47.4	60.6
01/12/2014 17:15	54.1	52.3	64.8	02/12/2014 04:30	49.1	47.7	56.2
01/12/2014 17:30	53.2	52.1	61.9	02/12/2014 04:45	49.3	47.9	62.6
01/12/2014 17:45	53.6	52.1	67.5	02/12/2014 05:00	49.7	48.5	56.0
01/12/2014 18:00	59.4	52.2	75.5	02/12/2014 05:15	50.5	49.1	59.6
01/12/2014 18:15	55.3	51.6	73.6	02/12/2014 05:30	54.7	49.6	76.2
01/12/2014 18:30	53.0	51.5	65.5	02/12/2014 05:45	51.4	50.1	58.4
01/12/2014 18:45	53.0	51.5	65.8	02/12/2014 06:00	51.7	49.9	67.8
01/12/2014 19:00	52.6	51.4	62.5	02/12/2014 06:15	51.8	50.5	56.6
01/12/2014 19:15	51.6	50.7	62.2	02/12/2014 06:30	51.5	50.2	58.2

Time	L_{Aeq}	$L_{AF,90}$	L_{AFmax}
02/12/2014 06:45	51.8	50.6	61.6
02/12/2014 07:00	51.9	50.7	60.8
02/12/2014 07:15	53.3	51.4	71.6
02/12/2014 07:30	59.0	51.9	80.2
02/12/2014 07:45	52.8	51.7	62.9
02/12/2014 08:00	53.7	52.2	71.1
02/12/2014 08:15	55.7	53.0	69.0
02/12/2014 08:30	54.5	53.4	65.8
02/12/2014 08:45	55.9	54.0	66.1
02/12/2014 09:00	56.6	54.3	66.1
02/12/2014 09:15	58.0	54.9	67.2
02/12/2014 09:30	57.7	55.6	71.7
02/12/2014 09:45	56.8	54.7	74.4
02/12/2014 10:00	58.8	54.8	77.8
02/12/2014 10:15	59.4	55.5	80.3
02/12/2014 10:30	59.6	55.3	73.8
02/12/2014 10:45	60.0	54.9	83.3
02/12/2014 11:00	58.8	55.1	72.8
02/12/2014 11:15	59.5	55.1	75.9
02/12/2014 11:30	59.0	55.8	70.2

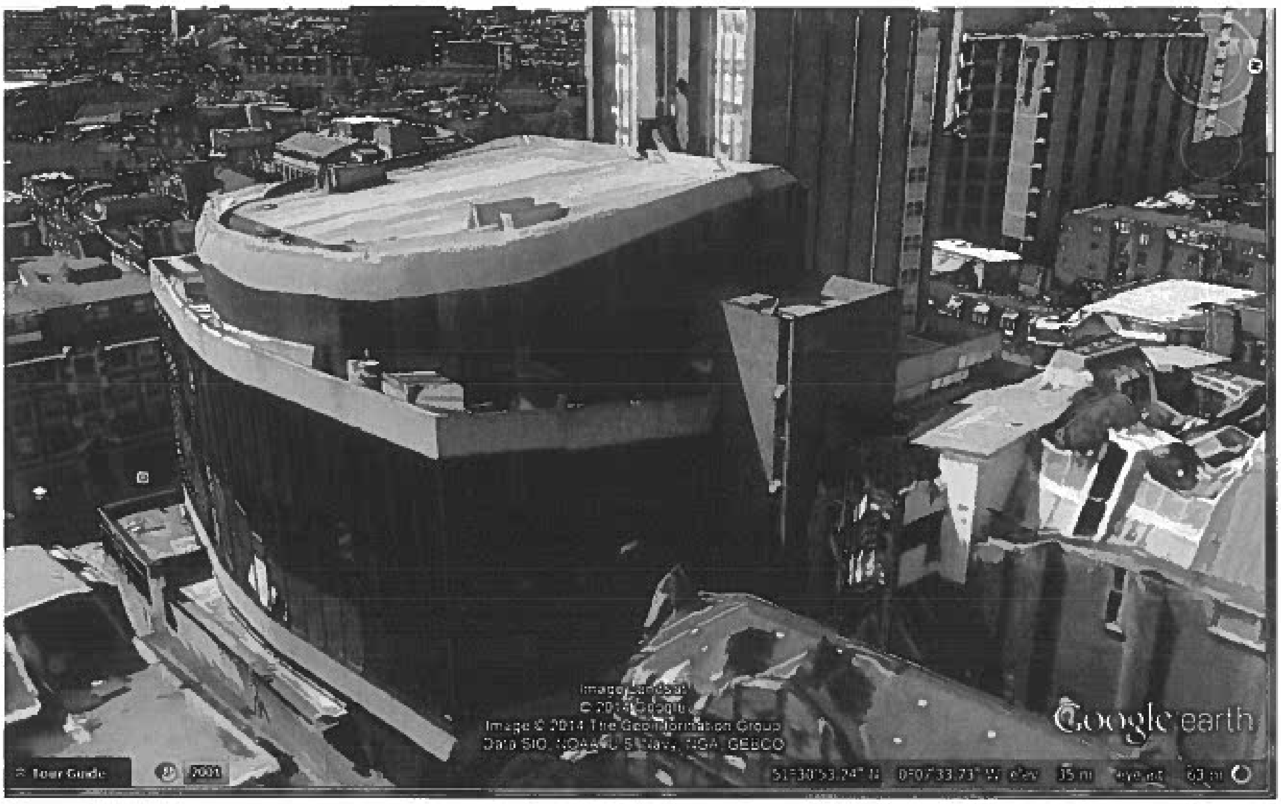
APPENDIX C

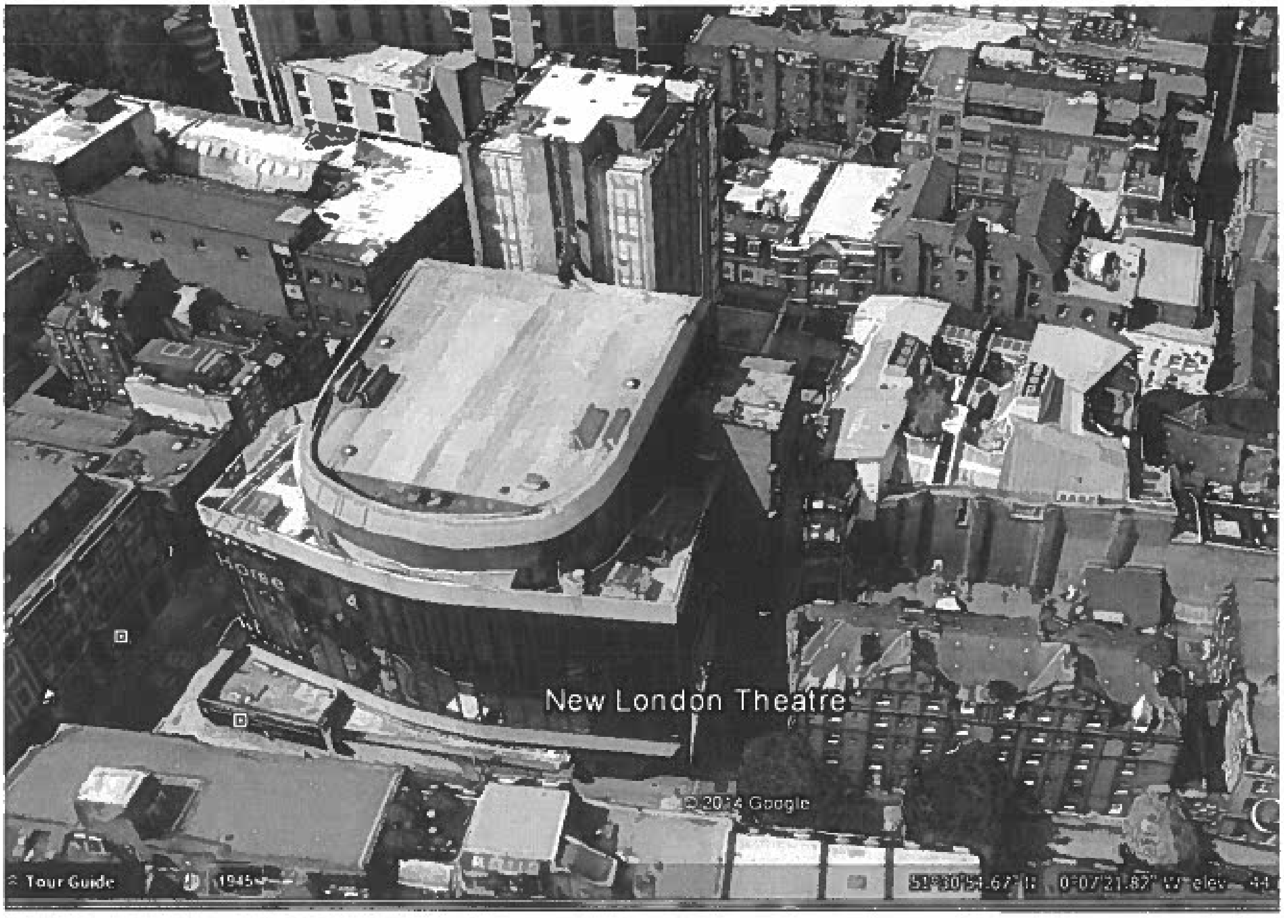
PLANS SHOWING PROPOSED PLANT AREA



Proposed new access hatch
Condenser No 2
Condenser No 1
Proposed Acoustic Screen inside line of parapet wall
MODIFIED TANK ROOM LAYOUT
Access Hatch
Vent Cowl
Position of original Acoustic Screen
Position of new proposed Acoustic Screen
Section A-A
Using alternative support system e.g. "Big Foot"
Condenser fixed to steels
200 x 200 x 6 steel plate with 10mm neoprene type pad below.
Roof Level
comfort
Air Conditioning Engineers
New London Theatre
S11340/9 Rev C

Aerial views



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APPENDIX D

CALCULATIONS

In all calculations three source locations are used to assess the fans in different parts of the plant area. Unit 1 is taken as the summation of three fans centred along the north west side of the area, Unit 2 is taken as the summation of three fans centred along the north east side of the area and Unit 3 as the summation of three fans located along the south east side of the area, as on the plant area layout.

Calculation to Receiver R1

Noise transmitted to upper windows in tower block

	Octave Band Centre Frequency								
	125	250	500	1k	2k	4k	8k	Hz	dBA
Condenser Sound Power Level (3 fans)	58.1	58.4	67.8	68.2	63.4	55.1	50.6	dB	72.8
Screening from Unit 1	-5	-4	-4	-3	0.0	0.0	0.0	dB	
Screening from Unit 2	-5	-5	-4	-4	-3	-2	0.0	dB	
Screening from Unit 3	-5	-5	-5	-4	-4	-3	0.0	dB	
18m Distance correction from Unit 1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	dB	
19m Distance correction from Unit 2	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	dB	
20m Distance correction from Unit 3	-34.0	-34.0	-34.0	-34.0	-34.0	-34.0	-34.0	dB	
SPL Contribution from Unit 1	20.0	21.3	30.7	32.1	30.7	22.0	17.5	dB	36.4
SPL Contribution from Unit 2	19.5	19.8	30.2	30.6	26.8	19.5	17.0	dB	34.8
SPL Contribution from Unit 3	19.1	19.4	28.8	30.2	25.4	18.1	16.6	dB	33.8
Combined noise level	24.3	25.0	34.7	35.8	33.0	24.9	21.8	dB	39.9
Façade correction	+3	+3	+3	+3	+3	+3	+3	dB	+3
Combined façade noise level								dB	42.9

In the above calculation:

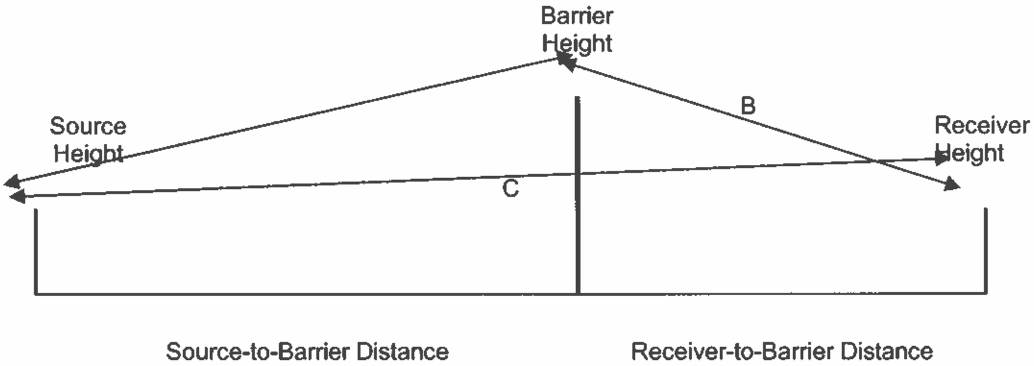
- The noise output for each condenser equates to three fans taken from the manufacturers data.
- The attenuation due to screening from the proposed vertical baffles is taken from the top of each unit location to the lowest windows with a direct view of the condensers at the higher levels of the tower block. The straight line distance attenuation is calculated based on hemi spherical radiation although, as the condensers are on a roof top some radiation may be spherical.
- The noise source is taken as being at the top of the condensers at a height of 1900mm above the top of the roof.
- The individual contribution for each of the three condensers is calculated and the results summed logarithmically. A +3 dB factor is added for the façade effect at the window.
- The receiver window is taken to be 12 metres above the top of the condensers. The barrier height is taken to be the baffle or acoustic louvre screen at a height of 2560mm above the height of the roof.

- The window selected for the calculation is the second window away from the wall nearest the auditorium as the closest window is screened by the wall of the auditorium.

Typical screening calculation for above:

Screening calculations for each source and receiver have been calculated using the method outlined in the above calculation spreadsheet. Source, receiver and barrier heights are relative based on estimates of a typical separation of 3m per floor.

BASIC BARRIER ATTENUATION



Source-to-Barrier Distance	1.0 m
Receiver-to-Barrier Distance	12.0 m

Source Height	1.9 m
Receiver Height	13.9 m
Barrier Height	2.6 m

Path difference = (a + b) - c   0.017 m

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
Attenuation - dB	**5**	**4**	**4**	**3**	**0**	**0**	**0**	**0**

CRTN
2.9 dBA

Noise transmitted to windows on tower block level with no direct line of sight to top of condensers

	Octave Band Centre Frequency								
	125	250	500	1k	2k	4k	8k	Hz	dBA
Condenser sound power level (3 fans)	58.1	58.4	67.8	68.2	63.4	55.1	50.6	dB	72.8
Screening from Unit 1	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	dB	
Screening from Unit 2	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	dB	
Screening from Unit 3	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	dB	
13m Distance correction from Unit 1	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	dB	
15m Distance correction from Unit 2	-31.5	-31.5	-31.5	-31.5	-31.5	-31.5	-31.5	dB	
16m Distance correction from Unit 3	-32.1	-32.1	-32.1	-32.1	-32.1	-32.1	-32.1	dB	
SPL Contribution from Unit 1	22.8	23.1	32.5	32.9	28.1	19.8	15.3	dB	
SPL Contribution from Unit 2	21.6	21.9	31.3	31.7	26.9	18.6	14.1	dB	
SPL Contribution from Unit 3	21.2	21.5	23.9	31.3	26.5	18.2	13.7	dB	
Combined noise level over screen	26.7	27.0	36.4	36.8	32.0	23.7	19.2	dB	40.8
Noise level in enclosure	52.8	53.1	62.6	62.9	58.1	51.9	47.8	dB	
Correction for louvre area ($12m^2$)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	dB	
Correction for distance (11m)	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	dB	
Breakout constants	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	dB	
SRI of Louvre	-5.0	-8.0	-11.0	-16.0	-18.0	-14.0	-12.0	dB	
Breakout through louvre	23.3	21.3	27.8	23.1	19.3	14.1	9.3	dB	31.1
Combined level at window								dB	41.2
Façade correction								dB	+3
Total facade level at window								dB	44.2

In the above calculation:

- The noise output for each condenser equates to three fans taken from the manufacturers data.
- The attenuation due to screening from the acoustic louvre is taken from each unit location to the lowest windows with no direct line of sight to the top of the condensers. The straight line distance attenuation is calculated based on hemi spherical radiation although, as the condensers are on a roof top some radiation may be spherical.
- The noise source is taken as being at the top of the condensers at a height of 1900mm above the top of the roof.
- The individual contribution for each of the three condensers is calculated and the results summed logarithmically.
- The barrier height is taken to be the baffle or acoustic louvre screen at a height of 2560mm above the height of the roof.
- The window selected for the calculation is the second window away from the wall nearest the auditorium as the closest window is screened by the wall of the auditorium.

- The noise level in the plant enclosure is calculated as a reverberant sound pressure level due to the logarithmic sum of the sound output from the 3 condensers (+4.8 dB) or all nine fans. This is a pessimistic estimate as it does not allow for screening between the condensers and the louvre in the plant area.

- Breakout through the louvre is calculated using the formula $L_{out} = L_{internal} + 10Log\ S - 20logR - 14 - SRI$ dB:

  - Where S is the surface area of the louvre

  - R is the distance from the louvre to the receiver

  - SRI is the Sound Reduction Index of the acoustic louvre.

- A +3 dB factor is added for the façade effect at the window.

- The total predicted façade level is calculated from the logarithmic sum of the sound passing through the louvre and that passing over it.

Calculation to receiver R2

Relative height 11m below top of condensers. Horizontal distance 8 m from nearest condenser

Octave Band Centre Frequency									
	125	250	500	1k	2k	4k	8k	Hz	dB
Condenser sound power level (3 fans)	58.1	58.4	67.8	68.2	63.4	55.1	50.6	dB	72.8
Screening from Unit 1	-13	-16	-19	-22	-24	-27	-30	dB	
Screening from Unit 2	-13	-16	-19	-22	-24	-27	-30	dB	
Screening from Unit 3	-13	-15	-18	-21	-24	-27	-30	dB	
14m Distance correction from Unit 1	-30.9	-30.9	-30.9	-30.9	-30.9	-30.9	-30.9	dB	
14m Distance correction from Unit 2	-30.9	-30.9	-30.9	-30.9	-30.9	-30.9	-30.9	dB	
16m Distance correction from Unit 3	-32.6	-32.6	-32.6	-32.6	-32.6	-32.6	-32.6	dB	
SPL Contribution from Unit 1	14.2	11.5	17.9	16.3	8.5	-2.8	-10.3	dB	
SPL Contribution from Unit 2	14.2	11.5	17.9	16.3	8.5	-2.8	-10.3	dB	
SPL Contribution from Unit 3	12.5	9.8	16.2	14.6	6.8	-4.5	-12.0	dB	
Combined noise level	18.5	15.8	22.2	20.1	12.8	1.5	-6.0	dB	26.0
Noise level in enclosure	52.8	53.1	62.6	62.9	58.1	51.9	47.8	dB	
Correction for louvre area (12m^2)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	dB	
Correction for distance (11m)	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	dB	
Breakout constants	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	dB	
SRI of Louvre	-5.0	-8.0	-11.0	-16.0	-18.0	-14.0	-12.0	dB	
Breakout through louvre	24.0	21.3	27.8	23.1	16.3	14.1	12.0	dB	31.1
Combined level at window								dB	32.2
Façade correction								dB	+3
Total facade level at window								dB	35.2

Calculation to receiver R3: Noise transmission to terrace garden overlooking Parker Mews

Relative height 12m below top of condensers. Horizontal distance 3.6 m from nearest condenser

Octave Band Centre Frequency									
	125	250	500	1k	2k	4k	8k	Hz	dB
Condenser sound power level (3 fans)	58.1	58.4	67.8	68.2	63.4	55.1	50.6	dB	72.8
Screening from Unit 1	-16	-19	-22	-25	-28	-31	-34	dB	
Screening from Unit 2	-14	-17	-20	-23	-26	-29	-32	dB	
Screening from Unit 3	-16	-19	-22	-25	-28	-31	-34	dB	
13m Distance correction from Unit 1	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	dB	
12m Distance correction from Unit 2	-29.6	-29.6	-29.6	-29.6	-29.6	-29.6	-29.6	dB	
13m Distance correction from Unit 3	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	-30.3	dB	
SPL Contribution from Unit 1	11.8	9.1	15.5	12.9	5.1	-6.2	-13.7	dB	
SPL Contribution from Unit 2	14.5	12.8	18.2	15.6	7.8	-3.5	-11.0	dB	
SPL Contribution from Unit 3	11.8	9.1	15.5	12.9	5.1	-6.2	-13.7	dB	
Combined noise level	17.7	15.5	21.4	18.8	11.0	-0.3	-6.1	dB	25.1
Noise level in enclosure	52.8	53.1	62.6	62.9	58.1	51.9	47.8	dB	
Correction for louvre area (11m^2)	10.4	10.4	10.4	10.4	10.4	10.4	10.4	dB	
Correction for distance (11m)	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	dB	
Breakout constants	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	dB	
SRI of Louvre	-5.0	-8.0	-11.0	-16.0	-18.0	-14.0	-12.0	dB	
Breakout through louvre	23.6	20.7	27.2	22.5	15.7	13.5	11.4	dB	30.5
Combined level at window								dB	31.6
Façade correction								dB	+3
Total facade level at window								dB	34.6

Calculation to receiver R4: Noise transmission to Parker Street flats overlooking Parker Mews

Relative height 10.2m below top of condensers. Horizontal distance 13m from nearest condenser

Octave Band Centre Frequency									
	125	250	500	1k	2k	4k	8k	Hz	dB
Condenser sound power level (3 fans)	58.1	58.4	67.8	68.2	63.4	55.1	50.6	dB	72.8
Screening from Unit 1	-11	-14	-17	-20	-23	-25	-28	dB	
Screening from Unit 2	-12	-15	-17	-20	-23	-26	-29	dB	
Screening from Unit 3	-12	-14	-17	-20	-23	-26	-29	dB	
19m Distance correction from Unit 1	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	dB	
16m Distance correction from Unit 2	-32.1	-32.1	-32.1	-32.1	-32.1	-32.1	-32.1	dB	
17m Distance correction from Unit 3	-32.6	-32.6	-32.6	-32.6	-32.6	-32.6	-32.6	dB	
SPL Contribution from Unit 1	13.5	10.8	17.2	14.6	6.8	-3.5	-11.0	dB	
SPL Contribution from Unit 2	14.0	11.3	18.7	16.1	8.3	-3.0	-10.5	dB	
SPL Contribution from Unit 3	14.5	11.8	18.2	15.6	7.8	-2.5	-10.0	dB	
Combined noise level	18.8	16.1	22.8	20.2	12.4	1.8	-5.7	dB	26.9
Noise level in enclosure	52.8	53.1	62.6	62.9	58.1	51.9	47.8	dB	
Correction for louvre area (22m^2)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	dB	
Correction for distance (15m)	-23.5	-23.5	-23.5	-23.5	-23.5	-23.5	-23.5	dB	
Breakout constants	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	dB	
SRI of Louvre	-5.0	-8.0	-11.0	-16.0	-18.0	-14.0	-12.0	dB	
Breakout through louvre	23.8	21.1	27.6	22.9	16.1	13.9	11.8	dB	30.9
Combined level at window								dB	32.4
Façade correction								dB	+3
Total facade level at window								dB	35.4

In the above calculations:

- The noise output for each condenser equates to three fans taken from the manufacturers data.
- The attenuation due to screening from the acoustic louvre is taken from each unit location to the highest windows at the receiver location. The straight line distance attenuation is calculated based on hemi spherical radiation although, as the condensers are on a roof top some radiation may be spherical.
- The noise source is taken as being at the top of the condensers at a height of 1900mm above the top of the roof.
- The individual contribution for each of the three condensers is calculated and the results summed logarithmically.
- The barrier height is taken to be the baffle or acoustic louvre screen at a height of 2560mm above the height of the roof.

- The noise level in the plant enclosure is calculated as a reverberant sound pressure level due to the logarithmic sum of the sound output from the 3 condensers (+4.8 dB) or all nine fans. This is a pessimistic estimate as it does not allow for screening between the condensers and the louvre in the plant area.

- Breakout through the louvre is calculated using the formula $L_{out} = L_{internal} + 10Log S - 20logR - 14 - SRI$ dB

  - Where S is the surface area of the louvre

  - R is the distance from the louvre to the receiver

  - SRI is the Sound Reduction Index of the acoustic louvre.

- A +3 dB factor is added for the façade effect at the window.

- The total predicted façade level is calculated from the logarithmic sum of the sound passing through the louvre and that passing over it.