

**Institute of Education University College
London (UCL)**

Plant Noise Break-Out Assessment

0052516

17 February 2023

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Glossary

Term	Definition
Ambient Noise (as defined in BS 4142:2014+A1 2019)	Totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.
Background Noise (as defined in BS 4142:2014+A1 2019)	A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using the Fast time weighting and quoted to the nearest whole number of decibels.
Decibel, dB	Decibel (dB) is a dimensionless unit commonly used to demonstrate sound levels. It is derived from the logarithm of the ratio between the measured level and the reference value. For sound pressure level (L_p) the reference value is 2×10^{-5} pascals. For sound power (L_w) reference value is 1×10^{-12} Watts.
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
$L_{90,T}$ ($L_{A90,T}$)	The sound pressure level exceeded for 90% of the measurement period. Referred to as background noise level.
$L_{Ar,T}$	Rating Noise Level (as defined in BS 4142:2014+A12019), the specific noise level plus any adjustment for the characteristic features of the noise.
$L_{eq,T}$ ($L_{Aeq,T}$)	The equivalent continuous noise level of a time-varying noise. It is the steady noise level that, over the period under consideration, contains the same amount of sound energy as the time-varying noise over the same period.
$L_{Fmax,T}$ ($L_{AFmax,T}$)	The maximum sound pressure level measured during the measurement period T using the fast time constant.
L_p	The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base of 10 of the ratio of the sound pressure to the reference pressure (2×10^{-5} pascals). The reference pressure shall be explicitly stated and is defined by the standard.
Specific Noise Level (as defined in BS 4142:2014+A1 2019)	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
Vibration	Force that oscillates about some specified reference point. Vibration is commonly expressed in terms of frequency such as cycles per second (cps), Hertz (Hz), cycles per minute (cpm) or (rpm) and strokes per minute (spm). This is the number of oscillations that occurs in that period. The amplitude is the magnitude or distance of travel of the force.
Weightings (as defined in BS EN 61672:2013):	A-Weighting: Frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.). C-Weighting: One of the frequency weightings corresponding to the 100-phon contour and the closest to the linear or un-weighted value.

1 Introduction

Buro Happold (acoustics) has been appointed by University College London (UCL) to provide acoustics consultancy on the proposed addition of a condenser unit, located on the service road that runs beneath the Institute of Education (IoE) building, 20 Bedford Way, London. The proposed wall-mounted outdoor unit will be surrounded by residential flats, offices, grass squares, and other associated spaces. An acoustic assessment is required to demonstrate that the noise emissions associated with the operation of the proposed condenser units are in line with the Local Planning Policy. This planning report should therefore be submitted to Camden Borough Council, the Local Planning Authority to demonstrate the potential impact of plant noise emissions on the surrounding Noise Sensitive Receptors (NSRs).

It is understood the scheme does not yet have planning permission, but that a planning application will be made promptly, depending on the outcome of this noise assessment. On this basis, it is suggested that the plant noise limits and noise survey methodology should comply with Camden Borough Council guidance and the standards which it references.

The acoustic parameters covered in this report fall under the sub-discipline of building services noise, highlighted in Figure 1—1.

1.1 Content

This report covers the following elements:

- External noise levels (from the survey)
- Required maximum permissible noise impact levels for plant
- Local Planning Authority (LPA) targets compliance
- Required limiting levels for external plant
- Noise impact assessment.

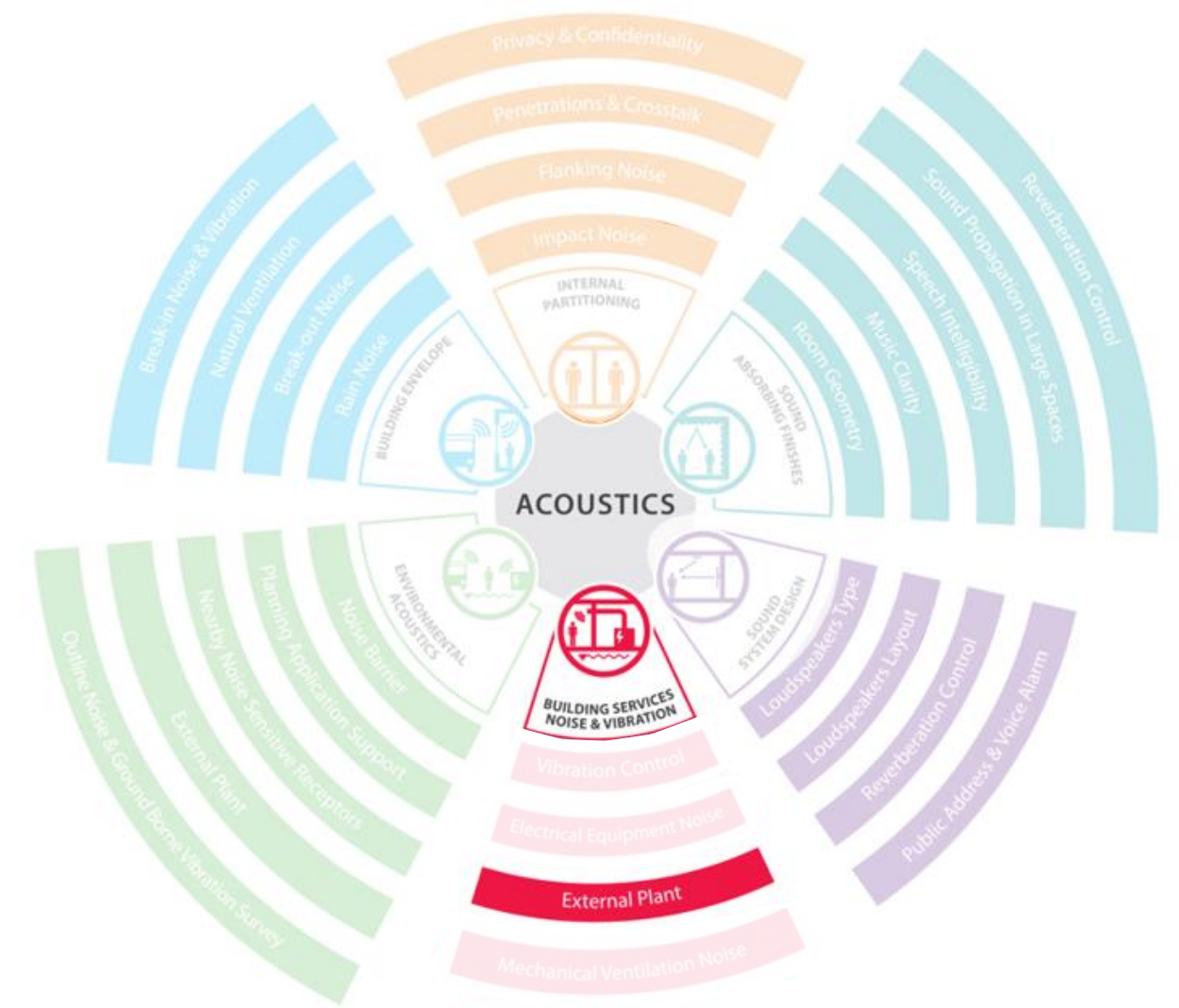


Figure 1—1 Acoustics sub-discipline

1.2 Camden Borough Guidelines

Camden Planning Guidance – Amenity (2019) highlights how any development involving external air extraction and conditioning equipment requires a formal acoustic assessment. It goes on to state that:

“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 report.”

The Camden Local Plan also asks for BS4142 to be used for cases relating to industrial and commercial noise sources and states that:

“For such cases, a ‘Rating Level’ of 10 dB below background (15 dB if tonal components are present) should be considered as the design criterion).”

The client specifically requested for Buro Happold to utilise BS 7445-1:2003, which BS 4142 complies with, therefore both have been referenced in this report.

1.3 Reference Codes & Standards

This acoustic design report references the following list of codes and standards:

- **BS 7445-1:2003 Description and measurement of environmental noise – Part 1: Guide to quantities and procedures:** provides guidelines for specifying noise limits and methodology for assessing environmental noise
- **BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound:** used for assessing the noise impact of industrial and commercial sources on noise-sensitive receptors (NSRs) and provides guidance as to the likely community response (BS 7445 compliant)
- **Camden Planning Guidance – Amenity (2019):** outlines what the local authority expects to see in this acoustic report
- **Local Planning Authority Criteria (Camden Local Plan):** specifies noise and vibration thresholds for noise-sensitive residential areas.

2 Site and External Noise Survey Results

2.1 Introduction

Buro Happold Engineering conducted two external noise surveys on 15th and 16th September 2021, and 7th and 8th February 2022 within the vicinity of the development site, relating to the design of the building and its associated services plant.

Both surveys were undertaken to capture the existing background noise levels ($L_{A90,T}$ dB) at the site and nearby NSRs. This allows for the specification of limiting noise levels for any externally located (or external terminations of the) external plant.

In this instance, the limiting plant noise levels are to be used to control noise emissions associated with the operation of the proposed condenser units. Where plant noise emissions are limited, this should see that the installation will not unduly increase existing noise levels in the vicinity of the site in line with pertinent criteria. Noise measurements were made using the following equipment (listed under their respective test durations):

- Long-term (minimum 24-hours):
 - Class 1 sound level meter, Rion NL-52 (serial number: 01265411)
 - Calibrator CEL-84/2 (serial number: 3/01818662)
 - Microphone 01 dB PRE 21 (serial number: 14038).

The sound level meter was checked before and after use with an acoustic calibrator. No significant drift was witnessed. Laboratory calibration certificates for all items of equipment are available upon request.

The weather conditions during the attended noise survey was noted as 5°C in temperature with no rain and wind speeds not typically exceeding 5 ms⁻¹ across both days. The weather was sunny on both days. In the previous survey the weather conditions were much the same, but with a higher temperature of 16°C.



Figure 2—1 Site map showing the noise measurement locations, and noise-sensitive receptors (NSRs) (source: Google Earth)

The values measured on-site were undertaken over relevant measurement periods, the key descriptor adopted in this instance is the **L_{A90,15mins} dB**. This is commonly referred to as the background noise level.

The **L_{A90,T} dB** can be described as an A-weighted sound pressure level exceeded for 90% of the measurement period i.e. a level that would be perceived as a constant, background noise level. Typically, largely unaffected by local traffic pass-by or by transient events. More usually attributable to constantly-running building services plant or distant road traffic. What you would hear when there is no local traffic present (or other readily-identifiable noise sources).

For this statistical value, the mode of the measurement values calculated every 15 minutes has been chosen to represent the ‘typical’ value for the range identified. The 15 minute duration is considered appropriate to provide the most common background noise level across the duration of the survey.

It is acknowledged that averaging statistical quantities interferes with their statistical basis, however, it is proposed that this practice has merit in representing a typical value for use in assessment.

2.2 Noise Sensitive Receptors

The following noise-sensitive receptors (NSRs) have been identified; these have been marked in green on the annotated aerial image (see Figure 2—1):

- Hotel rooms located adjacent to the eastern boundary of the IoE building on Bedford Way
- Residential, commercial, and academic buildings adjacent to the southern boundary of the IoE building on Russell Square
- Residential, commercial, and academic buildings are located adjacent to the western boundary of the IoE building on Thornough Street and Woburn Square.

For this report, the building in between Woburn square and the western face of IoE have been identified as the most susceptible to plant noise (detailed in Figure 2—2), hence the decision to measure background noise level at Location 1 (see Section 0).



Figure 2—2 Closest NSR to the west of the site

2.3 Noise Survey Results

Time history graphs for the noise monitoring carried out at Position 1 are shown in Appendix A.

As outlined in Section 1.2, the Camden Borough Council states that noise emitted from the proposed plant and machinery should not exceed 10 dB below the typical external background noise level measured at 1 m outside any window of a noise-sensitive receiver. Therefore, the results reported in

Noise measurements (7 th and 8 th February 2023)				
Period	Start time	End time	L _{A90,15minutes} dB	Comments
Day	15/09/2021 10:00-23:00 hours	16/09/2021 07:00-10:00 hours	54	Ongoing construction work present, including vehicle access, unloading, and loading of goods. Opposite a constantly running existing plant. (See Appendix A for full graphical representation of the results)
Night	15/09/2021 23:00-00:00 hours	16/09/2021 00:00-07:00 hours	54	

Table 2—2
provide a reference level for setting the maximum permissible plant noise levels at nearby NSRs.

2.4 Discussion

As can be seen from the measurement results, both the present daytime and night-time modal background levels are L_{A90,15minutes} 54 dB. In the previous study the daytime background noise level was slightly greater than the night-time background noise level with modal values being L_{A90,15minutes} 50 dB and L_{A90,15minutes} 48 dB respectively. In both studies the data indicates there is a near constant level of plant noise at the IoE from existing air conditioning equipment, with increases in noise level in the day due to ongoing construction and use of the access road, but these are brief events and not dominant in the background noise.

Table 2—1 Noise survey results (7th and 8th February 2023)

Noise measurements (7 th and 8 th February 2023)				
Period	Start time	End time	L _{A90,15minutes} dB	Comments
Day	15/09/2021 10:00-23:00 hours	16/09/2021 07:00-10:00 hours	54	Ongoing construction work present, including vehicle access, unloading, and loading of goods. Opposite a constantly running existing plant. (See Appendix A for full graphical representation of the results)
Night	15/09/2021 23:00-00:00 hours	16/09/2021 00:00-07:00 hours	54	

Table 2—2 Noise survey results (15th and 16th September 2021)

Noise measurements (15 th and 16 th September 2021)				
Period	Start time	End time	L _{A90,15minutes} dB	Comments
Day	15/09/2021 10:00-23:00 hours	16/09/2021 07:00-10:00 hours	50	Occasional van driving through, unloading, and loading of goods on wheeled carts. Opposite a constantly running existing plant. (See Appendix A for full graphical representation of the results)
Night	15/09/2021 23:00-00:00 hours	16/09/2021 00:00-07:00 hours	48	

3 Plant Noise Break-Out



3.1 Introduction

Any newly introduced external plant associated with the refurbishment works should be controlled to see that the Camden Borough Council requirements are achieved and that noise emissions do not cause an adverse impact upon existing NSRs. This section outlines suitable noise limits and if this proposed plant noise emissions associated with the condensers are compliant with these limits.

3.2 Proposal

A single condensing unit is to be located on the service road that runs beneath the Institute of Education (IoE) building. The location is show in Figure 3—1.

The proposed unit is a PKA -M60KA which has a sound pressure level of L_p 49 dBA at (assumed) 1 m. Manufacturers data for this unit is presented in Appendix B.

3.3 Design Criteria

- Target values to limit the impact of noise break-out from a noise-generating plant at nearby NSRs are detailed in Camden Councils' guidelines presented in Section 1.2. The design criteria are reproduced below for reference:
- The rating level ($L_{A,r,Tr}$ dB) (calculated in accordance to BS 4142:2014+A1:2019) is at least 10 dB below the lowest background noise level ($L_{A90,15mins}$ dB) for the proposed operating period; and
 - The rating level ($L_{A,r,Tr}$ dB) (calculated in accordance to BS 4142:2014+A1:2019) is at least 15 dB below the lowest background noise level ($L_{A90,15mins}$ dB) for the proposed operating period should plant be identified as having “acoustic features” (e.g. intermittency, tonal characteristics, and impulsivity).

Individual plant items may need to be designed to a lower limit such that the overall total achieves the stated criteria above. This is because the plant rating limits are representative of the cumulative noise emissions of all plant items operating at the development.

3.4 External Plant Noise Limits at the Nearest NSRs

Based on the background noise levels during the day and night-time periods (see Section 2.3), cumulative limiting plant noise levels at the nearby noise-sensitive receptors have been set, as displayed in Table 3—1.

It is understood that there are no tonal elements associated with the proposed plant and other acoustic characteristics, such as intermittency. The condensers are expected to operate for 24 hours a day and therefore a rating limit that is 10 dB below the background noise level is recommended by Buro Happold as this is in line with Camden Borough Council criteria.

Table 3—1 Limiting rating levels based on measured background noise levels

Measurement Period	Modal background noise level $L_{A90,15-minute}$ dB	Plant Rating Limit at 1 meter from nearest NSR façades $L_{A,r,Tr}$ dB
Day-time (07:00-23:00 hours)	50	40
Night-time (23:00-07:00 hours)	48	38

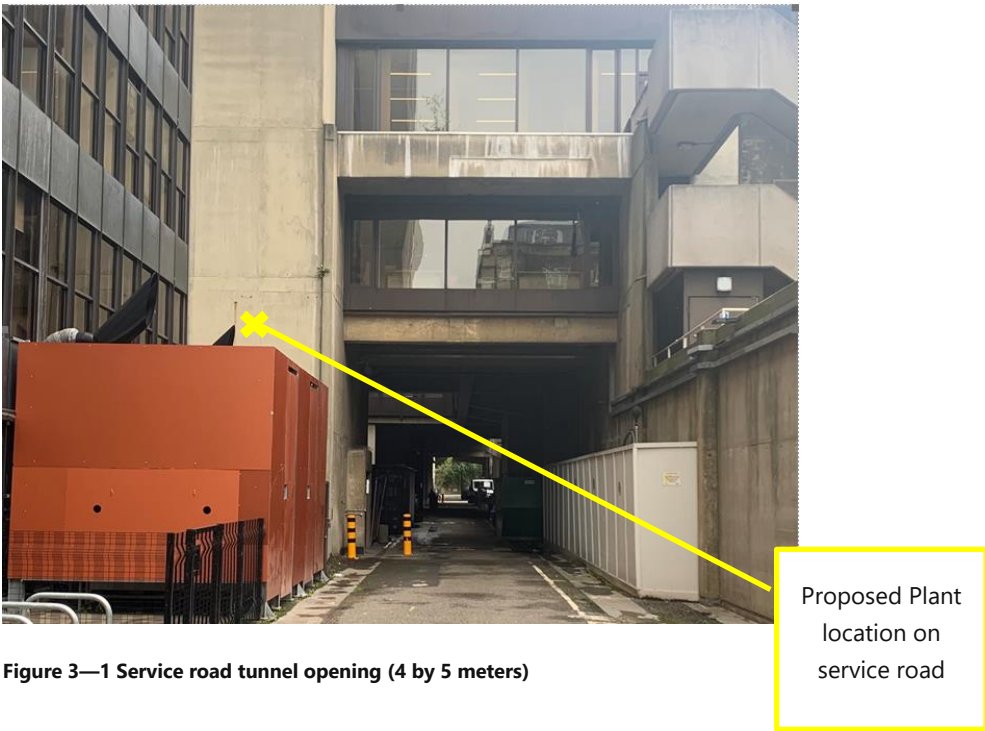


Figure 3—1 Service road tunnel opening (4 by 5 meters)

3.5 Plant Noise Levels at the Nearest NSRs

Due to the plant being in a semi-enclosed tunnel (see Figure 3—1), both direct sound and reverberant reflected sound needs to be considered. This has been calculated by using distance measurements extracted from street map data, the condenser unit sound pressure level of L_p 49 dBA at (assumed) 1 m (presented in Appendix B), and the following assumptions that are considered to represent a robust scenario:

- The NSRs facing plant items head-on at the opening of the tunnel (0° degree viewing angle)
- The tunnel is a highly reverberant space with a low absorption coefficient (average room coefficient, $\bar{\alpha}$ =0.08)
- The condenser unit is next to three reflective surfaces (floor and 2No. walls).

The following presents the values used in the calculation and predicts a noise level of $L_{Ar,Tr}$ **31 dB** at the nearest NSR.

- L_p 49 dBA at 1 m from the proposed condenser unit
- + 9 dB reflection correction for 2No. wall and floor reflections
- – 27 dB distance attenuation (distance of 22 m and assuming a point source)

If any changes that could affect the credibility of these measurements and assumptions arise, i.e. modification to plant type or location, Buro Happold should be informed so that a review of calculations can be undertaken.

4 Conclusion

An acoustic survey was conducted in the vicinity of the development site to assess the existing noise climate. Analysis of the typically measured background noise levels has been undertaken. The noise impact on the nearest NSR façade was then calculated using a combination of site measurement results, manufacturer noise level data and assumptions such as room dimensions.

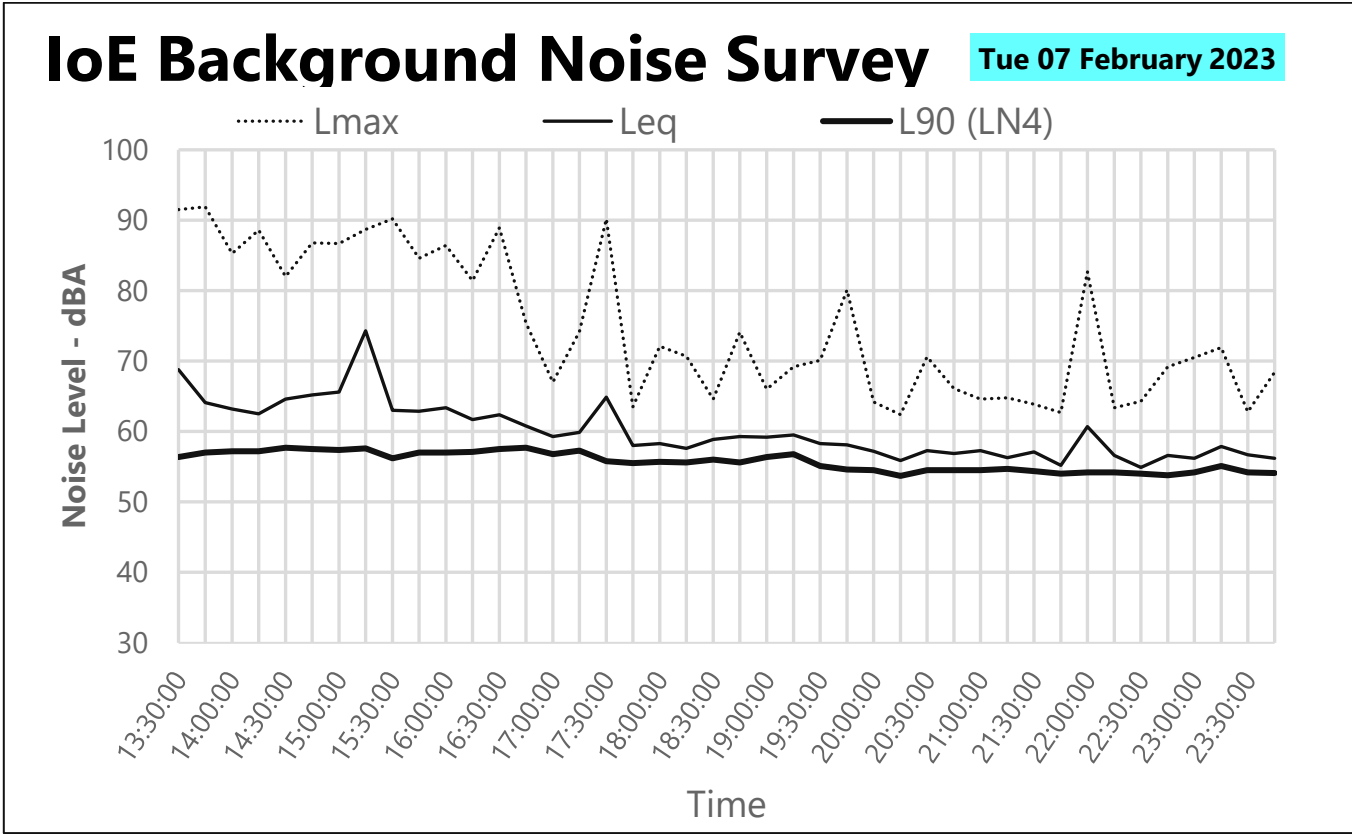
As can be seen from the long-term measurements, the external plant should be limited to a worst-case $L_{A90,15mins}$ 38 dB(A) during night-time periods.

The acoustic calculations presented in Section 3.5 suggest that if the condenser unit is installed in the agreed location, then the worst-case noise impact on the closest NSRs to the west of the IoE could be up to $L_{A,r,Tr}$ 31 dB.

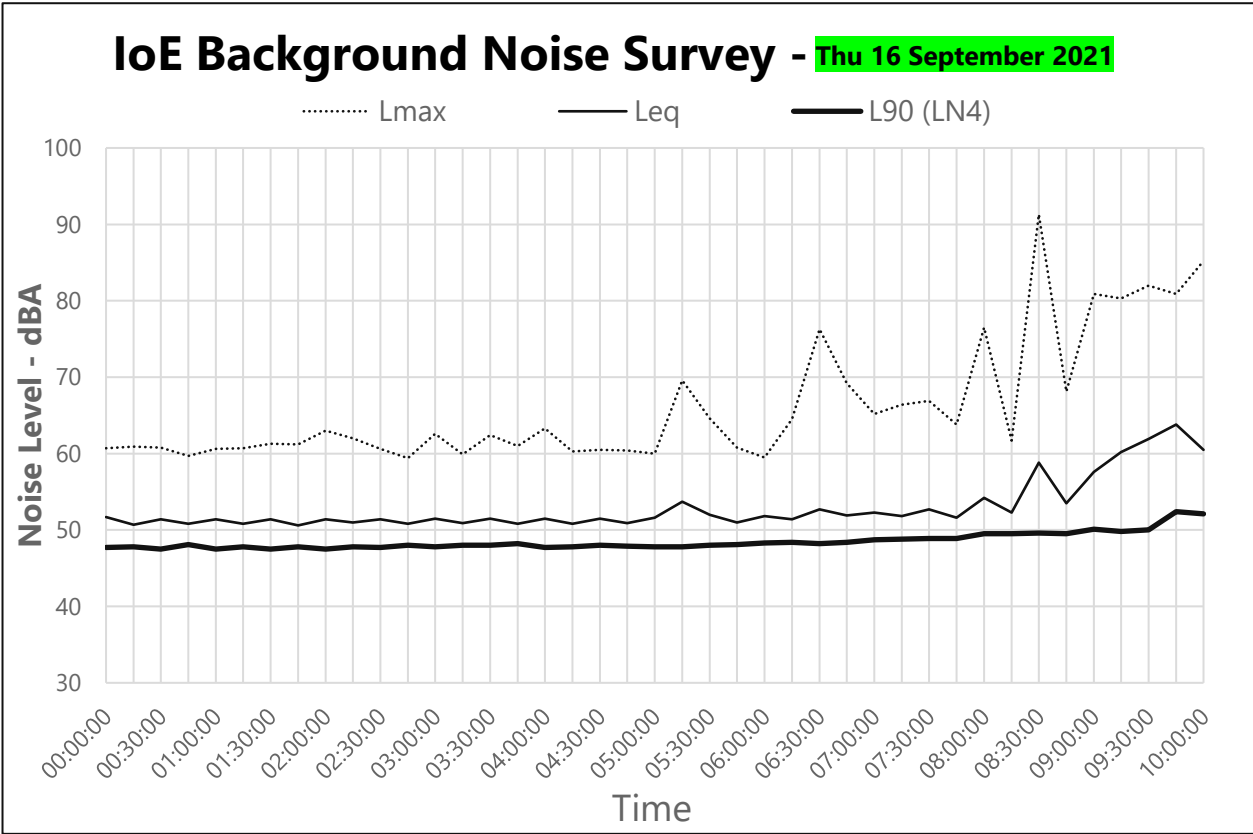
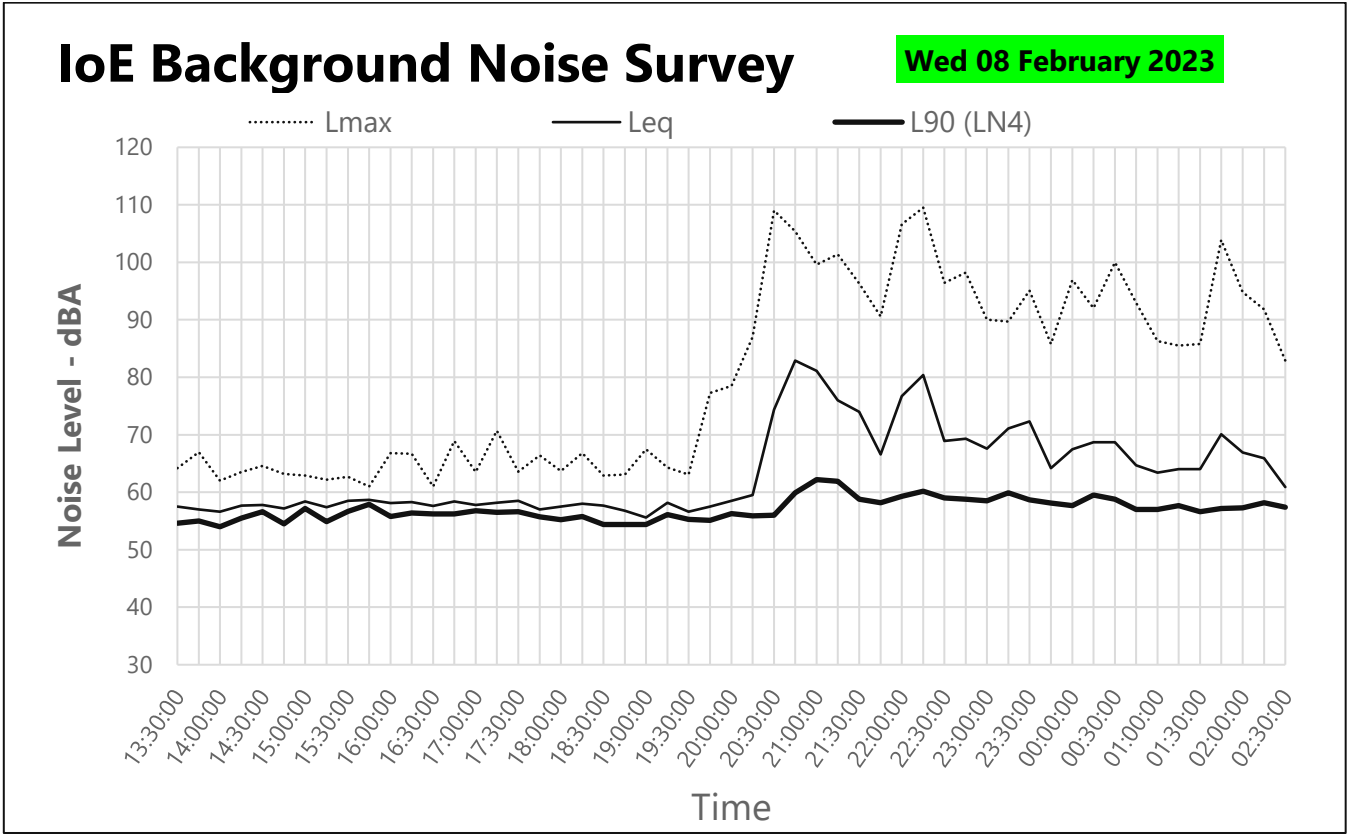
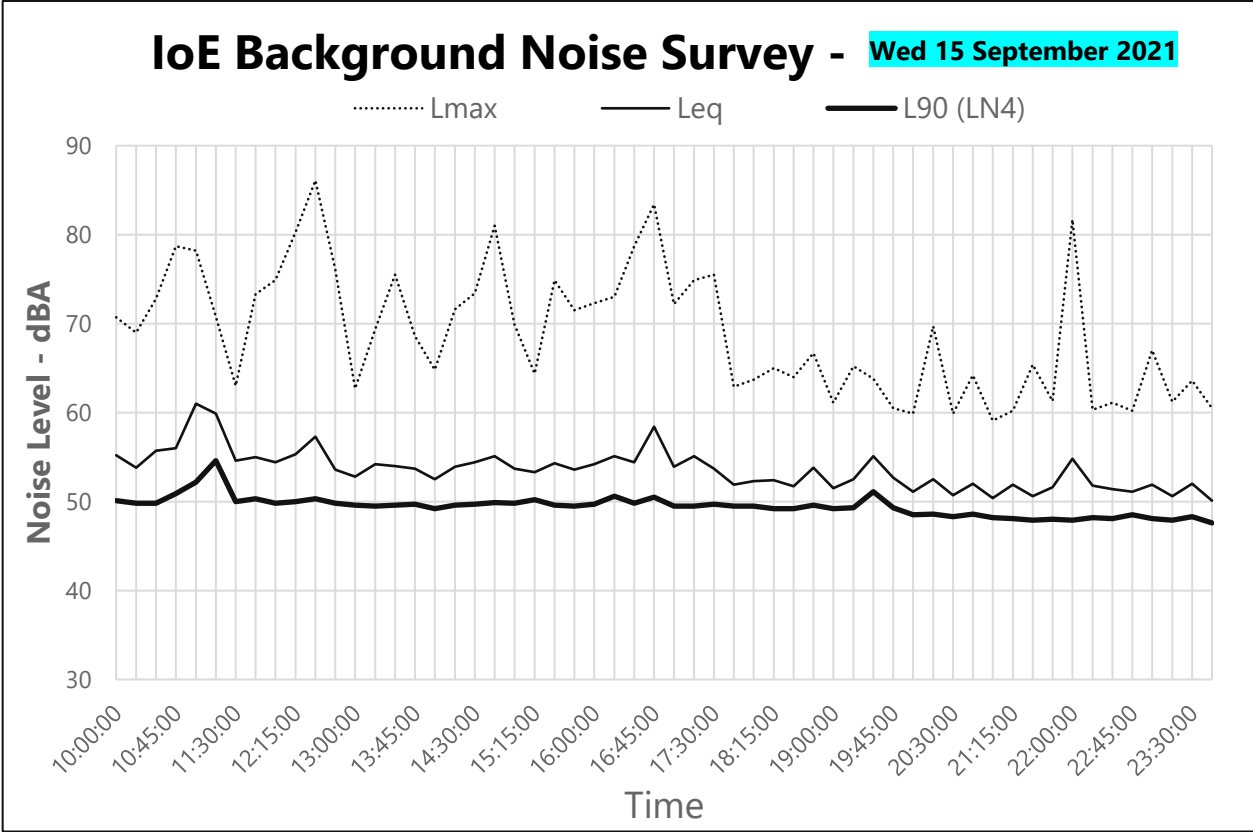
This level complies with Camden Borough Council requirements, which state that new plant noise emissions should be 10 dB below the background noise level. The proposed development is therefore likely to be non-disruptive, and acoustic concerns are not considered to represent any barrier to development.

Appendix A Noise Survey Graphs

A.1 Appendix 1: Long-term measurement data (Location 1) 7th and 8th February 2023



A.2 Appendix 2: Long-term measurement data (Location 1) 15th and 16th September 2021



Appendix B Outdoor Condenser Unit Technical Specification

Air Conditioning

Product Information

PKA-M R32

Wall Mounted System

Power Inverter Heat Pump

R32

POWER INVERTER

PKA-M INDOOR UNITS		PKA-M35LA	PKA-M50LA	PKA-M60KA	PKA-M71KA	PKA-M100KA	PKA-M100KA
CAPACITY (kW)	Heating (nominal)	4.1 (1.6-5.2)	5.0 (2.5-7.3)	7.0 (2.8-9.2)	8.0 (3.5-10.2)	11.2 (4.5-14.0)	11.2 (4.5-14.0)
	Cooling (nominal)	3.6 (1.6-4.5)	4.6 (2.3-5.6)	6.1 (2.7-6.7)	7.1 (3.3-8.1)	9.5 (4.9-11.4)	9.5 (4.9-11.4)
	Heating (kW)	3.5 (1.35-4.4)	4.25 (2.15-6.2)	5.95 (2.4-6.95)	6.8 (3.0-8.65)	9.5 (3.85-11.8)	9.5 (3.85-11.8)
	Cooling (kW)	3.3 (1.45-4.15)	4.23 (2.1-5.15)	5.5 (2.5-6.15)	6.55 (3.05-7.45)	9.2 (4.5-10.5)	9.2 (4.5-10.5)
SEER (nominal)		0.74	0.66	0.66	0.78	0.73	0.73
SEER (nominal)		3.94 / 4.20	3.72 / 3.71	4.04 / 3.91	3.78 / 3.81	3.61 / 3.95	3.61 / 3.95
SEER (nominal)		4.0 / 6.5	4.3 / 6.6	4.3 / 6.6	4.3 / 6.6	4.4 / 6.5	4.4 / 6.4
SEER (nominal)		A+ / A++	A+ / A++	A+ / A++	A+ / A++	A+ / A++	A+ / A++
SEER (nominal)		125-137-153-182	125-137-153-182	300-333-367	300-333-367	333-383-433	333-383-433
SEER (nominal)		12.7 (1/2")	12.7 (1/2")	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")
SEER (nominal)		6.35 (1/4")	6.35 (1/4")	8.52 (3/8")	8.52 (3/8")	8.52 (3/8")	8.52 (3/8")
SEER (nominal)		34-37-40-43	34-37-40-43	38-42-45	38-42-45	41-45-49	41-45-49
SEER (nominal)		60	60	64	64	65	65
SEER (nominal)		896 x 237 x 299	896 x 237 x 299	1170 x 295 x 365	1170 x 295 x 365	1170 x 295 x 365	1170 x 295 x 365
SEER (nominal)		12.6	12.6	21	21	21	21
SEER (nominal)		6	6	6	6	6	6
SEER (nominal)		4	4	4	4	4	4
SEER (nominal)		PAR-40MAA	PAR-40MAA	PAR-40MAA	PAR-40MAA	PAR-40MAA	PAR-40MAA
SEER (nominal)		PAR-FI 32MA	PAR-FI 32MA	PAR-FI 32MA	PAR-FI 32MA	PAR-FI 32MA	PAR-FI 32MA

PUZ-ZM OUTDOOR UNITS		PUZ-ZM35VKA	PUZ-ZM50VKA	PUZ-ZM60VKA	PUZ-ZM71VHAR1	PUZ-ZM100VKA1	PUZ-ZM100VKA1
SOUND PRESSURE LEVEL (dB(A))	Heating/Cooling	46 / 44	46 / 44	49 / 47	49 / 47	51 / 49	51 / 49
	Cooling	65	65	67	67	69	69
SOUND POWER LEVEL (dB(A))	Heating/Cooling	46	46	70	70	116	123
	Cooling	65	65	67	67	69	69
DIMENSIONS (mm)	Width x Depth x Height	809 x 300 x 630	809 x 300 x 630	950 x 330 + 25 x 943	950 x 330 + 25 x 943	1050 x 330 + 40 x 1338	1050 x 330 + 40 x 1338
	Weight (kg)	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	380-415v, 50Hz
ELECTRICAL SUPPLY	Phase	Single	Single	Single	Single	Single	Three
	System Power Input (kW)	Heating/Cooling (nominal)	1.640 / 0.869	1.347 / 1.239	1.732 / 1.560	2.116 / 1.863	3.102 / 2.405
STARTING CURRENT (A)	Heating/Cooling (kW)	0.81 / 0.84	1.12 / 1.12	1.25 / 1.05	1.54 / 1.92	2.47 / 2.06	2.47 / 2.06
	Starting Current (A)	5.0	5.0	6.0	6.0	13.0	6.0
SYSTEM RUNNING CURRENT (A)	Heating/Cooling (MAX)	4.97 / 4.31 [13.4]	5.96 / 5.57 [13.4]	7.41 / 6.65 [19.3]	9.10 / 7.96 [19.4]	13.46 / 10.45 [27.1]	4.49 / 5.45 [8.6]
	Fuse Rating (BS88) - HRC (A)	16	16	25	25	32	16
MAXIMUM CABLE LENGTH (m)	MAXIMUM CABLE LENGTH (m)	3	3	3	3	3	5
	MAXIMUM PIPE LENGTH (m)	50	50	55	55	100	100
MAXIMUM HEIGHT DIFFERENCE (m)	MAXIMUM HEIGHT DIFFERENCE (m)	30	30	30	30	30	30
	CHARGE REFRIGERANT (kg) / CO ₂ EQUIVALENT (t) - R32 (GWP 675) + 30m	2.0 / 1.35	2.00 / 1.35	2.80 / 1.89	2.80 / 1.89	4.00 / 2.70	4.00 / 2.70
MAXIMUM ADDITIONAL REFRIGERANT (kg) / CO ₂ EQUIVALENT (t) - R32 (GWP 675)	MAXIMUM ADDITIONAL REFRIGERANT (kg) / CO ₂ EQUIVALENT (t) - R32 (GWP 675)	0.30 / 0.20	0.30 / 0.20	0.80 / 0.54	0.80 / 0.54	2.80 / 1.89	2.80 / 1.89

PKA-M35/50LA DIMENSIONS

UPPER VIEW

FRONT VIEW

SIDE VIEW

PKA-M60/71/100KA DIMENSIONS

UPPER VIEW

FRONT VIEW

SIDE VIEW

MITSUBISHI ELECTRIC

Changes for the Better

Telephone: 01707 282880

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Note: The fuse rating is for guidance only. Please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/technical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas. R410A (GWP 2088), R32 (GWP 675), R407C (GWP 1774), R134a (GWP 1433), R513A (GWP 601), R464B (GWP 446), R1234ze (GWP 7) or R1234ze (GWP 4). These GWP values are based on Regulation (EU) No 815/2014 from IPCC 4th edition. In case of Regulation (EU) No 600/2001 from IPCC 3rd edition, these are as follows: R410A (GWP 1975), R32 (GWP 550), R407C (GWP 1850) or R134a (GWP 1300).

Effective as of May 2020

Mitsubishi Electric

Green Gateway

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