Swiss Cottage Library

Assessment of noise from roof-top equipment

London Borough of Camden

21 October 2021

2020/SEP/01

Notice

This document and its contents have been prepared and are intended solely as information for London Borough of Camden and use in relation to seek planning permission to replace end of life roof plant with energy efficient renewable plant

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Document history

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Client signoff

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Project	Swiss Cottage Library
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1. Introduction

Atkins are acting as the Agent on behalf of Camden Borough Council and in accordance with the Government's National Planning Policy Framework (NPPF) for England, for their application for planning permission to make some alterations on Swiss Cottage Library building.

The proposed design will:

- introduce a new insulated flat roof covering above the existing concrete deck;
- replace the aluminium framed single glazed windows on the first and second floor with like-for-like double glazed equivalents;
- introduce insulation in concealed areas behind the concrete clad façade;
- make minor interventions to re-lamp existing light fittings with LED equivalents and introduced motorised rooflight openers; and
- replace end-of-life roof plant with energy efficient renewable plant.

The proposed new external plant will be installed on the roof of the building.

An environmental noise survey and plant noise impact assessment is required as part of the planning application.

Atkins Noise and Vibration team has been appointed to undertake the following tasks as a part of the noise impact assessment:

- Environmental noise survey.
- Setting noise emission criteria for the proposed plant.
- Planning compliance assessment and outline noise mitigation measures where required.

The information about the proposed MEP systems is included in RIBA Stage 4 report, as provided by the MEP design team. The key MEP information is summarised in Appendix E.

It is understood that the plant will only operate during the library working hours, approximately from 8am to 6pm.

2. Site Description

Swiss Cottage Library is a public building built in 1963-4 for the Borough of Hampstead by Sir Basil Spence. The cigar shaped building plan is orientated on an approximate north - south axis that is adjacent to Avenue Road and is bounded by five conservation areas; Belsize, Elsworthy, Fitzjohns-Netherhall, South Hampstead, St. John's Wood (Camden) and St. John's Wood (Westminster).

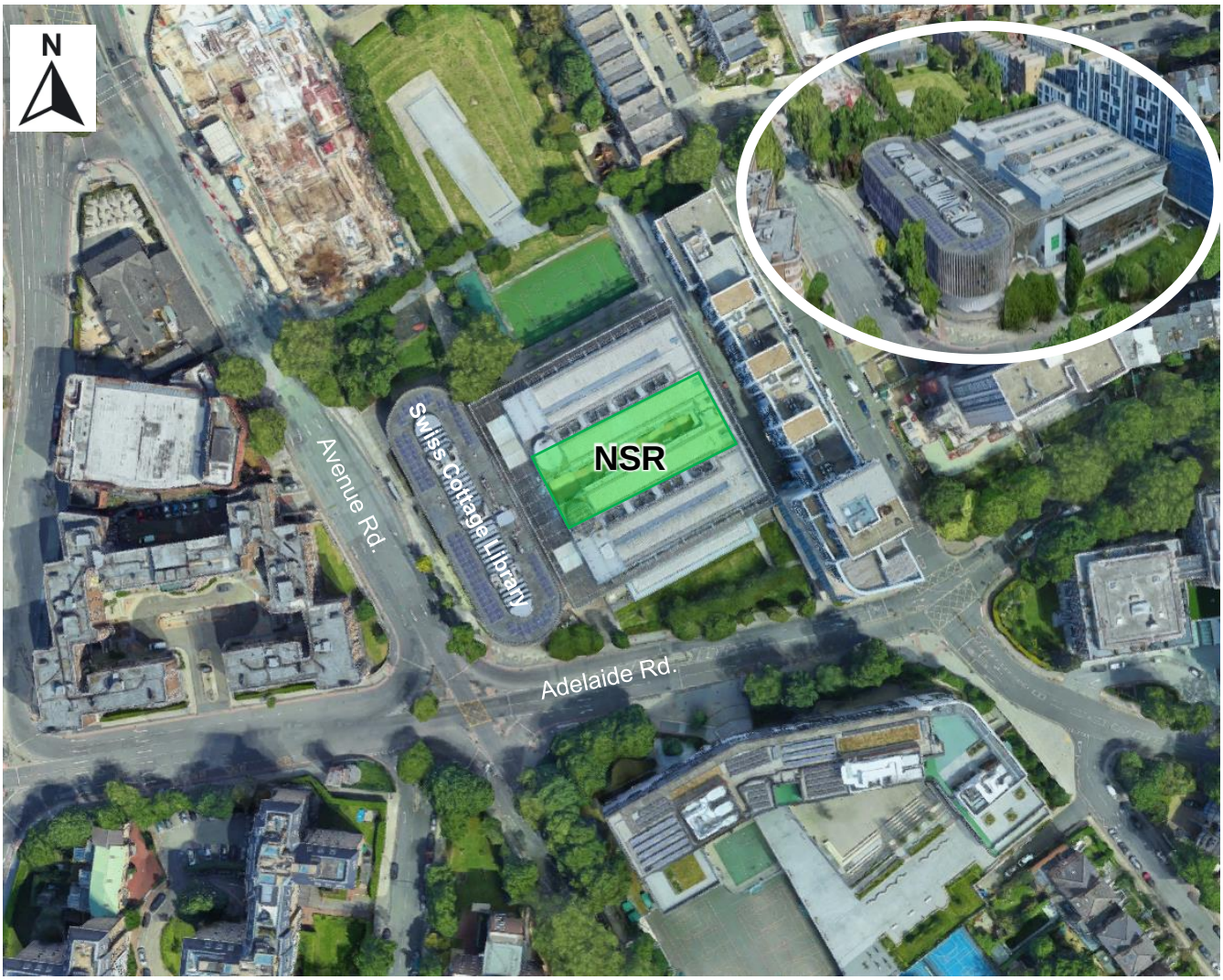
Plant services are located in the basement and on the roof. The roof also includes a series of north-facing raised rooflights that were intended to introduce borrowed light into the building.

The location of the proposed new external plant on the roof of the building can be seen on a drawing in Appendix E.

The nearest noise sensitive receptors (NSR) to the new MEP units have been identified as the flats on the roof of Leisure Centre to the east.

Site and NSR location are provided below in Figure 2-1.

Figure 2-1 - Site location plan – Top view & View looking North



The existing acoustic environment has been found to be influenced predominantly by road traffic noise from Avenue Road and Adelaide Road. Other less prominent noise sources include the playground area and sport area to the north and the MEP units on Swiss Leisure Centre and Swiss Cottage Library itself.

3. Assessment Criteria

The following documents, standards and guidance have been used in setting the plant noise emission criteria:

- Camden Local Plan 2017.
- Camden Planning Guidance. Amenity (January 2021).
- BS 4142:2014 (+A1 2019) Methods for rating and assessing industrial and commercial sound

3.1. Camden Local Plan 2017

The Industrial and Commercial Noise Sources section in the Local Plan advises that a relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise and it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion. The noise levels applicable to proposed industrial and commercial developments (including plant and machinery) from Table C of the local plan Appendix 3 is reproduced below.

Table 3-1 - Table C Appendix 3 Camden Local Plan 2017

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room.

3.2. Camden Planning Guidance. Amenity (January 2021).

The London Borough of Camden planning guidance on noise and vibration amenity provides guidance regarding the application of Local Plan polices A4 noise and vibration and A1 Managing the impact of development, which seek to protect residents of both existing and new residential developments and the occupiers of other noise-sensitive developments from the adverse effects of noise and vibration. Appendix 3 of the Local Plan supports these policies and sets out expected standards in terms of noise and vibration.

When assessing acoustic reports, the Council will consider the reported measurements against the noise thresholds set out in Appendix 3 of the Local Plan. The thresholds are expressed as 'effect levels', which sets out a hierarchy of expected changes in behaviour and impact on health and wellbeing in response to increasing noise levels (measured in decibels - dB). The 'effect levels' are summarised below and explained in detail in National Planning Practice Guidance (NPPG).

- No observed effect level (NOEL) – the level below which no effect can be detected on health and quality of life.
- Lowest observable adverse effect level (LOAEL) – the level above which changes in behaviour (e.g. closing windows for periods of the day) and adverse effects on health (e.g. sleep disturbance) and quality of life can be detected.
- Significant observed adverse effect level (SOAEL) – the level above which adverse effects on health and quality of life occur. This could include psychological stress, regular sleep deprivation and loss of appetite.

Developments proposing plant, ventilation, air extraction or conditioning equipment and flues will need to provide the system's technical specifications to the Council accompanying any acoustic report. 'BS4142 Method for rating Industrial and Commercial Sound' contains guidance and standards which should also be considered within the acoustic report.

3.3. BS4142: 2014+A1:2019

BS 4142:2014+A1:2019 "Methods for rating and assessing industrial and commercial sound" refers to the sound produced by an assessed source at a sensitive receptor (e.g. outside a façade of a residential building) as 'specific' sound. The specific sound level is determined by calculating or measuring the equivalent continuous A-weighted sound pressure level of the source over the assessment time period 'T' ($L_{Aeq,T}$), this time period being one hour during the day (from 07:00 to 23:00) and 15 minutes at night (from 23:00 to 07:00).

Where certain acoustic features are present in the sound perceived at the assessment location, the Standard requires an acoustic feature correction to be added to the specific sound level to obtain the rating level. Corrections can be included for tonality, impulsivity, intermittency, and other sound characteristics that make it "readily distinctive".

- Tonality: Where tonality is audible at a receptor a penalty of between 0 and 6 dB may be applied. Subjectively, a 2 dB penalty may be applied where a tone is just perceptible, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.
- Impulsivity: Where impulsivity is audible at a receptor a penalty of between 0 and 9 dB may be applied. Subjectively, a 3 dB penalty may be applied where impulsivity is just perceptible, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.
- Intermittency: If intermittency is readily distinctive against the residual acoustic environment at the receptor, a penalty of 3 dB can be applied.
- Other Acoustic Features: Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment at the receptor, a penalty of 3 dB can be applied.

The procedure contained in BS 4142 assesses the potential impact of sound by determining the margin by which the rating level of the specific sound source exceeds the background sound level, examining also the context in which the sound occurs or will occur.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
    - The lower the rating level is relative to the measured background 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.

Where the initial estimate of the impact needs to be modified due to the context, all pertinent factors should be considered, including:

- The absolute level of the sound;

The character and level of the residual sound compared to the character and level of the specific sound;

- The sensitivity of the receptor, including whether dwellings already incorporate design measures that secure good internal and/or outdoor conditions, such as:
  - Façade insulation treatment;
  - Ventilation and/or cooling that will reduce the need to have windows open to provide rapid or purge ventilation;
  - and Acoustic screening.

4. Noise Survey

4.1. Survey Methodology

To establish the existing ambient and background noise levels a noise survey was undertaken between Friday 24th and Thursday 30th September 2021. The survey consisted of an unattended measurement on the roof of Swiss Cottage Library.

An integrating sound level meter was located in a quiet area of the roof far from the main noise sources on the surroundings and far from the noise sources on the roof of the building, so that measured values are representative of background noise at the nearest noise sensitive receptors. The Long Term Noise Measurement #1 (LTNM1) location along with the layout of the new plant and nearest noise sensitive receptors compound are shown in Appendix D.

The measurements were undertaken under free-field conditions: the microphone was positioned 1.5m above the roof and at least 4m from any significant vertical reflective surface.

Fifteen-minute continuous measurements were carried out at each location, recording ambient and background noise levels in terms of parameters $L_{Aeq,15min}$ and $L_{A90,15min}$ respectively.

Survey measurements were carried out in accordance with guidelines included in BS7445 1-3:2003 Description and measurement of environmental noise and in line with the industry best practice guidance.

4.2. Survey Equipment

The equipment used during the survey is detailed in the equipment schedule below. The sound level meter was fitted with a windshield. A sensitivity check was undertaken on the sound level meter before and after the measurements, with no significant differences noted in levels. Calibration certificates are available on request.

Table 4-1 Noise Survey Equipment

Description	Manufacturer/Model	Serial Number
Integrating Sound Level Meter	01dB FUSION	11199
Acoustic Calibrator	01dB CAL21	34565046

The weather during the measurements was suitable for external noise measurements: most of the time it was dry with wind speeds below 5m/s for the duration of the survey. Weather conditions therefore did not have any significant influence on the measured noise levels.

Data obtained during periods with rain and/or wind speed above 5m/s has been ignored for the assessment and results of the ambient and background noise levels.

4.3. Survey Results

A summary of the typical measured noise levels from the long-term measurements is shown in Table 3-1-Typical measured noise levels, and the time history is shown graphically in Appendix C.

Table 4-2 Summary of Survey Results

Position	Daytime (0700-2300)		Night-time (2300-0700)		
	dB $L_{Aeq,16hr}$	dB $L_{A90,15min}$*	dB $L_{Aeq,8h}$	dB $L_{A90,15min}$*	dB $L_{Amax,F}$**
LTNM1	60	54	56	52	71

*Representative background noise level was determined based on the modal value of the measured $L_{A90,15min}$ values over the relevant time-period.

**The reported $L_{Amax,F}$ is the level not exceeded more than 10 times during the night-time period .

The existing acoustic environment has been found to be influenced predominantly by road traffic noise from Avenue Road and Adelaide Road. Other less prominent noise sources include the playground area and sport area to the north and the MEP units on Swiss Leisure Centre and Swiss Cottage Library itself.

5. Noise Sources

The proposed plant items are summarized in Table 5-1 below. The information has been taken from the operational schedule provided by the MEP design team is included in RIBA Stage 4 report.

The location of the new external plant on the roof is shown on a drawing in Appendix E.

Table 5-1 MEP Units Operational Schedule.

Ref Outdoor Unit	Location	Brand/Model	Sound Power Level (dBA)*	
AHU Units				
AHU 01	Roof North	FläktGroup/ CAIRplus SX 096.096IVVV - 1 Pcs	Inlet Connection	56
			Exhaust Connection	77
			Casing	51
AHU 02	Roof Middle	FläktGroup/ CAIRplus SX 064.096IVVV - 1 Pcs	Inlet Connection	56
			Exhaust Connection	75
			Casing	48
AHU 03	Roof South	FläktGroup/ CAIRplus SX 096.096IVVV - 1 Pcs	Inlet Connection	57
			Exhaust Connection	75
			Casing	51
Reverse Cycle Heat Pumps				
HP 1	Roof North	Mitsubishi/ PUZ-M250YKA.UK	Max. Cooling/ Heating	72**
HP 2	Roof Middle			
HP 3	Roof South			
Toilet Extract Fans				
TE1	Middle (East)	EC350202 – Woods EC Twin Box 350	Outlet	71
TE2	Middle (West)	EC250202 - Woods EC Twin Box 250	Outlet	68
Air Source Heat Pumps				
ASHP-01 and ASHP-02	Middle (East)	Daikin-EWYT115B-XRA1+OP204	Unit	75**

* The single figure acoustic data has been supplemented with octave band sound spectra provided by the MEP design team or within manufacturers' service manual data (refer to Appendix E)

**Sound power level data for HP and ASHP units has been calculated from sound pressure levels provided by the MEP design team and included in the manufacturers' service manuals (refer to Appendix E)

It has also been considered that AHU units will be fitted (Inlet and exhaust) with attenuators with the following acoustic performance (noise insertion loss).

Table 5-2 Attenuator Acoustic Performance (dB).

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Attenuator	7	11	21	37	37	26	18	14

6. Assessment

In this section the impact of the proposed plant on the neighbouring noise sensitive receptor is assessed.

To assess this impact, noise levels from the new external MEP units must be predicted and compared to the existing external background sound levels at the neighbouring receptor.

6.1. Assessment Methodology

Calculations have been undertaken to predict the specific sound levels $L_{Aeq,T}$ from the mechanical plant items at the nearest noise sensitive receptor in the daytime reference time period, in accordance with BS 4142 methodology.

The calculations have been based on the plant sound data provided in Section 5.

The predictions were carried out using industry standard calculation methods, as outlined below:

- Distance losses to the receptors were calculated based on the inverse square law or plane area source propagation, as applicable.
- Owing to the number of reflective surfaces (roof top and roof edge) it has been deemed inappropriate to apply directivity corrections.
- Acoustic screening and main acoustic reflections by intervening building structures has been taken into account, where applicable.
- Calculations of noise from the inlet and exhaust ducts of outdoor units AHU 01, AHU 02 and AHU 03 incorporate attenuator losses, with allowance made for attenuator self-noise.

In accordance with BS 4142, the following reference time period has been used in this assessment to determine specific sound levels:

- 1 hour during the day (0700-2300 hours).

The worst-case of all plant operating continuously and simultaneously throughout the reference period has been assumed. However, toilet extract fans have been assumed to operate 25% of the day time period.

The plant will operate continuously without intermittency that would attract attention and based on available equipment specification it is not expected to have any impulsive or tonal characteristics. No acoustic feature corrections have therefore been added to the predicted specific sound levels $L_{Aeq,T}$ to obtain the rating sound levels $L_{Ar,T}$.

6.2. Noise Levels Predictions

Table 6-1 below shows results of the plant noise calculations for the nearest noise sensitive receptors.

Table 6-1 Predicted Noise Levels Outside the NSR

Receptor	Period	Plant noise level, $L_{Aeq,T}$ (dB)
Position 1 and nearby receptors	Day time (0700-2300)	44

6.3. Assessment Results

Based on the results of the noise survey and the sound propagation calculations, Table 6-2 provides a BS 4142 assessment for the proposed plant noise.

Table 6-2 BS 4142 Assessment

Parameter	Value (Daytime)	BS 4142 Clause	Commentary
Background sound level, L_{A90}	54	8.1	Typical background sound levels during daytime and night-time periods

Parameter	Value (Daytime)	BS 4142 Clause	Commentary
Specific sound level, $L_{Aeq,T}$	44	7.3	Specific noise level at the NSR as an A-weighted equivalent continuous SPL in the reference period
Acoustic feature correction	0	9.2	No acoustic features expected
Sound rating level, $L_{Ar,T}$	44	9.1	Specific noise corrected for acoustic features
Difference between rating and background sound levels	-10	11	Low impact

The results of the BS 4142 assessment indicate that plant noise levels would be below the background sound level during daytime periods, which indicates low impact. The levels are therefore expected to be compliant with the Local Authority requirements.

7. Conclusions

New roof plant is proposed as part of the renovation works at the Swiss Cottage Library.

A noise impact assessment has been conducted based on the relevant standards and guidance to determine the impact of noise from the plant on nearby noise sensitive receptors.

The assessment indicates that the plant noise levels at nearby noise sensitive receptors during the proposed period of plant operation would meet the Council's criteria.

Appendices

Appendix A. Glossary of Acoustics Terms

AIRBORNE SOUND

Sound which is transmitted from the source via the surrounding air, as distinct from transmission through the structure which supports the sound source (cf. structure borne sound).

AMBIENT NOISE

Totally encompassing sound in a given situation at a given time usually is a composite of sounds from many sources near and far.

ATTENUATION, SOUND

A reduction in the intensity of a sound signal.

A - WEIGHTING dB(A)

The sound pressure level determined when using the frequency-weighting network A. The A-weighting network modifies the electrical response of a sound level meter so that the sensitivity of the meter varies with frequency in approximately the same way that the sensitivity of the human hearing system varies with frequency.

The human ear has a non-linear frequency response; it is less sensitive at low and high frequencies and most sensitive in the range 1 to 4 kHz. The A-weighting is applied to measured or calculated sound pressure levels so that these levels correspond more closely to the response of the human ear. A-weighted sound levels are often denoted as dB(A).

BACKGROUND NOISE LEVEL, L_{A90}, T

The A-weighted sound pressure level of non-specific noise in decibels exceeded for 90% of the given time, T.

DECIBEL (dB)

1. Unit level which denotes the ratio between two quantities that are proportional to power; the number of decibels corresponding to the ratio of two amounts of power is 10 times the logarithm to the base 10 of this ratio.

2. A linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers.

3. A unit which indicates that a quantity has a certain LEVEL above some pre-defined reference value.

4. The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear.

DIFFUSE SOUND FIELD

A sound field in which energy density is everywhere the same and sound waves are likely to be travelling in any direction with equal probability.

EQUIVALENT CONTINUOUS A-WEIGHTED SOUND PRESSURE LEVEL (L_{Aeq})

1. The hypothetical continuous, A-weighted, sound pressure level which would contain the same amount of acoustic energy as a time-varying, A-weighted, sound pressure level when assessed over the same, specified, time period.

2. Value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T starting at t_1 and ending at t_2 and measured in decibels, has the same mean square sound pressure as the sound under consideration whose level varies with time.

FACADE NOISE LEVEL

A facade noise level is the noise level 1m in front of the most exposed window or door in a building facade. The effect of reflection is to produce a slightly higher (+2.5 dB) sound level than it would be if the building was not there.

FAST (F) - See Time Weightings

FREE FIELD

1. A free sound field is a field in a homogeneous, isotropic medium free from boundaries. In practice it is a field in which the effects of the boundaries are negligible over the region of interest. The actual pressure impinging on an object (e.g., a microphone) placed in an otherwise free sound field will differ from the pressure which would exist at the point with the object removed, unless the acoustic impedance of the object matches the acoustic impedance of the medium.

2. An environment in which there are no reflective surfaces within the frequency region of interest.

3. A region in which no significant reflections of sound occur.

4. It is considered that free-field environmental noise measurements need to be made at least 3.5m from any reflecting structure.

HERTZ, Hz

This is the unit of frequency representing the number of times a periodic wave repeats itself per second.

IMPULSE (I) - See Time Weightings

MAXIMUM SOUND LEVEL, $L_{pA,max}$

The highest value of the A-weighted sound pressure level that occurs during a given event or time period. The time-weighting should be specified.

MEASUREMENT TIME INTERVAL, T_M

The total time over which measurements are taken.

OCTAVE BANDS, OCTAVE BAND SOUND PRESSURE LEVEL

1. A range of frequencies whose upper limit is twice the frequency of the lower limit.

2. The octave-band pressure level of a sound is the band pressure level for a frequency band corresponding to a specified octave. (The location of the octave-band pressure level on a frequency scale is usually denoted by the geometric mean of the upper and lower frequencies of the octave.) The ISO standard octave centre frequencies are 32, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k Hz (etc.).

ONE-THIRD OCTAVE BAND SOUND PRESSURE LEVELS

The ISO standard one-third octave band frequencies are 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3, 8 Hz and decade multiples thereof.

PERCENTILE LEVEL (STATISTICAL SOUND LEVEL INDICES, L_{AN}, L_{A90})

L_{AN} is the dB(A) level exceeded N% of the time measured on a sound level meter with Fast(F) time weighting, e.g. L_{A90} the dB(A) level exceeded for 90% of the time, is commonly used to estimate background noise level. L_{A10}, the level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise.

REFERENCE TIME INTERVAL, T_r

The time interval to which an equivalent continuous A-weighted sound pressure level can be referred. [

SLOW (S) - See Time Weightings

SOUND PRESSURE LEVEL (L_p)

1. The level of the pressure of the sound above the internationally accepted reference value of 20 µPa ($2x10^{-5}N/m^2$), which corresponds to the pressure of the quietest sound an average person can hear at the frequency of 1000 Hz. It is a quantity that can be measured, thus the intensity of a sound can be derived from it.

2. The sound pressure level is a measure of a dynamic variation in atmospheric pressure. The pressure at a point in space minus the static pressure at that point.

3. A value equal to 20 times the logarithm to the base 10 of the ratio of the ratio of the root-mean-square pressure of a sound to a reference pressure, which is normally taken to be $2x10^{-5}N/m^3$.

SOUND POWER LEVEL (L_W)

1. The sound power level of a sound source, in decibels, is 10 times the logarithm to the base 10 of the ratio of sound power radiated by the source to a reference power. The reference power is 1 picowatt ($1x10^{-12}$ watt).

2. The sound power level is the fundamental measure of the total sound energy radiated by a source per unit time.

3. A value equal to 10 times the logarithm to the base 10 of the ratio of the total acoustic power emitted by a source to a reference power, which is normally taken to be 10^{-12} watt.

TIME WEIGHTINGS, FAST (F), SLOW (S) AND IMPULSE (I)

Time weighting is used in sound level meters to stabilize the reading. This is achieved by standardizing the speed with which the metering circuit and meter respond. Two different averaging's are used (1) 'FAST', 'F', which has a time constant of 125 ms, and (2) 'SLOW', 'S', which has a time constant of 1000 ms. The impulse (I) characteristic is sometimes used to measure gunshots, punch presses, etc. It has a rise time constant of 35 ms and a decay time constant of 1500 ms.

Appendix B. Site Photographs

In the following figures the photographs were taken on site.

Figure B1: Measurement position on top of roof

Figure B2: Measurement position on top of roof

Figure B3: General view of surroundings from roof top

Figure B4: General view of surroundings from roof top

Figure B5: General view of residential dwellings from roof top

Figure B6: General view of existing plant items and residential dwellings on roof top

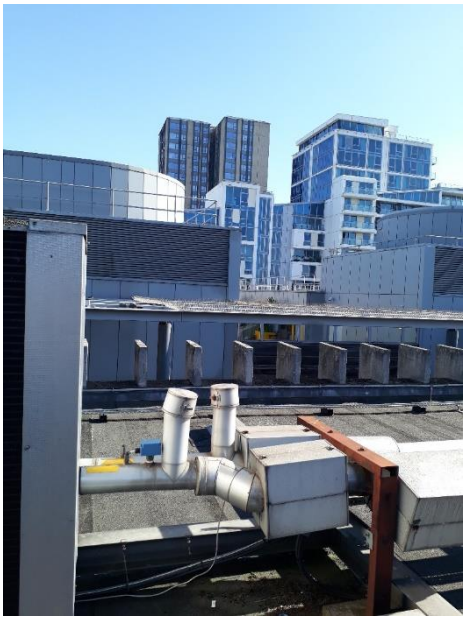
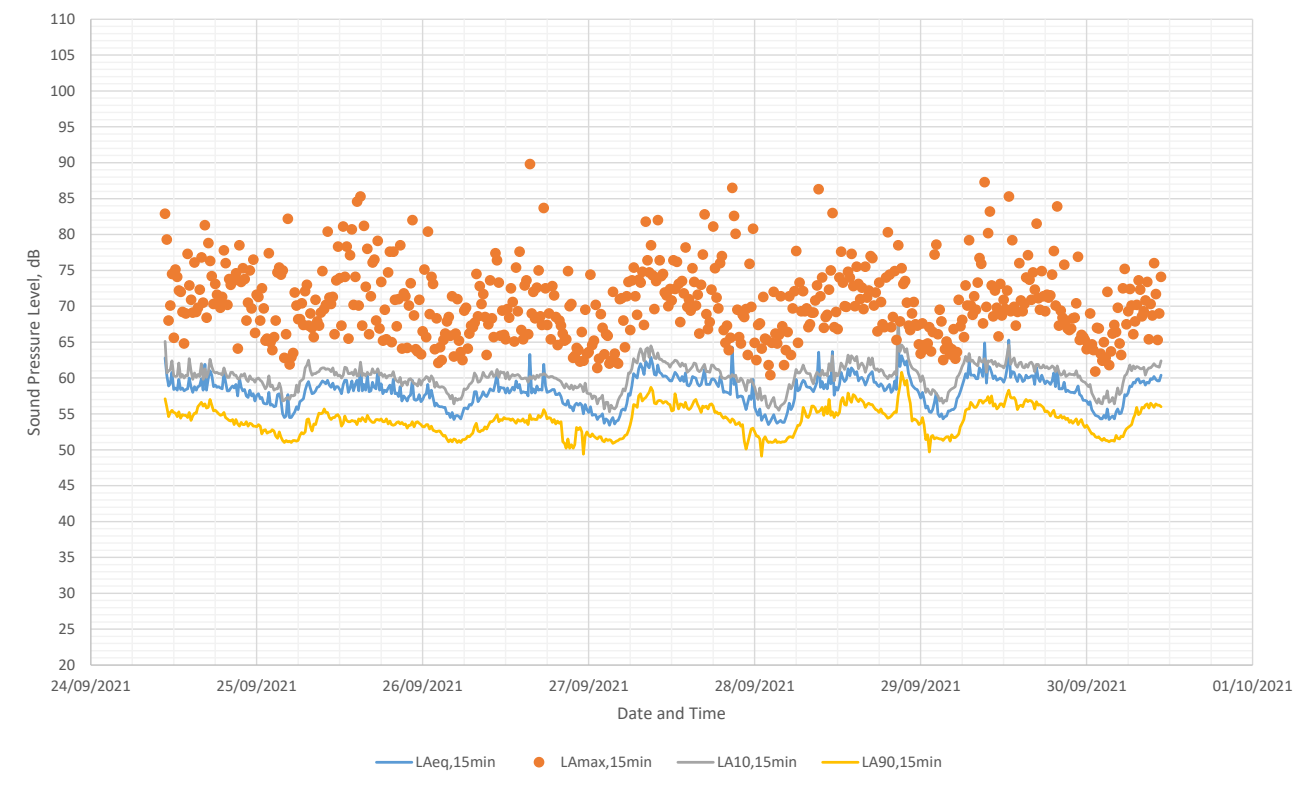


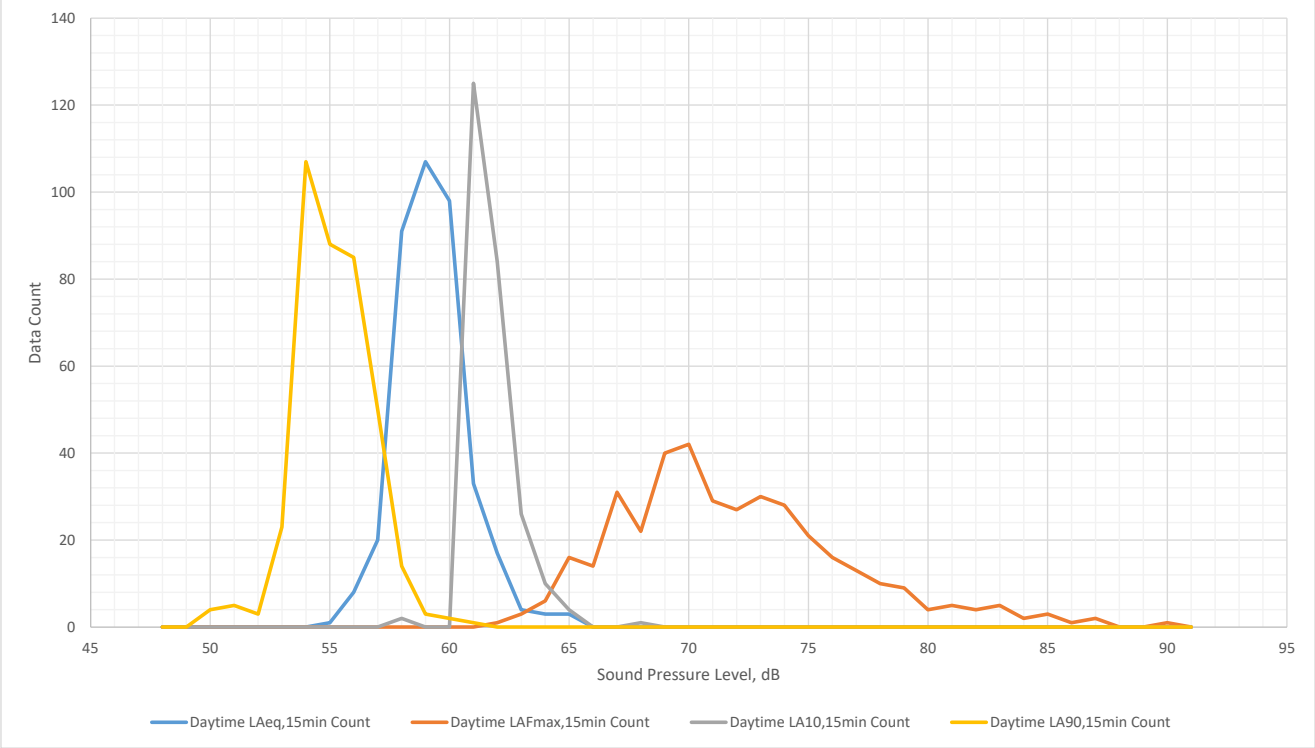
Figure B7: General view of existing plant items on roof top

Appendix C. Noise Survey Results

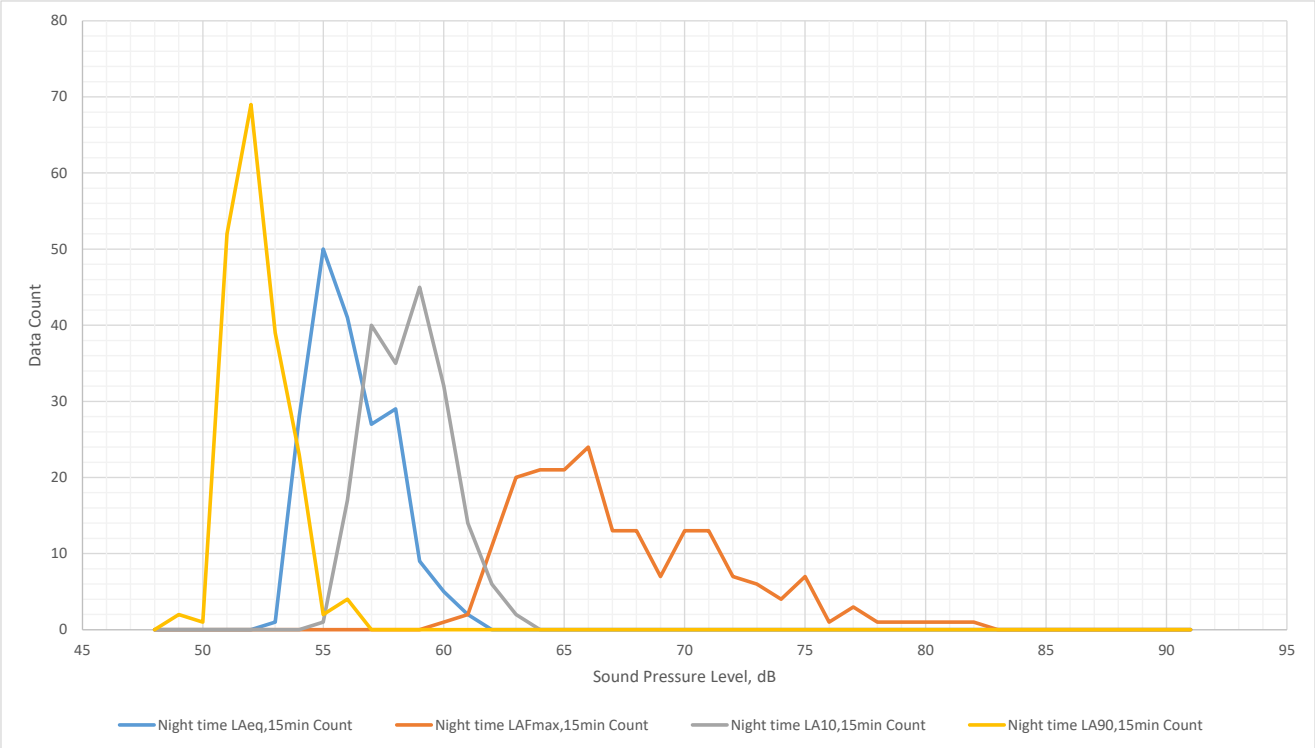
C.1. Temporal Results



C.2. Data counts (Daytime)



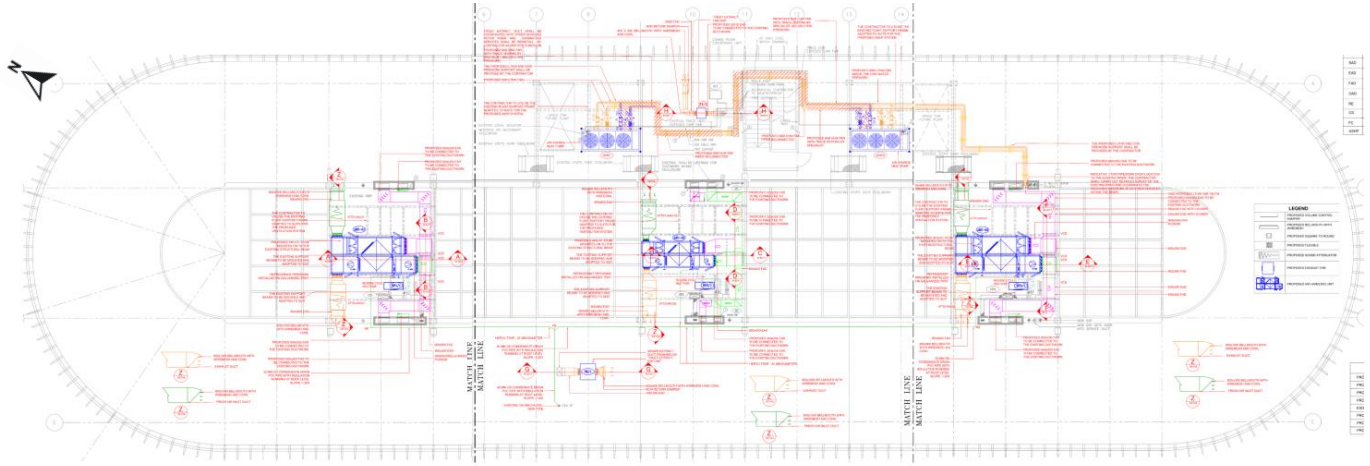
C.3. Data counts (Night-Time)



Appendix D. Site Plan and Survey Location

Appendix E. MEP Data

Location of new external units (in blue)



		Direction	Type	Value	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
North	AHU01	East	Inlet	Lw	58	66	58	54	44	45	43	40
	AHU01	West	Exhaust	Lw	66	79	73	75	73	68	63	60
	AHU01		Casing	Lw	52	63	47	44	44	43	27	20
North	HP1/1			SPL	70.5	62.5	61	60.5	56.5	53	49	43
				@1.3m								
Mid	AHU02	East	Inlet	Lw	62	64	58	54	45	45	44	41
	AHU02	West	Exhaust	Lw	66	74	71	72	71	68	64	61
	AHU02		Casing	Lw	52	58	45	41	42	43	28	20
Mid	HP2/1			SPL@1.3m	70.5	62.5	61	60.5	56.5	53	49	43
Mid	TE 1	East		Lw	67	71	73	69	63	62	62	48
Mid	TE 2	West		Lw	61	65	63	63	63	61	59	50
Mid	ASHP/1			SPL @1m	63.6	66.5	60.7	61.2	58.7	57.6	51	43.6
Mid	ASHP/2			SPL@1m	63.6	66.5	60.7	61.2	58.7	57.6	51	43.6
South	AHU03	East	Inlet	Lw	63	65	60	55	46	47	45	43
	AHU03	West	Exhaust	Lw	64	80	71	73	71	67	62	58
	AHU03		Casing	Lw	50	64	45	42	42	42	26	20
South	HP3/1			SPL@1.3m	70.5	62.5	61	60.5	56.5	53	49	43

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