NOISE IMPACT ASSESSMENT

Client: - Luxlo Ltd

Project: - 15 Park Square East

Qt Acoustics

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EXECUTIVE SUMMARY

Qt Acoustics were appointed by Luxlo Ltd to review the acoustic impact of the proposed mechanical services plant at roof top level of 15 Park Square East, London, NW1 4LH.

This report demonstrates that the proposed plant is in compliance with the local authority planning policy.

Environmental noise monitoring of the site has been undertaken and representative noise levels have been recorded to allow assessment in accordance with local planning requirements. Noise level calculations have been performed to predict the noise rating level of the proposed mechanical services plant in relation to the local planning conditions for noise emission.

Relevant standards in the form of model planning conditions from Camden Borough Council (CBC) have been considered. The report demonstrates that the proposed plant provides a low impact to neighbouring noise sensitive properties and complies with the model planning conditions.

1.0 Introduction

It is proposed to install new mechanical services plant in the form of an external air conditioning unit on the rooftop of 15 Park Square East, London, NW1 4LH to serve the residential dwelling within the building. The property is located within a residential terrace and in a predominantly residential area.

Qt Acoustics have therefore been commissioned to undertake a detailed environmental noise assessment of the site in line with local planning conditions.

2.0 Objectives

The objectives of this assessment are:

- To establish, by means of environmental noise monitoring, the existing noise climate of the site.
- To measure the existing L_{A90} (background noise level) at a location representative of the noise climate currently experienced at neighbouring noise sensitive properties.
- To propose suitable plant noise emission criteria based on relevant Standards and Planning Requirements.
- To perform predicted noise level calculations of the proposed plant incorporating any acoustic mitigation measures to provide a detailed assessment of the noise impact on neighbouring noise sensitive properties and specifically in relation to local planning condition requirements.

This report presents the results of the noise survey and the subsequent impact assessment of the mechanical services plant with any associated acoustic mitigation measures.

3.0 Site Description

The site is located at 15 Park Square East, London, NW1 4LH and falls within the boundary of Camden Borough Council (CBC). 15 Park Square East is used for residential purposes, contains a single dwelling and located in an area of predominantly residential properties. The nearest noise sensitive residential properties are located to the rear and at 18 Park Square East and adjacent at 14 Park Square East:

- **Location 1 – 18 Park Square East – Top floor window of rear of property nominally 12 metres from proposed AC. (Note: - benefits from partial natural screening by the building)**
- **Location 2 – 14 Park Square East – Top floor front window located nominally 7.5 metres from proposed AC. (Note: - benefits from natural screening by the building)**

15 Park Square East is located in the Camden area of London and between The Regent's Park and Euston rail station.

Please see Appendix D for a map of the area.

4.0 Acoustic Criteria

Local authority planning conditions and relevant British Standards are relevant in noise impact assessments. Criteria relating to noise emission from mechanical services plant is detailed below.

4.1 Local Authority Specific Planning Conditions.

Camden Borough Council typical requirements for assessing the noise impact from mechanical services plant for developments of this nature are contained within Policy DP28 "Noise & Vibration" Table E from Camden Development Policies 2010 as below: -

Table 4.1.1

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 discreet continuous note (whine, hiss, screech, hum) at 1 metre 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 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$_{LAeq}$

5.0 Environmental Noise Survey

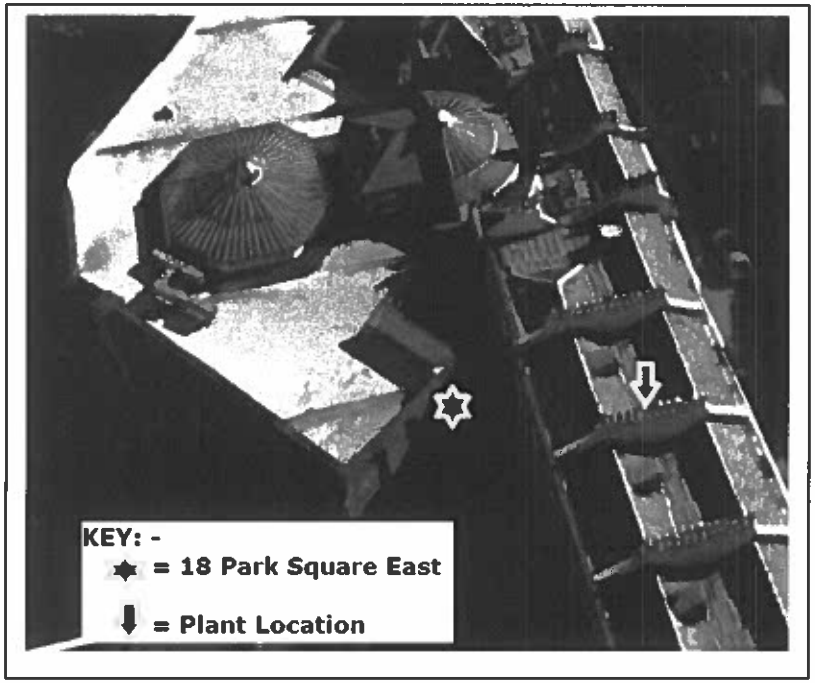
5.1 Instrumentation

The environmental nose survey was undertaken using the following equipment:-
NTI Audio XL2 Serial No. A2A-08390-E Class 1 integrating and data logging sound level meter conforming to the relevant sections of BS EN 61672-1:2013
NTI Audio M2230 microphone monitoring assembly comprising of MA220 pre-amp - serial no. 3426 and microphone capsule serial number 8047 class 1 conforming to the relevant sections of BS EN 61672-1:2013.
Full calibration certificates are provided within Appendix H.

5.2 Measurement Position

Our survey concluded that the nearest/most impacted noise sensitive property is located to the rear and at 18 Park Square East and incorporates a window nominally 12 metres from the proposed plant location, this location benefits from partial screening from the proposed plant noise. Additionally a nearer window was identified within 14 Park Square East and located on the front façade nominally 7 metres from the proposed plant location but benefits from substantial screening from the proposed plant noise. The noise monitoring instrumentation was located at roof top level of 15 Park Square East and in close proximity to the neighbouring noise sensitive windows.

Figure 5.2.1 – Position of Mechanical Plant "AC" and Nearest Residential Properties.



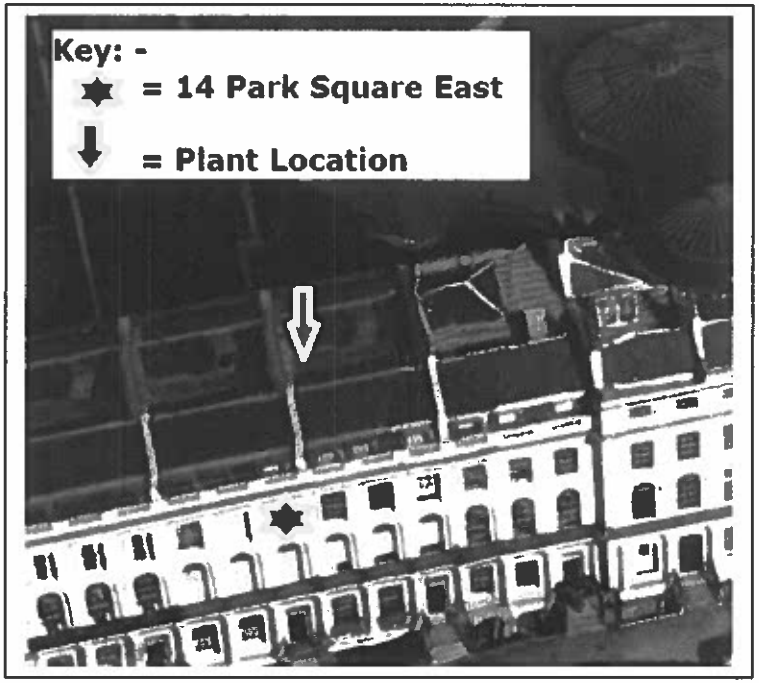
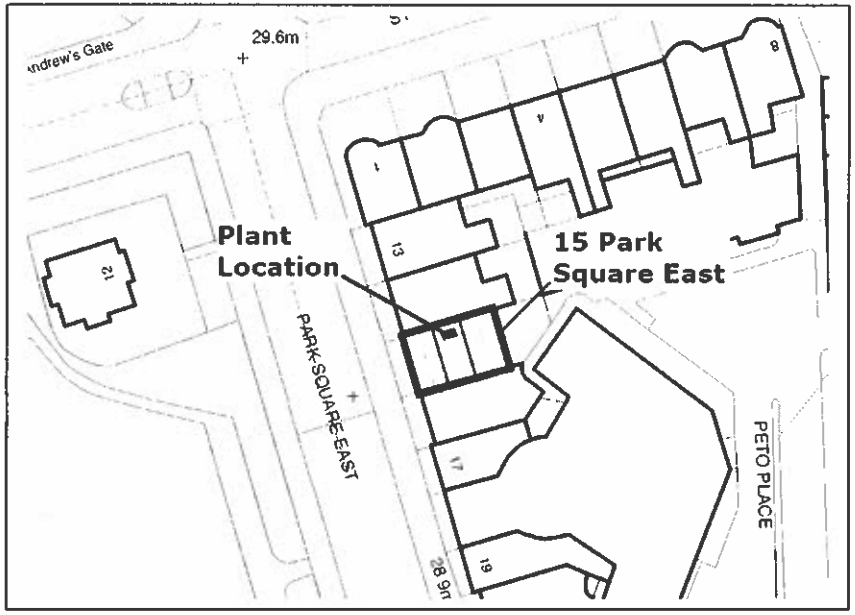


Figure 5.2.2 – Position of Mechanical Plant "AC" and Aerial View of 51 South Street.



Additional residential properties were identified close to 15 Park Square East but are either at a greater distance or benefit from being in the acoustic shadow of the building.

5.3 Measurement Procedure

The noise monitoring equipment was configured to monitor consecutive 15 minute samples of the site noise level over a period of 24-hours. Measurements were logged concurrently for the ambient sound level ($L_{Aeq,15\ min}$), background Noise Level ($L_{A90,15\ min}$) and $L_{A10,15\ min}$ (Often used as a traffic noise percentile). The noise monitoring was an unattended test and as such the sound level meter was also configured to record a continuous audio sample of the entire test duration to assist with identification of any extraneous noise sources.

The microphone monitoring assembly was located at a height of 1.5 metres above the flat roof level and at a distance of more than 3.5 metres from any neighbouring façade (in this instance that of the nearest noise sensitive property). The sound level meter manufacturer's windshield and bird spike assembly were used in order to minimise risk of external interference.

The environmental noise monitoring was performed from 14:15 hours on Wednesday 20th April 2016 to 14:15 hours on Thursday 21st April 2016 and the report based on results over this period.

A field calibration check of the sound level meter and microphone monitoring assembly was undertaken before and after the noise measurement. No deviation was recorded and a microphone sensitivity of 42.6 mV/Pa maintained.

The procedure, measurements and interpretation were all undertaken in accordance with BS7445, parts 1&2. All provided sound pressure level measurements are referenced to $2x10^{-5}$ Pa.

5.4 Weather Conditions

The noise monitoring period was without precipitation and the ground surface was dry. The weather conditions were recorded for the duration of the noise monitoring period and indicated stable weather suitable for test purposes. The details are provided below:-

Test	Temperature	Wind Speed	Wind Direction	Cloud Cover
	°C	m/s	General	%
Maximum	23	3.7	E	100%
Minimum	6	0.0	SW	10%

As such the prevailing weather conditions during the noise monitoring period are deemed to be suitable for the purpose of environmental noise testing and would not result in excessive external interference to measurement.

5.5 Site Noise Climate

The immediate area surrounding 15 Park Square East is predominantly residential. Commercial properties are located in the extended area and at a significantly greater distance along Marylebone Road.

The main noise source within the area is traffic noise from surrounding roads. Whilst Park Square East is not a high traffic street the road network density within this area of London results in an underlying noise from vehicle movements.

Neighbouring residential premises have small quantities of mechanical services plant and contribute to the noise climate in the area.

Intermittent noise from over ground rail was not detectable at the site although main line rail track and underground stations are nearby nominally 100 metres away.

Intermittent aircraft noise was identified and presumed from Heathrow and London City airport, other air traffic was also present in the form of helicopter movements across London.

6.0 Measurement Result Summary

A 24-hour unattended noise test was undertaken at roof top level of 15 Park Square East and in close proximity to the nearest noise sensitive property facade. The full results are provided in graphical and numerical format within Appendix B & C. A summary of the results is provided in table 6.1 below.

Table 6.1 Summary of Minimum Background Noise Levels – Day/Eve/Night

Time Period	Lowest Background Noise Level
	$L_{A90, 15min}$
Day Time (07:00-19:00 hrs)	52 dB
Evening (19:00-23:00 hrs)	50 dB
Night (23:00-07:00 hrs)	46 dB

The proposed plant is to be operated day or night and generally as per the heating & cooling load of the property requires, as such it is considered to operate on a 24-hour basis.

From table 6.1 we can determine that existing noise levels at the roof of the site do not exceed the 60 dB L_{A90} test from the CBC condition and as such the planning condition requires the limiting noise level at the sensitive façade to be directly related to the lowest recorded background noise level for the proposed operating period.

Mechanical services plant of this nature are inverter controlled and as such will vary speed subject to heat load requirements and not cycle on & off as older generations of AC plant may. It is possible that the noise emission of the proposed AC plant may be considered tonal in nature without acoustic mitigation treatment and as such and on the basis of a worst case assessment the additional 5 dB penalty as stipulated within CBC planning condition is to be adopted.

In order to comply with the requirements of the planning condition of 10 dB below lowest measured background noise level the following limits should be applied to any noise generated by the proposed mechanical services when extrapolated to the nearest noise sensitive property facade:-

Table 6.2 – Plant Noise Limits – CBC adopted Camden Development Policies 2010 – DP28 Planning Condition

Time Period	Plant Noise Limits
	$L_{Aeq, 15min}$
Plant Operating Hours (24 hrs)	36 dB

7.0 Plant Noise Emission

The proposed plant is to be installed generally in accordance with the roof plan drawing provided within Appendix E. This section summarises the plant, and provides a noise impact assessment with reference to the planning condition requirements.

7.1 Plant Information and Operation

The proposed plant is to be installed on the existing roof and generally as per the attached roof plan provided within Appendix E.
The plant is required to operate 24-hours a day or as 15 Park Square East requires and so as to maintain a comfortable internal temperature.

7.1.1 The proposed mechanical services plant consists of the of the following equipment:-

Item 1 – Panasonic U-4LE1E5 external air conditioning condensing unit – 52 dB(A) @ 1 metre [1]

[1] The Manufacturer's published noise levels in octave bands are provided within Appendix F.

The air conditioning plant is to be installed using proprietary rubber-in-shear vibration isolators suitably selected for the equipment weight and so as to reduce transfer of any vibration to the building structure.

7.2 Plant Noise Assessment

Plant noise levels with with plant located as per Appendix E have been calculated for the proposed periods of operation and extrapolated to 1 metre from the nearest noise sensitive property facade. The calculations have been performed with the plant operating at full speed and in the noisier heating mode and as such represent a worst case scenario and one that is only occasionally experienced in practice. A full and detailed set of calculations are provided within Appendix G.

Our calculations indicate a predicted noise level of 30 dB(A) for the proposed AC plant at the most impacted neighbouring property located at 18 Park Square East.

7.2.1 CBC Model Planning Criteria

The proposed plant is inverter speed controlled to slowly vary plant operating speeds in line with building requirements. As such it would not regularly cycle on and off or rapidly change speed so as to cause intermittent or impulsive type sounds. The proposed plant may however be considered tonal in nature. As such the model planning criteria indicated by CDC requires the plant to be 10 dB below the lowest background noise level when extrapolated to the nearest or most affected noise sensitive property as set out within table 6.2.

Our detailed calculations (provided within Appendix G) indicate that the requirements of CBC can be achieved for 24-hour plant operation.

Table 7.2.2 – Plant Noise CBC Planning Condition & Predicted Noise Levels

Time Period	Plant Noise Limits	Calculated Plant Noise
	$L_{Aeq,15min}$	$L_{Aeq,15min}$
AC Plant = 24-hour so Night (23:00-07:00 hrs)	36 dB	30 dB

As such this report clearly demonstrates compliance with the planning criteria.

8.0 Conclusions

Qt acoustics have performed environmental noise monitoring at the site in order to establish representative background noise levels for the proposed plant operating periods. Relevant standards in the form of the model planning conditions from CBC have been considered. This assessment indicates a low impact to neighbouring noise sensitive properties and compliance with the model planning conditions.

Appendix A. Glossary of Terms

Decibel (dB)
Adopted as the common unit of measurement in acoustics. The unit of the decibel is dimensionless and is used in acoustics for sound measurements to define the ratio between the measured pressure level and a reference pressure level – typically $2x10^{-5}$ N/m^2 or the threshold of hearing.

"A" Weighting
Arithmetic correction for different frequencies to closer represent the typical sensitivity of the human ear to sound. Suited to low level noises of around 40 phon (close to 40 dB(A)) and provides an simple single figure weighted indication of the perceived level of loudness by a human.

Noise Percentile Level - L_N
Statistical Analysis of the noise level where "N" can be from 0.1% to 99.9% and represents the noise level exceeded for "N" percent of the measurement time. Commonly used with "A-Weighting" as above and measured over a set period of time 't' e.g. $L_{A99,15\ min}$ indicates the noise level exceeded for 99% of the measurement period of 15 minutes. See below for commonly used noise percentiles.

$L_{A90,t}$ or Background Noise Level
The A-Weighted noise level exceeded for 90% of the time 't' and is referred to as the "background noise level" for BS4142 type noise assessments and quoted to the nearest whole dB.

$L_{A10,t}$
The A-Weighted noise level exceeded for 10% of the time 't' and is referred to as the "traffic noise level".

$L_{Aeq,t}$
The A-Weighted equivalent continuous sound pressure over the measurement period of time 't' and is referred to as the "traffic noise level".

$L_{Amax,t}$
The A-Weighted instantaneous maximum sound pressure that occurred during the measurement period of time 't'.

Assessment Position
Unless otherwise stated is a location 1 metre from the façade of the nearest noise sensitive property.

Specific Sound Source
The noise source being assessed within this report (typically the proposed mechanical services plant equipment).

Specific Sound Level
The equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval.

Ambient Sound Level
Equivalent continuous A-Weighted sound pressure level of the totally encompassing sound in a given situation at a given time at the assessment location over a given time interval.

Rating Level, $L_{ar,Tr}$
The Specific Sound Level with any adjustment for characteristic features of the sound such as tonality or impulsivity.

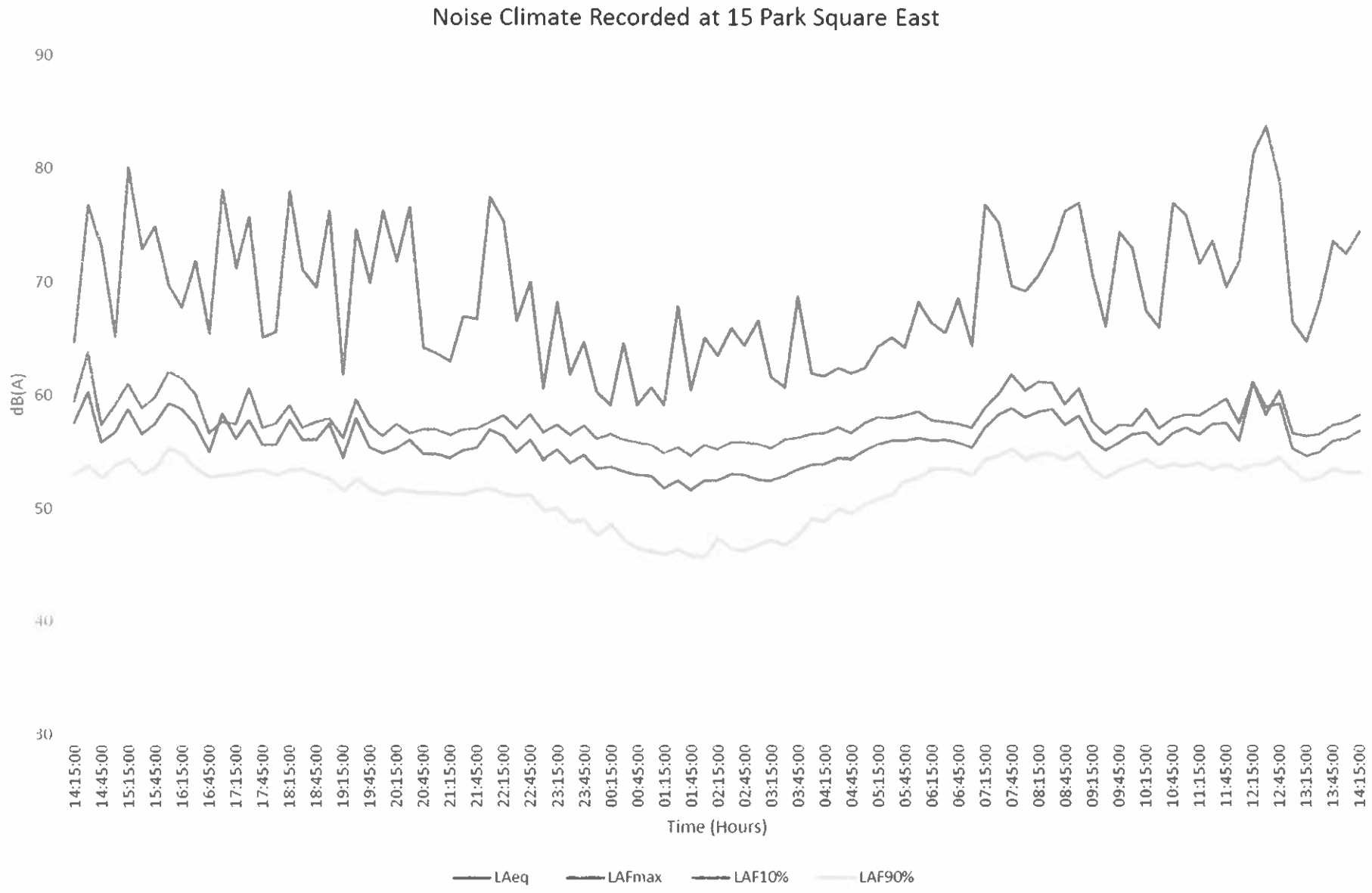
Residual Sound
The ambient sound remaining at the assessment location when the specific sound source is supressed to such a degree that it does not contribute to the ambient sound.

Appendix B. Table of Environmental Noise Monitoring Results

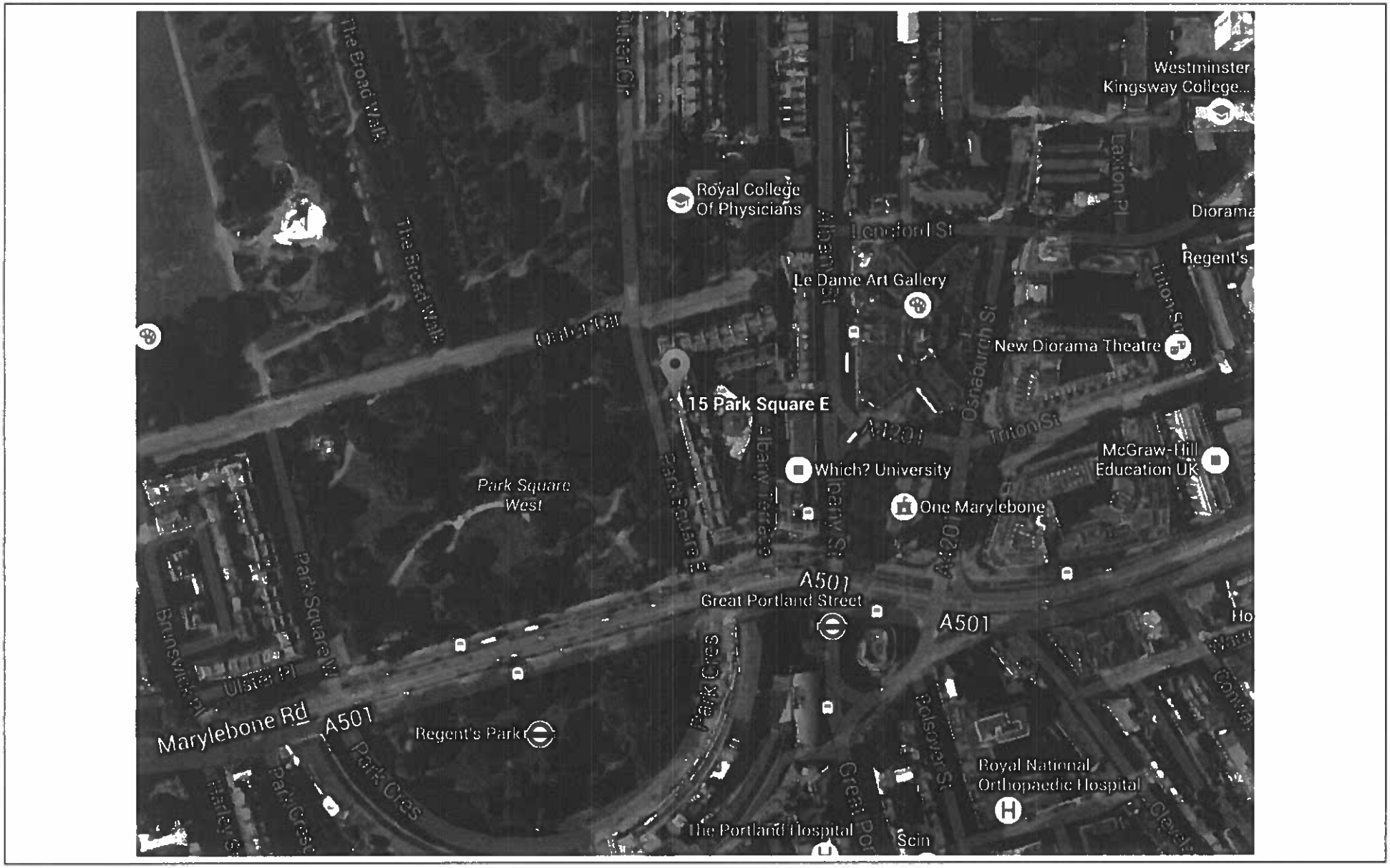
Date	Time	L_{Aeq}	L_{AFmax}	$L_{AF10\%}$	$L_{AF90\%}$
20/04/2016	14:15:00	57.6	64.7	59.5	53
20/04/2016	14:30:00	60.3	76.8	63.8	53.7
20/04/2016	14:45:00	55.9	73.1	57.4	52.7
20/04/2016	15:00:00	56.8	65.2	59.1	53.8
20/04/2016	15:15:00	58.8	80.1	61	54.3
20/04/2016	15:30:00	56.6	72.9	58.9	53
20/04/2016	15:45:00	57.5	74.9	59.8	53.6
20/04/2016	16:00:00	59.3	69.7	62.1	55.3
20/04/2016	16:15:00	58.8	67.7	61.5	54.7
20/04/2016	16:30:00	57.4	71.9	60.1	53.5
20/04/2016	16:45:00	55	65.4	56.7	52.8
20/04/2016	17:00:00	58.4	78.2	57.7	52.9
20/04/2016	17:15:00	56.2	71.2	57.5	53
20/04/2016	17:30:00	57.8	75.7	60.6	53.3
20/04/2016	17:45:00	55.6	65.1	57.2	53.4
20/04/2016	18:00:00	55.6	65.6	57.5	52.9
20/04/2016	18:15:00	57.8	78	59.1	53.4
20/04/2016	18:30:00	56.1	71.1	57.2	53.4
20/04/2016	18:45:00	56.1	69.5	57.7	53
20/04/2016	19:00:00	57.5	76.3	58	52.6
20/04/2016	19:15:00	54.5	61.8	56.3	51.5
20/04/2016	19:30:00	58	74.7	59.6	52.6
20/04/2016	19:45:00	55.4	69.9	57.3	51.7
20/04/2016	20:00:00	54.9	76.3	56.4	51.3
20/04/2016	20:15:00	55.3	71.8	57.5	51.7
20/04/2016	20:30:00	56.1	76.6	56.7	51.5
20/04/2016	20:45:00	54.8	64.2	57	51.4
20/04/2016	21:00:00	54.8	63.7	57	51.4
20/04/2016	21:15:00	54.5	63	56.5	51.3
20/04/2016	21:30:00	55.1	67	57	51.3
20/04/2016	21:45:00	55.4	66.7	57.1	51.6
20/04/2016	22:00:00	57	77.5	57.7	51.8
20/04/2016	22:15:00	56.4	75.3	58.2	51.3
20/04/2016	22:30:00	55	66.6	57.1	51.1
20/04/2016	22:45:00	56.1	70	58.3	51.2
20/04/2016	23:00:00	54.3	60.6	56.8	**49.8**
20/04/2016	23:15:00	55.2	68.2	57.4	50.1
20/04/2016	23:30:00	54.1	61.8	56.5	48.8
20/04/2016	23:45:00	54.7	64.7	57.3	49
21/04/2016	00:00:00	53.6	60.3	56.2	47.6
21/04/2016	00:15:00	53.7	59.1	56.6	48.6
21/04/2016	00:30:00	53.3	64.6	56.1	47.3
21/04/2016	00:45:00	53	59.1	55.9	46.5
21/04/2016	01:00:00	52.9	60.7	55.6	46.2
21/04/2016	01:15:00	51.9	59.1	54.9	46
21/04/2016	01:30:00	52.5	67.9	55.4	46.4
21/04/2016	01:45:00	51.7	60.4	54.6	45.8
21/04/2016	02:00:00	52.5	65.1	55.6	**45.7**
21/04/2016	02:15:00	52.5	63.5	55.2	47.4
21/04/2016	02:30:00	53.1	65.9	55.9	46.5
21/04/2016	02:45:00	53	64.4	55.9	46.3
21/04/2016	03:00:00	52.6	66.6	55.7	46.8
21/04/2016	03:15:00	52.5	61.6	55.3	47.2
21/04/2016	03:30:00	52.9	60.7	56.1	46.8
21/04/2016	03:45:00	53.5	68.7	56.3	47.6
21/04/2016	04:00:00	53.9	61.9	56.6	49.1
21/04/2016	04:15:00	54	61.7	56.7	48.9
21/04/2016	04:30:00	54.5	62.4	57.2	50
21/04/2016	04:45:00	54.4	61.9	56.7	49.6
21/04/2016	05:00:00	55.1	62.4	57.6	50.4
21/04/2016	05:15:00	55.7	64.3	58.1	50.9

21/04/2016	05:30:00	56	65.1	58	51.3
21/04/2016	05:45:00	56	64.2	58.2	52.4
21/04/2016	06:00:00	56.3	68.2	58.6	52.7
21/04/2016	06:15:00	56	66.4	57.8	53.5
21/04/2016	06:30:00	56.1	65.5	57.7	53.5
21/04/2016	06:45:00	55.9	68.5	57.5	53.4
21/04/2016	07:00:00	55.4	64.4	57.2	52.9
21/04/2016	07:15:00	57.2	76.9	58.9	54.3
21/04/2016	07:30:00	58.3	75.2	60.1	54.6
21/04/2016	07:45:00	58.9	69.7	61.8	55.2
21/04/2016	08:00:00	58.1	69.2	60.4	54.3
21/04/2016	08:15:00	58.6	70.6	61.2	54.7
21/04/2016	08:30:00	58.8	72.9	61.1	54.7
21/04/2016	08:45:00	57.4	76.3	59.2	54.3
21/04/2016	09:00:00	58.2	77	60.6	54.9
21/04/2016	09:15:00	56	70.6	57.7	53.4
21/04/2016	09:30:00	55.1	66.1	56.6	52.7
21/04/2016	09:45:00	55.9	74.4	57.4	53.4
21/04/2016	10:00:00	56.6	73	57.3	53.8
21/04/2016	10:15:00	56.8	67.5	58.8	54.3
21/04/2016	10:30:00	55.6	66	57.1	53.6
21/04/2016	10:45:00	56.7	77	58	53.9
21/04/2016	11:00:00	57.2	76	58.3	53.7
21/04/2016	11:15:00	56.6	71.6	58.2	54
21/04/2016	11:30:00	57.5	73.7	59	53.5
21/04/2016	11:45:00	57.6	69.6	59.7	53.9
21/04/2016	12:00:00	56	71.9	57.6	53.4
21/04/2016	12:15:00	61.2	81.4	61.1	53.8
21/04/2016	12:30:00	59	83.8	58.3	53.9
21/04/2016	12:45:00	59.3	78.8	60.4	54.5
21/04/2016	13:00:00	55.3	66.5	56.7	53.3
21/04/2016	13:15:00	54.6	64.8	56.4	52.4
21/04/2016	13:30:00	55	68.2	56.6	52.8
21/04/2016	13:45:00	56	73.7	57.4	53.5
21/04/2016	14:00:00	56.2	72.5	57.7	53.2
21/04/2016	14:15:00	56.9	74.6	58.3	53.2

Appendix C – Environmental Noise Monitoring Graphs



Appendix D – Location Plan – Site & Surrounding Area



Appendix E – Location Plan (Rooftop) – Plant Position

Appendix F – Plant Data Sheets

Panasonic U-4LE1E5

Mini VRF SYSTEM Unit Specifications

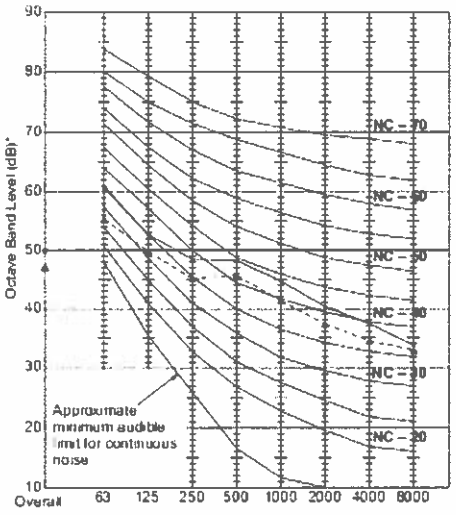
1. Outdoor Unit

(2) Sound Pressure Level

U-4LE1E5, U-4LE1E8

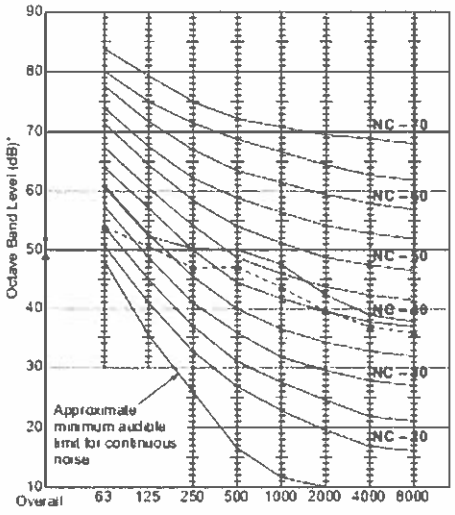
<Cooling>

Model	U-4LE1E5 U-4LE1E8
Sound Pressure Level	Standard mode : 50 dB (A) Silent Mode : 47 dB (A)
Condition	1 m in front at height of 1.5 m



<Heating>

Model	U-4LE1E5 U-4LE1E8
Sound Pressure Level	Standard mode : 52 dB (A) Silent Mode : 49 dB (A)
Condition	1 m in front at height of 1.5 m



* 0 dB = 0.0002 bar

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Appendix G – Acoustic Calculations

Project: 15 Park Square East
Ref: QT11359
Date: 10/05/2016
Title: Calculation - AC to 1m from Nearest Residential Window.

Location 1 - 18 Park Square East - Panasonic U-4LE1E5 - Qty 1					Octave Band Centre Frequency (Hz)								
Row Ref No.	Description	Option 1	R2	R1	63	125	250	500	1000	2000	4000	8000	Global (dB)
1	Manufacturer's Published Plant Octave Band SPL @ 1m dB ref 20 µPa				61.0	52.0	50.0	50.0	48.0	42.0	39.0	38.0	**62.3**
2	1 off units				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	Maximum Plant Noise SPL @1m dB Ref ref 20 µPa	1+2			61.0	52.0	50.0	50.0	48.0	42.0	39.0	38.0	
4	Distance correction from 1 metres to 11 metres from Noise Sensitive Receptor	20 x LOG(R2/R1)	1	11	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8	
5	Directivity Correction (+3 dB)				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
6	SPL at Facade	3+4+5			43.2	34.2	32.2	32.2	30.2	24.2	21.2	20.2	**44.5**
7	dB(A) Correction				-26.0	-16.0	-9.0	-3.0	0.0	1.0	1.0	-1.0	
8	A-Weighted SPL at Facade	6+7			17.2	18.2	23.2	29.2	30.2	25.2	22.2	19.2	**34.4**
9	Attenuation - Natural Screening Effect of Building	Fresnel No. Calc	Path Diff =	0	-5	-5	-5	-5	-5	-5	-5	-5	
10	A-Weighted SPL at Facade	8+9			12.4	13.4	18.4	24.4	25.4	20.4	17.4	14.4	**29.7**

Location 2 - 14 Park Square East - Panasonic U-4LE1E5 - Qty 1					Octave Band Centre Frequency (Hz)								
Row Ref No.	Description	Option 1	R2	R1	63	125	250	500	1000	2000	4000	8000	Global (dB)
11	Manufacturer's Published Plant Octave Band SPL @ 1m dB ref 20 µPa				61.0	52.0	50.0	50.0	48.0	42.0	39.0	38.0	**62.3**
12	1 off units				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
13	Maximum Plant Noise SPL @1m dB Ref ref 20 µPa	1+2			61.0	52.0	50.0	50.0	48.0	42.0	39.0	38.0	
14	Distance correction from 1 metres to 6.4 metres from Noise Sensitive Receptor	20 x LOG(R2/R1)	1	6.4	-16.1	-16.1	-16.1	-16.1	-16.1	-16.1	-16.1	-16.1	
15	Directivity Correction (+3 dB)				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
16	SPL at Facade	3+4+5			47.9	38.9	36.9	36.9	34.9	28.9	25.9	24.9	**49.2**
17	dB(A) Correction				-26.0	-16.0	-9.0	-3.0	0.0	1.0	1.0	-1.0	
18	A-Weighted SPL at Facade	6+7			21.9	22.9	27.9	33.9	34.9	29.9	26.9	23.9	**39.1**
19	Attenuation - Natural Screening Effect of Building	Fresnel No. Calc	Path Diff =	0.7	-9	-11	-14	-16	-19	-22	-25	-28	
20	A-Weighted SPL at Facade	8+9			12.8	11.7	14.2	17.5	15.6	7.7	1.7	-4.3	**22.0**

Target Design = 36 dB(A) for 24-hour operation
Therefore Compliance with planning condition demonstrated

Appendix H – Sound Level Meter Calibration Certificates

NTi AUDIO — LESS NOISE MORE SOUND

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **M2230** consisting of
  - **MA220** Serial Number **3426**
  - **Capsule** Serial Number **8047**
- Certificate issued: **03 October 2014**
- Results: **PASSED** (for detailed report see next page)

Tested by: M. Frick

Signature:

Stamp: NTi Audio AG

NTi AUDIO — LESS NOISE MORE SOUND

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **XL2**
- Serial Number: **A2A-08390-E0**
- Certificate issued: **03 October 2014**
- Results: **PASSED** (for detailed report see next page)

Tested by: M. Frick

Signature:

Stamp: NTi Audio AG