Plant Noise Impact Assessment
Planning Report

Client:	Essential Group
Project:	48 Monmouth Street London WC2H 9EP
Our Reference:	RF 85761/NIA
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1.0 Introduction

New building services items of plant are proposed at No48 Monmouth Street in London.

Noise Solutions Ltd (NSL) has been appointed to undertake an environmental noise survey and prepare a plant noise impact assessment to support the planning application.

To assist with the understanding of this report an introduction to acoustics and a glossary of acoustic terms can be found in Appendix A.

2.0 Site Description

The building at No 48 Monmouth Street is a terraced property with retail premises on the ground floor and office space above. There are several nearby residential properties, the closest located in the adjacent property at 46 Monmouth Street, and the aerial photograph in Appendix B shows the relationship of the site with nearby premises.

The current proposals allow for the installation of an outdoor air conditioning (AC) condenser unit at the rear of the premises.

The proposed plant will serve a retail shop and therefore will only operate during the daytime period.

3.0 Policy Context

3.1 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE[1]), published in March 2010, sets out the long-term vision of Government noise policy. The Noise Policy aims, as presented in this document, are: "*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse effects on health and quality of life;*
- *mitigate and minimise adverse effects on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The NPSE makes reference to the concepts of NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) as used in toxicology but applied to noise impacts. It also introduces the concept of SOAEL (Significant Observed Adverse Effect Level) which is described as the level above which significant adverse effects on health and quality of life occur.

The first aim of the NPSE is to avoid significant adverse effects, taking into account the guiding principles of sustainable development (as referenced in Section 1.8 of the NPSE). The second aim seeks to provide guidance on the situation that exists when the potential noise impact falls between the LOAEL and the SOAEL, in which case: *"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and*

[1] Noise Policy Statement for England, Defra, March 2010

quality of life while also taking into account the guiding principles of sustainable development."

Importantly, the NPSE goes on to state: *"This does not mean that such adverse effects cannot occur."*

The NPSE does not provide a noise-based measure to define SOAEL, acknowledging that the SOAEL is likely to vary depending on the noise source, the receptor and the time in question. NPSE advises that: *"Not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

It is therefore likely that other guidance will need to be referenced when applying objective standards for the assessment of noise, particularly in reference to the SOAEL, whilst also taking into account the specific circumstances of a proposed development.

3.2 National Planning Policy Framework

The National Planning Policy Framework (NPPF[2]) was published in March 2012. One of the documents that the NPPF replaces is Planning Policy Guidance Note 24 (PPG 24[3]) "Planning and Noise."

Paragraph 109 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, water or noise pollution or land stability."*

The NPPF goes on to state in Paragraph 123 *"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 thorough 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 use 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."*

The NPPF document does not refer to any other documents regarding noise other than the NPSE.

[2] National Planning Policy Framework, DCLG, March 2012
[3] Planning Policy Guidance 24: Planning and Noise, DCLG, September 1994

Paragraph 11 of the NPPF states that *"planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."*

Paragraph 13 of the NPPF states that *"the National Planning Policy Framework constitutes guidance for local planning authorities and decision-takers both in drawing up plans and as a material consideration in determining applications."*

Therefore, if a development/local plan does not align closely with the NPPF, planning decisions should be based on assessments which align with the NPPF. So for instance if a development is refused permission due to conflicts with the local plan, this decision can be overturned (i.e. via the appeal process) if the local plan did not closely align with the aims in the NPPF.

Paragraph 17 of the NPPF states that one of the 12 principles of planning is that it should *"not simply be about scrutiny, but instead be a creative exercise in finding ways to enhance and improve the places in which people live their lives."*

3.3 Planning Practice Guidance – Noise

As of March 2014, a Planning Practice Guidance (PPG[4]) for noise was issued which provides additional guidance and elaboration on the NPPF. It advises that when plan-making and decision-taking, the Local Planning Authority should consider the acoustic environment in relation to:

- *Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved.*

This guidance introduced the concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). NOAEL differs from NOEL in that it represents a situation where the acoustic character of an area can be slightly affected (but not such that there is a perceived change in the quality of life). UAEL represents a situation where noise is 'noticeable', 'very disruptive' and should be 'prevented' (as opposed to SOAEL, which represents a situation where noise is 'noticeable' and 'disruptive', and should be 'avoided').

As exposure increases above the LOAEL, the noise begins to have an adverse effect and consideration needs to be given to mitigating and minimising those effects, taking account of the economic and social benefits being derived from the activity causing the noise. As the noise exposure increases, it will then at some point cross the SOAEL boundary.

The LOAEL is described in PPG as the level above which *"noise starts to cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some*

[4] Planning Practice Guidance – Noise, http://planningguidance.planningportal.gov.uk/blog/guidance/noise/, 06 March 2014

of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life."

PPG identifies the SOAEL as the level above which *"noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area."*

In line with the Explanatory Note of the NPSE, the PPG goes on to reference the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG acknowledges that: *"…the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation."*

The relevant guidance in the PPG in relation to the adverse effect levels is summarized below:

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not Intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very Disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.4 Local Policy

Camden London Borough Council Development Policy DP28 – Noise and Vibration, adopted in November 2010, sets out to achieve a number of Core Strategy Policies including *CS5 – Managing the impact of growth and development*, *CS9 – Achieving a*

successful Central London, CS11 – Promoting sustainable and efficient travel and *CS16 – Improving Camden's health and well-being*. Their Policy DP28, Noise and Vibration, states that the Council will seek to ensure that noise and vibration is controlled and managed.

To deliver this the Council will:

"*will not grant planning permission for… development likely to generate noise pollution;"*

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

The Development Policy DP28 contains the following guidance:

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	00:00-24:00	5dB(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	00:00-24:00	10dB(A) $<L_{A90}$
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	00:00-24:00	10dB(A) $<L_{A90}$
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	00:00-24:00	55dBL_{Aeq}

The council has a Planning Guidance Document, CPG 6 - Amenity, adopted September 2011 as part of the Local Development Framework. This document provides specific guidance on noise and refers to Planning Policy Guidance Note PPG 24: Planning and Noise, which is no longer current policy.

In the Planning Guidance Document it is stated that:

"*Detailed acoustic/noise and vibration information in the form of a report will be required if your development proposes… the installation of plant, ventilation or air conditioning equipment;"*

"*The appropriate amount and detail of information required will depend on the specific circumstances of your proposal. At a minimum you will be expected to provide the following information to support your application:*

- *Description of the proposal;*
- *Description of the site and surroundings, a site map showing noise and vibration sources, measurement locations and noise receivers;*
- *Background noise levels;*
- *Details of instruments and methodology used for noise measurements (including reasons for settings and descriptors used, calibration details);*
- *Details of the plant or other source of noise and vibration both on plan and elevations and manufacturers specifications;*
- *Noise or vibration output from proposed plant or other source of noise and vibration, including:*
  - *Noise or vibration levels;*
  - *Frequency of the output;*
  - *Length of time of the output;*
  - *Features of the noise or vibration e.g. impulses, distinguishable continuous tone, irregular bursts;*
- *Manufacturers' specification of the plant, supporting structure, fixtures and finishes;*
- *Location of neighbouring windows (and use if applicable);*
- *Details of measures to mitigate noise or fume emissions and vibration;*
- *Details of any associated work including acoustic enclosures and/or screening;*
- *Cumulative noise levels of all the proposed and existing units;*
- *Hours/days of operation."*

4.0 Acoustic Standards and Guidance

4.1 BS4142: 2014

British Standard (BS) 4142: 2014[5]: Methods for rating and assessing industrial and commercial sound describes a method for rating and assessing sound of an industrial or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The industrial or commercial sound is assessed outside a dwelling or premises used for residential purposes, upon which sound is incident.

[5] BS 4142:2014 Methods for rating and assessing industrial and commercial sound

The procedure contained in BS4142 is to quantify the "specific sound level", which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15 minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.

The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.

The penalty for tonal elements is between 0dB and 6dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."*

The penalty for impulsive elements is between 0dB and 9dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."*

The background sound level should be established in terms of the L_{A90} noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. This should not normally be less than 15 minute intervals. The standard states that: *"A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."*

The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

The standard goes on to note that: "*Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

BS4142 requires uncertainties in the assessment to be considered, and where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

Moreover, the standard states that "*sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems".*

5.0 Baseline Conditions

An unattended environmental sound pressure level survey was undertaken from Friday 8 January to Monday 11 January 2016. The survey was undertaken in order to establish the prevailing sound pressure levels at a location representative of the sound climate (without any existing plant noise emissions) outside the nearest noise sensitive windows to the proposed outdoor unit. Full details of the survey are provided in Appendix D alongside a time history graph of the measurements (presented in Appendix E).

The background sound levels were assessed using statistical analysis of the measured $L_{A90,5min}$ values, as advised in BS 4142:2014, the results of which can be seen in the histograms below.

Figure 1: Histogram of background night-time sound pressure levels

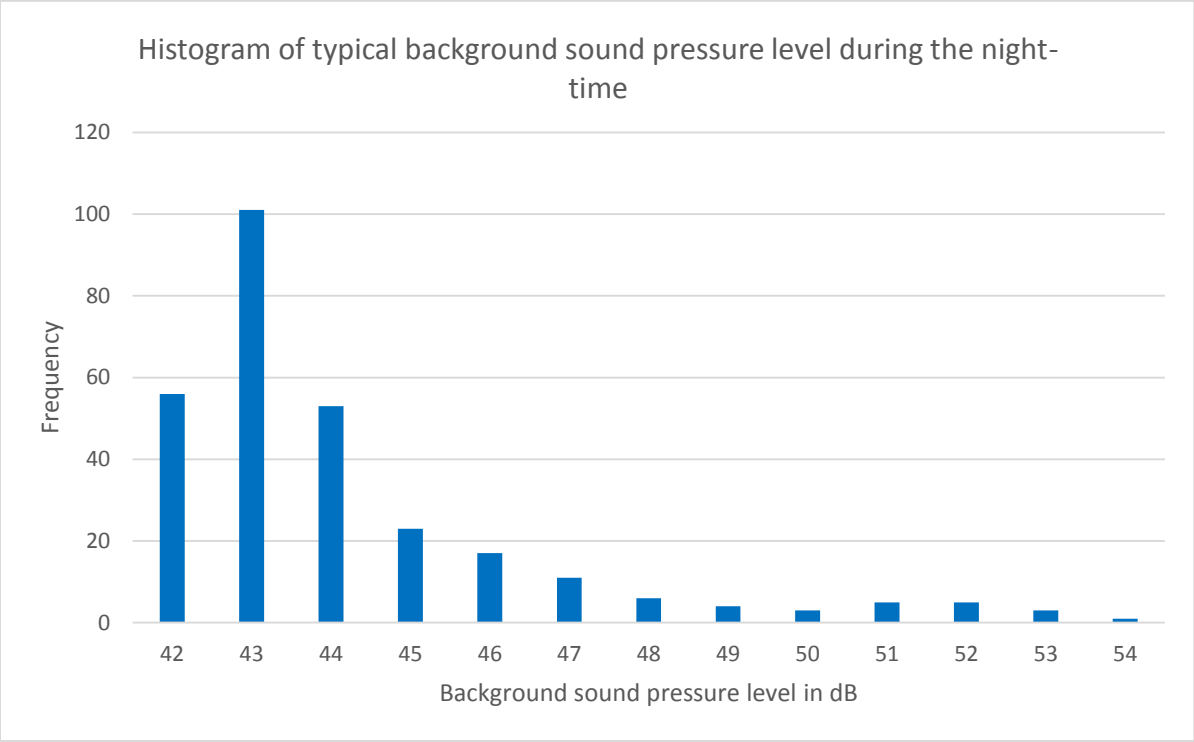
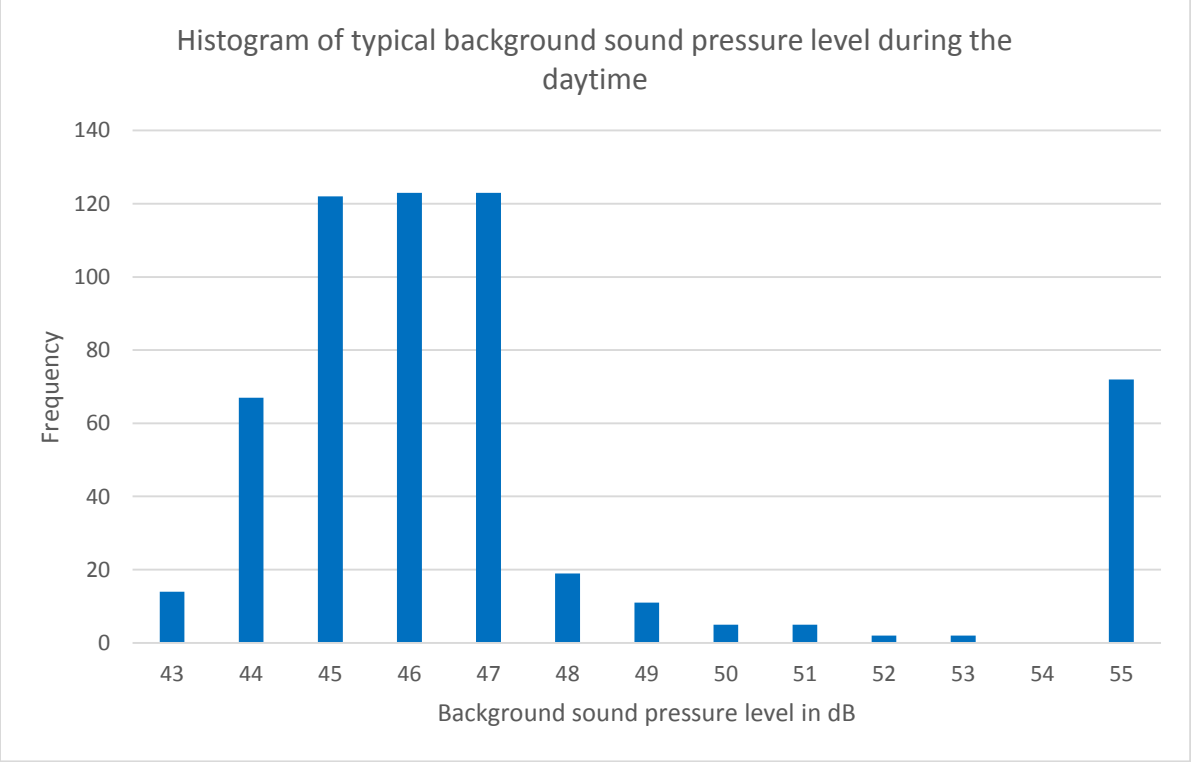


Figure 2: Histogram of background daytime sound pressure levels



Taking into consideration the slightly elevated background sound levels due to rainfall and the fact that background sound levels during the evening are lower, it would be prudent to select the level of 44dB L_{A90} as the representative daytime background sound level for the purposes of the assessment.

6.0 Plant noise impact assessment

6.1 Plant Location

The proposed outdoor condenser unit will be placed on the flat roof at the rear of No 48 Monmouth Street as shown in the aerial photograph in Appendix B. This will be approximately 1m from the nearest office window above the retail premises at 48 Monmouth Street (Reference R1), and approximately 4m from the nearest residential window at 46 Monmouth Street (Reference R2).

6.2 Plant noise emissions

The proposed outdoor plant unit is made by Mitsubishi model MUZ-EF35VE which can emit a sound pressure level of 50dB L_{Aeq} in heating mode and 49 dB L_{Aeq} in cooling mode at 1m from the unit (manufacturer's published information is included in Appendix D).

The plant will serve the retail premises on the ground floor and therefore it will only operate during the daytime to provide cooling or heating.

In order to calculate the rating level of the plant, the corrections for the character of the plant noise must be added to the specific noise level of the plant. The first (and preferred) subjective method provided in BS4142: 2014 is not possible as the units are not yet installed. The frequency analysis options are also limited as only octave band data is available for the preliminary selection assessed herein. The octave band information does not indicate any tonal component and similar units assessed have previously not been considered tonal, and therefore it is not considered that any correction should be added for the tonal nature of the plant noise.

The units will also be inverter driven, and therefore will gradually increase or decrease in operating capacity depending on the level of cooling needed. This gives a positive indication that there will be no sudden onset of noise when the unit turns on, and therefore it is considered that there is no need to add any correction to the plant noise level for these aspects of the character.

However, in order to be robust, a 3dB penalty correction will be added to the specific level. The full set of plant noise level predictions is included within Appendix F.

6.3 BS4142:2014 Assessment for R2

Table 6 Assessment of plant noise impact

Results		**Relevant Clauses of BS4142:2014**	**Commentary**
Typical Background Sound level	L_{A90} = 44 dB	8.1, 8.2	Representative typical background sound level determined from a range of measurements
Specific Sound Level	$L_{Aeq,T}$ = 46dB	7.3.6	Calculations presented in Appendix F

Acoustic Feature Correction	3dB	9.2	As plant will be fitted with inverter drives and will not be tonal a nominal penalty is applied as advised in BS4142
Rating Level	(40+3) dB = 49 dB		
Excess of Rating Level over background sound level	(43-44) dB = +5dB		
Assessment of impact: likely to be an indication of a low impact, depending on the context.		11	

6.4 Context and uncertainty

As the standard advises, the estimated impact must be considered within the context of the site and the surrounding acoustic environment. The following must, therefore, also be taken into consideration when determining the potential impact that may be experienced:

- The assessment assumes that the plant will operate continuously and simultaneously at the maximum duty. However, this will only happen occasionally if ever.

- The assessment is undertaken at a single residential window. The impact on all other residential windows will be considerably lower due to higher distance losses.

Where possible uncertainty in this assessment has been minimised by taking the following steps:

- The measurement of the background sound levels was taken over more than 24 hours.

- The meter and calibrator used have a traceable laboratory calibration and was field calibrated before and after the measurements.

- Uncertainty in the calculated impact has been reduced by the use of well-established calculation methods.

- Care was taken to ensure that the measurement position was representative of the noise climate outside the nearby residential dwellings and not at a position where higher noise levels are present (i.e. due to existing plant noise emissions).

6.5 BS8233: 2014 and WHO assessment

A BS4142 assessment only considers external noise levels at the location of sensitive receptors and does not consider the attenuation offered by the building envelope, nor does it consider the noise impact at the nearby office windows at 48 Monmouth Street.

The sound attenuation offered by a building will be governed by its weakest element, acoustically speaking. This is invariably the glazing and any natural ventilation provision.

Standard thermal double glazing fitted to most houses will achieve a sound insulation rating of around 27 dB Rw + Ctr. With windows open for ventilation, and assuming a 15 dB attenuation (as referenced in WHO), internal noise levels of around 25 dB $L_{Aeq,\ 8\ hours}$ would be expected solely due to the plant noise emissions from the proposed units. The BS 8233 and WHO internal night-time noise guideline level of 30 dB $L_{Aeq,8\ hours}$ would therefore be met with windows open. However, it should be noted that the existing environmental sound levels (without any plant noise) are so high that internal noise levels with windows open will not comply with the WHO/BS8233 criteria. Therefore, it may be assumed that the neighbouring properties keep their windows closed in order for desirable internal noise levels to be met. If the overlooking windows belong to bedrooms, it may be the case that alternative means of background ventilation are in place. The air permeability of the dwellings may also be high enough to not necessitate opening windows during the night-time. With windows closed, the associated plant noise impact will be even lower, at around 20dB inside the nearest affected residential room.

Typically local authorities do not consider commercial premises to be as sensitive to noise as residential properties and, therefore, emissions criteria are generally relaxed at these locations.

It is considered appropriate to control plant noise levels to meet the recommended internal noise levels provided in BS8233: 2014 *Guidance on sound insulation and noise reduction for buildings* for indoor amenity within office spaces. The standard states a range of internal noise levels for various spaces used for 'study and work requiring concentration' between 35 and 50dB L_{Aeq}.

BS8233 gives general guidance on the expected sound insulation performance of a given building façade, with details of how various elements can affect the overall performance. Concerning windows, it states that:

If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15dB.

This implies that should windows on a noise affected façade be openable, a sound insulation value of 15dB should be applied to the whole façade to an internal room being assessed. It should be noted that a sound insulation performance of much greater than 15dB is expected for non-openable standard double glazed windows. However in order to assess the worst case scenario, this report assumes that windows may be opened if desired.

The closest window belonging to the commercial office at No 48 Monmouth Street is approximately 1m from the proposed plant. The maximum sound pressure level due to the plant will be 53dB at this window inclusive of façade reflections, which is within the guideline range above.

6.6 Discussion of results

The BS4142 assessment has demonstrated that the proposed plant will result in a low impact which is not considered to be adverse when taking into consideration the absolute noise levels and the likely use of the units.

Therefore, as the impact is considered to lie below the LOAEL, no mitigation measures are put forward apart from the inclusion of appropriate vibration isolation measures around the pipework and below the units to avoid any transfer of vibration to the building. This is to

avoid structure borne noise due to vibrations travelling through the building structure and re-radiating inside the neighbouring property. It should be noted that the plant noise impact does not comply with the typical requirements of the local authority by 11dB. As the proposals comply with national noise policy then no mitigation measures are put forward. In case Camden Council wishes to impose the requirements in their policy (dated prior to the publication of the NPPF in March 2012) the unit will have to be installed inside a propriety acoustic enclosure (due to overlooking receptors).

7.0 Summary

Items of outdoor building services plant are proposed to be located near the roof top of No 48 Monmouth Street, London.

Noise Solutions Ltd has been appointed to undertake a plant noise emissions impact assessment for the proposed plant.

An environmental sound survey has been undertaken to establish the prevailing representative background sound level around the site, which was used in the assessment.

The cumulative plant noise emission level for the plant selection has been predicted at the most affected noise sensitive receptor using appropriate standards and in line with national policy. The plant noise emissions are not considered to give rise to adverse impacts at the neighbouring residential properties and therefore no mitigation measures are proposed apart from the use of appropriate vibration isolation mountings. In case Camden Council wishes to impose the requirements in their policy (dated prior to the publication of the NPPF in March 2012) the unit will have to be installed inside a propriety acoustic enclosure (due to overlooking receptors).

APPENDIX A

APPENDIX A – Introduction to acoustics and glossary of terms

Introduction to Noise

Noise is defined as unwanted sound, and the unit of measurement is the decibel (dB(A)). Noise levels range from the threshold of hearing at 0 dB(A) to levels of over 130 dB(A) at which point noise becomes painful.

Sound consists of vibrations transmitted to the ear as rapid variations in air pressure. The more rapid the fluctuation the higher the frequency of the sound. Frequency is the number of pressure fluctuations per second and is expressed in Hertz (Hz).

The sensitivity of the human ear varies with frequency. To allow for this phenomenon, sound level meters are often equipped with a set of filters that modify the response of the sound level meter in a similar way to the human ear; these filters are referred to as the 'A-weighting network'. The 'dB(A)' notation is used to indicate when noise levels have been filtered using the A-weighting network. It has been found that changes in noise level when measured in dB(A) correlate better with changes in subjective reaction than to changes in noise measured without using the A-weighting network.

Noise Descriptors

The subjective response to noise is dependent not only upon the sound pressure level and its frequency but also on its duration and the time of day it occurs. In the environment, noise levels fluctuate in response to events, for instance with aircraft passing overhead or changes in the quantity and speed of road traffic on nearby roads. For this reason environmental noise is often described in terms of an equivalent continuous sound pressure level, which can be thought of as a constant noise level over a time period (T) that contains the same sound energy as the fluctuating noise level.

Decibel Addition

If the sound levels from two or more sources have been measured or predicted separately, and the combined sound level is required, the sound levels must be added together. However, due to the fact the decibel is a logarithmic value they cannot be added together using normal arithmetic. For instance if you add two sound pressure levels of 50 dB, the answer is 53 dB and not 100 dB.

Human Sensitivity to Change

Generally, a change of 3 dB(A) in environmental noise is the minimum change perceptible to a human. However, there is research that suggests with respect to road traffic noise, immediately following a change in traffic flow or road alignment people may find benefits or disbenefits when noise changes are as small as 1 dB(A). A change of 1 dB(A) is equivalent to an increase in traffic flow of 25 per cent or a decrease in traffic flow of 20 per cent. These effects last for a number of years, however, in the longer term, perceived noise nuisance may tend towards the steady state level associated with the new source, which is generally lower.

Free-field and Façade Incident Levels

Due to the effects of reflection, sound pressure levels measured close to large vertical reflecting surfaces such as building façades higher than those that are measured away from reflective surfaces.

Sound pressure levels measured 1 meter from a large solid, reflecting surface are termed 'façade incident' levels, whilst those measured at least 3 meters away from any reflective surfaces (apart from the ground) are termed 'free-field'. Façade incident levels are typically 3 dB higher than free-field levels and therefore it is important to know the conditions under which a noise measurement or prediction has been undertaken.

An indication of the range of sound levels found commonly in the environment is given below.

Sound Pressure Level, dB(A)	**Environmental Condition**
0	Threshold of hearing
10	Breathing
20	Background in broadcasting studio
30	Quiet bedroom at night
40	Quiet library
50	Average home
60	Conversational speech at 1m
70	Vacuum cleaner at 1m
80	Kerbside of busy road at 5m
90	Diesel truck at 10m
100	Disco, 1m from speaker
110	Chain saw at 1m
120	Threshold of discomfort
130	Around 50m from a jet aircraft at take off
140	Threshold of pain

The subjective response to a noise is dependent not only upon the sound pressure level and its frequency, but also its intermittency. Various statistical indices have been developed to try and correlate annoyances with the noise level and its fluctuations in a changing noise environment. The indices and parameters used in this report are defined below.

$L_{Aeq,T}$ - a noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound under investigation. It is in effect the energy average level over the specified measurement period (T) and is the most widely used indicator for environmental noise.

L_{AFmax} - The maximum A-weighted noise level over the time period T, and unless described otherwise, it is measured using the 'fast' sound level meter response. The L_{AFmax} is

sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{Aeq} noise level but will still affect the noise environment.

L_{AN} - If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The L_{AN} indices are used for this purpose. The terms refers to the A-weighted level (in decibels) exceeded for n% of the time specified.

$L_{A10,T}$ is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. $L_{A10,T}$ is commonly used to describe traffic noise.

$L_{A90,T}$ is the noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example.

L_{A1} is the level exceeded for 1% of the time and as such gives an indication of the maximum noise level that discounts one-off atypical events.

Ambient sound : The total sound at a given place, usually a composite of sounds from many sources near and far. Should not be confused with "background sound." 17.4 Residual sound

The ambient sound remaining at a given position in a given situation when the specific sound source is suppressed to a degree such that it does not contribute to the ambient sound.

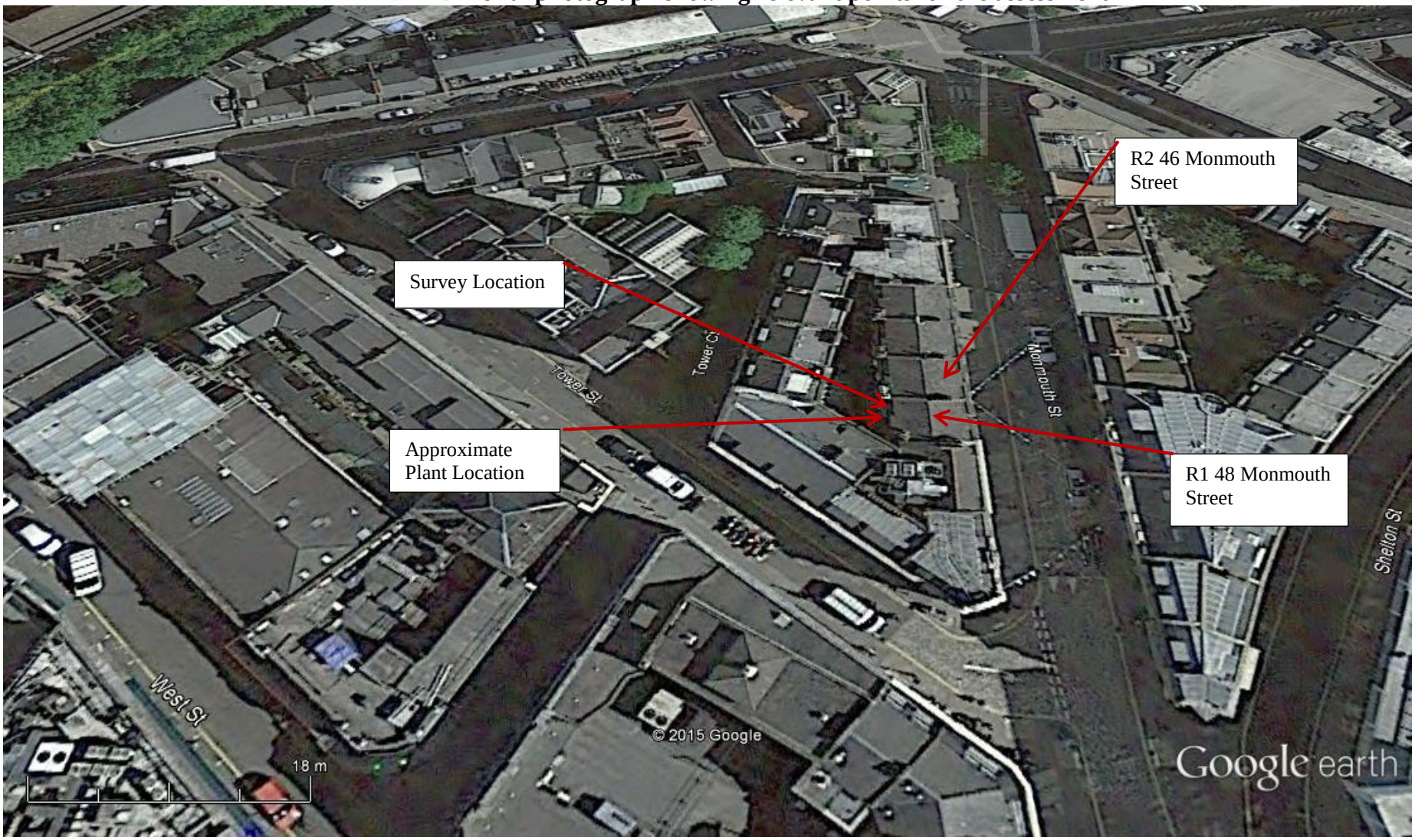
Background sound level, LA90,T : The A-weighted sound pressure level of the residual sound at the assessment position that is exceeded for 90% of a given time interval, T, measured using Fast time weighting, and quoted to the nearest whole number of decibels.

Specific sound source : The sound source under investigation for assessing the likelihood of complaints.

Specific sound level, LAeq, T : The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific sound source over a given reference time interval.

Rating level, LAeq, T : The specific sound level plus any adjustment for the characteristic features of the sound.

APPENDIX B-Aerial photograph showing relevant points for the assessment



Courtesy of Google Maps (www.google.maps)

APPENDIX C

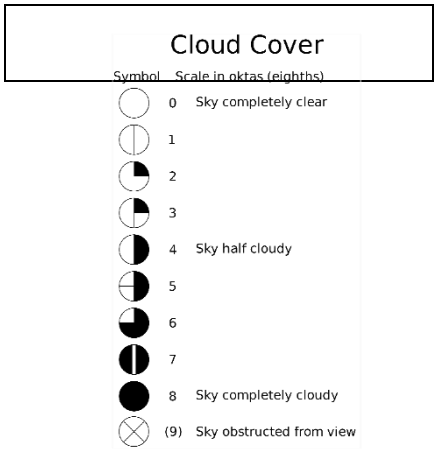
Details of environmental sound survey

C.1. Measurement period

Measurements of the existing background sound levels were undertaken between 12:40 hours on Friday 8 January 2016 and 11:40 hours on Monday 11 January 2016. The sound level meter was programmed to record the A-weighted L_{eq}, and L_{90} noise indices for consecutive 10-minute sample periods for the duration of the survey.

C.2. Weather Conditions

Weather conditions were determined both at the start and on completion of the survey. Even though there was no rainfall at the beginning and end of the survey, there was sporadic rainfall throughout the survey. The duration of the survey was chosen in order to ensure that a large number of readings were taken in order to minimize the effect of rainfall (which usually slightly increases background noise levels). As the measurement position was sheltered from any surrounding roads, it is considered that the meteorological conditions in conjunction with the duration of the survey did result in representative background sound level readings. The table below presents the weather conditions recorded at the beginning and the end of the two surveys.

			Weather Conditions	
Measurement Location	**Date**	**Description**	**Beginning of Survey**	**Completion of Survey**
1	8 January to 11 January 2016	Temperature (°C)	8	7
		Precipitation:	Dry	Dry
		Cloud cover (oktas - see guide)	5	6
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Yes	Yes
		Wind Speed (m/s)	1.2	1.7
		Wind Direction	Westerly	Westerly
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

C.3 Measurement position

The sound level meter was positioned on the flat roof at the rear of 48 Monmouth Street. The noise climate at the measurement position was dominated by local road traffic. The measurement position was in free field conditions.

C.4. Equipment

Details of the equipment used during the survey is provided in the table below. The sound level meter was calibrated before and after the survey(s); no significant change (+/-0.2 dB) in the calibration level was noted.

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Rion NL-52 / 00654035	21/09/2015	CONF091517
Condenser microphone	Rion UC-59 /08290		
Preamplifier	Rion NH-25 / 54080		
Calibrator	Rion NC-74 /34535932	02/06/2015	14746

C.5. Results

The results of the survey are considered to be representative of typical prevailing sound pressure levels at the façades of the nearest noise sensitive receptors to the proposed plant area. The noise climate during the survey period was dominated by local road traffic movements. The results of the survey are presented in a time history graph and in Appendix E.

APPENDIX D

Preliminary selection of roof top outdoor plant

M Series New Product Information MSZ-EF35VES

MITSUBISHI ELECTRIC
AIR CONDITIONING SYSTEMS

R410A

MSZ-EF35VES

Inverter Heat Pump

R410A Wall Mounted System

The new Zen MSZ-EF series is a stylish, silver wall mounted system. Featuring the new Nano-Platinum filter system, these models also offer industry leading noise levels and have a distinctively styled front panel that not only looks appealing but also helps to make cleaning of the unit easier.

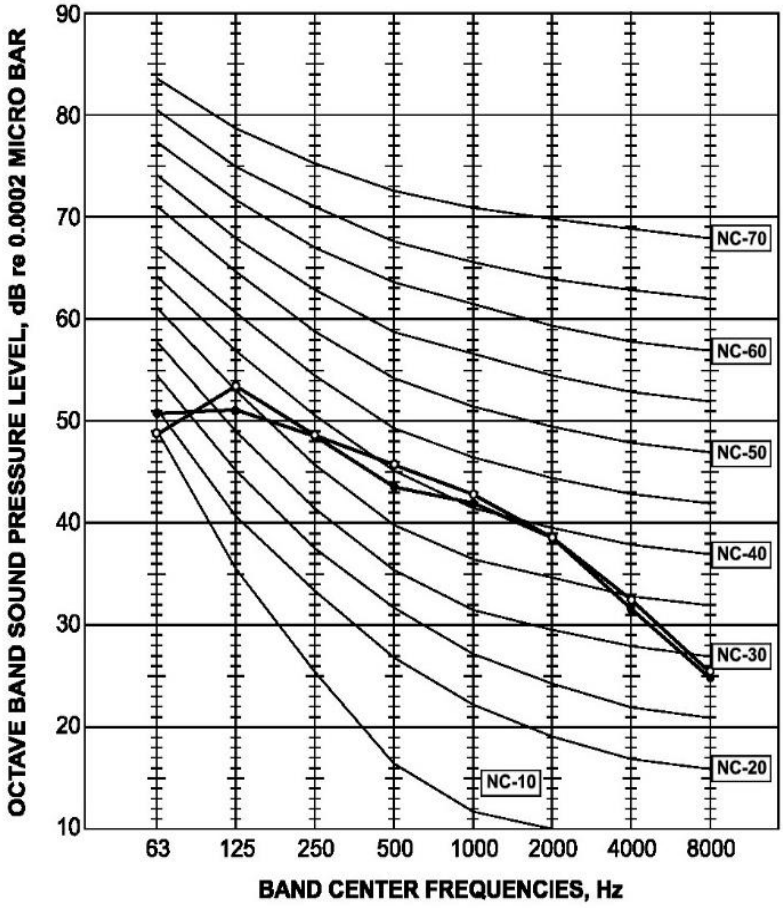
- **Anti-Allergy Enzyme filter is optional**

Pictures not to scale

Plant noise emissions at octave band centre frequencies

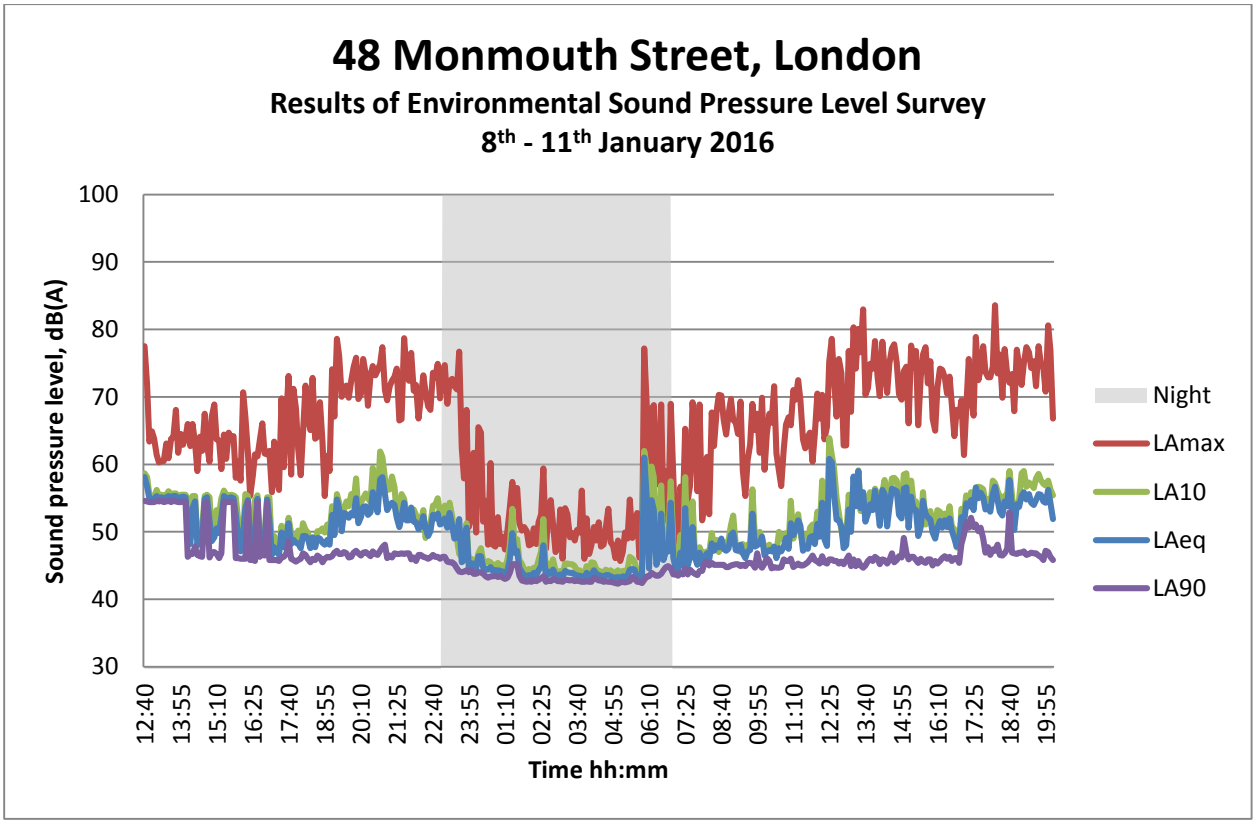
MUZ-EF35VE MUZ-EF35VEH

FUNCTION	SPL(dB(A))	LINE
COOLING	49	●—●
HEATING	50	○—○



APPENDIX E

Environmental sound survey results in a time history graph



APPENDIX F

Plant noise emission impact predictions at neighbouring window

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	dBA
Sound pressure level of unit at 1m	48	54	49	46	43	38	32	50
Divergence Loss (dB) 4m	-10	-10	-10	-10	-10	-10	-10	
Façade Corrections	6	6	6	6	6	6	6	
Resultant at 1m from neighbouring window	44	50	45	42	39	34	28	46