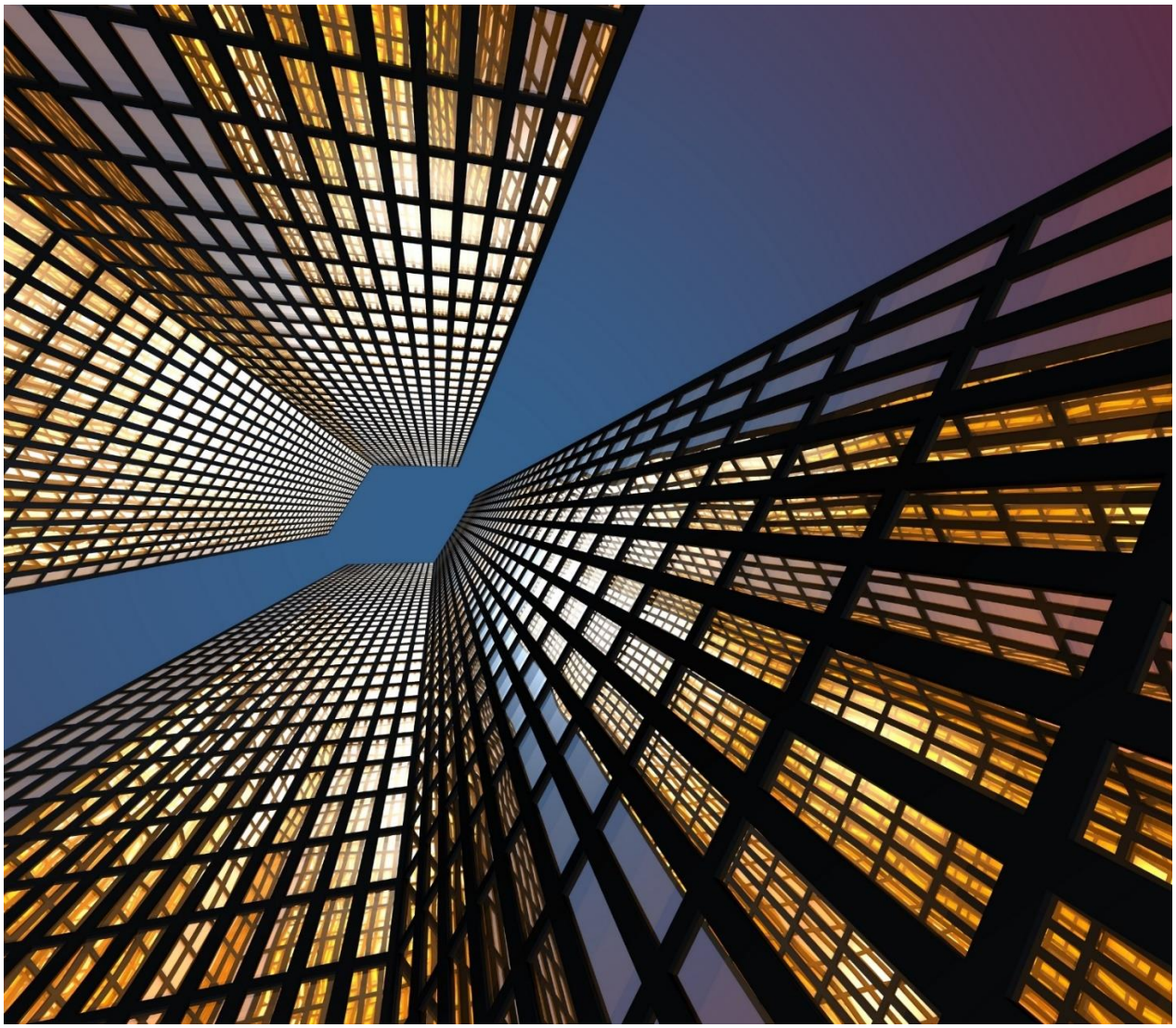
Report

17th September 2021

TEMPLE

LEADERS IN ENVIRONMENT, PLANNING & SUSTAINABILITY.

Report for – Thornton Reynolds
T5281 – Holborn Links Estate – Norfolk House (Project 3)
Plant Noise Assessment



Document version control

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Executive Summary

Temple Group (Temple) has been appointed by Thornton Reynolds Ltd to undertake a preliminary plant noise assessment for equipment proposed as a part of the redevelopment of Norfolk House, Southampton Place, WC1A 2AL. This office development includes installation of condensers at roof level.

This report presents criteria for plant noise emissions, the methodology, and results of an external noise survey undertaken at the site to establish the background noise levels in the area. These have been used to assess the impact of the proposed roof mounted plant on the nearest noise sensitive receptors.

Camden Council's policy documents express their requirement that the external Rating Level emitted from the building services plant to be lower than the Background sound level by 10dB (15dB if tonal components are present) at the nearest noise sensitive receptors.

Based on the manufacturer's sound pressure level data, it is predicted that noise emissions will be adequately controlled during the daytime and the night-time. Plant noise levels will be at least 10dBA below the Background sound level and will comply with Camden Council's noise limits.

1.0 Introduction

Proposals are in place to install new mechanical plant on the roof of Norfolk House as part of the office redevelopment. Temple has been appointed to undertake a noise assessment for the new building services plant that will be installed at roof level.

The purpose of the noise assessment is to establish the impact on nearby noise sensitive receptors and, where required, to provide outline mitigation measures for further noise attenuation. The assessment has been carried out in line with the guidance from Camden Council and relevant national standards.

The following sections of the report describe criteria for plant noise emissions, assessment methodology, external noise measurement methodology, along with results of the assessment of the proposed plant.

The acoustic terminology used in this report is explained in **Appendix A.**

2.0 Policy, Standards and Guidance related to Noise Emission Limits

2.1 Standards and Guidance

British Standard 7445 – Description and *Measurement of Environmental Noise*

British Standard 7445 Part 1 (BS 7455-1:2003)[1] defines the basic quantities to be used for the description of noise in community environments and describes basic procedures for the determination of these quantities.

The methods and procedures described in this British Standard are intended to be applicable to sounds from all sources, individually and in combination, which contribute to the total noise at a site.

British Standard 7445 Part 2 (BS 7455-2:1991)[2] describes methods for the acquisition of data which provide descriptors that enable:

a) a description of the environmental noise in a specified area of land to be made in a uniform way;

b) the compatibility of any land use activity or projected activity to be assessed with respect to existing or predicted noise; and

c) Using the data as a basis, authorities may establish a system for selecting the appropriate land use, as far as levels of noise are concerned, for a specified area, or the sources of noise - existing or planned - which are acceptable with respect to land use, existing or planned.

British Standard 4142:2014+A1:2019 – Methods for rating and assessing industrial and commercial sound

British Standard 4142 (BS 2014+A1:2019)[3] describes methods to use outdoor sound levels to assess the likely effects of sound of an industrial and/or commercial nature on people who might be inside or outside a dwelling or premises used for residential purposes upon which the sound is incident.

The standard requires determination of the following:

- Rating level - $L_{Aeq,Tr}$ sound level produced by the specific sound source at the assessment location with any adjustment added to the specific sound level if a tone, impulse or other acoustic characteristic occurs, or is expected to be present.
- Background sound level, $L_{A90,T}$ – A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T.

[1] British Standards Institute (BSI), (2003): 'BS 7445 – Description and Measurement of Environmental Noise. Part 1: Guide to Quantities and Procedures'. BSI, London.

[2] British Standards Institute (BSI), (1991): 'BS 7445 – Description and Measurement of Environmental Noise. Part 2: Guide to the Acquisition of Data Pertinent to Land Use'. BSI, London.

[3] British Standards Institute (BSI), (2014+A1:2019): 'BS 4142 – Methods for rating and assessing industrial and commercial sound

- T_r is the reference time interval over which the specific sound level is determined. This is 1-hour for daytime (07:00-23:00 h) and 15-minutes for night-time (23:00-07:00 h).

An estimate of the impact of the specific sound generated can be obtained by subtracting the measured background sound level from the rating level, and the following is considered:

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

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

c) A difference of around +5dB 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.

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the sound under investigation. A correction factor is added to this level to account for the acoustic character of the sound as follows:

- Tonality – A correction of up to 6dB depending on the prominence of tones;
- Impulsivity – A correction of up to 9dB depending on the prominence of impulsivity;
- Other sound characteristics – A 3dB correction may be applied where a distinctive acoustic character is present that is neither tonal nor impulsive;
- Intermittency – A 3dB correction may be applied where the specific sound has identifiable on-off conditions.

All pertinent factors should be taken into consideration when assessing the impact, including the following:

- 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.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor.

2.2 Local Authority Requirements

Camden Local Plan 2017

The Camden Local Plan[4] was adopted by council on the 3rd of July 2017. It replaces the core strategy and Camden Development Policies as the basis for planning decisions and future development in Camden.

Policy A1 Managing the Impact of development states:

"The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity"

Noise and vibration levels are factors that are considered under Policy A1.

Policy A4 Noise and vibration states:

"The council will seek to ensure that noise and vibration is controlled and managed.

Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:

- *Development likely to generate unacceptable noise and vibration impacts; or*
- *Development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*

We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development."

Appendix 3 of the Camden Local Plan 2017 sets out the noise thresholds for industrial and commercial noise sources, it states the following:

"A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document 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 (15 dB if tonal components are present) should be considered as the design criterion.

[4] Camden Local Plan, 2017. Camden Council

Table 2.1 Camden Local Plan Appendix 3 Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing noise sensitive receptor	Assessment location	Design period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (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 88dBL_{Amax}	'Rating level' greater than 5dB above background or events exceeding 88dBL_{Amax}

2.3 Consultation

On Wednesday 21st April, Richard Budesha, a consultant at Temple contacted the Camden Council noise team (RegulatoryServices@camden.gov.uk) via email. The correspondence summarised the proposed methodology for undertaking the noise survey and subsequent plant noise assessment. At the time of writing this report (17th September 2021) no response has been received.

3.0 The Site and its Surroundings

Norfolk House is located on the corner of Southampton Place, WC1A 2AL and High Holborn, WC1V 6PS, London. The location of the site is indicated in Error! Reference source not found. in Error! Reference source not found..

The site is close to Holborn Station and the surroundings include residential and commercial use buildings. The nearest noise sensitive residential receptor to the proposed rooftop plant locations were noted to be the third-floor windows of the residential properties above the Princess Louise public house on High Holborn; approximately 22m away from the existing plant housed on the roof of Norfolk House. The existing plant is due to be removed and all measurements of the current noise climate were undertaken with the plant switched off. Additional residential receptors were identified as the flats above the businesses on the other side of Southampton Place; approximately 35m away from the existing plant housed on the roof of Norfolk House

The client has proposed to install the following external plant:

Norfolk House

- 4 Large Condensers (Mitsubishi PUMY-P300YBM)
- 1 Small Condenser (Mitsubishi PUMY-P112YKM)

The plant proposed will be operating at 100% fan speed during office hours (daytime) and the larger units will operate at a reduced capacity of 50% for heating during the night-time.

Figure C.1 in **Appendix C** shows the layout of the proposed plant on Norfolk House.

Plant Specification sheet data can be found in **Appendix D**, the data from which has been summarised below in **Table 3.1 and Table 3.2**.

Table 3.1 Condenser noise data during heating (Sound pressure Level at 1m)

	Octave Band Sound Pressure Levels at 1m Hz (dB)							
Model	63	125	250	500	1000	2000	4000	8000
PUMY-P112YKM	58.0	55.0	54.5	51.5	49.5	45.0	38.0	32.0

Table 3.2 Large P300 Condensers

Model	Cooling SPL (dBA at 1m)	Heating SPL (dBA at 1m)
Mitsubishi P300 Condensers 100% Fan speed	61.0	67.0
Mitsubishi P300 Condensers 85% Fan speed	55.5	59.5
Mitsubishi P300 Condensers 70% Fan speed	51.5	55.5
Mitsubishi P300 Condensers 60% Fan speed	48.5	53.0
Mitsubishi P300 Condensers 50% Fan speed	47.0	50.5

4.0 Measurement Methodology

4.1 Unattended Monitoring

An unattended environmental noise survey was carried out between Wednesday 28th April and Tuesday 4th May 2021 to obtain prevailing noise levels at the site.

Measurement Position 1 (MP1) was located on the southern edge of the Norfolk House roof facing High Holborn, Newton Street and the nearest residential receptor. Measurement Position 2 (MP2) was located on the north-eastern edge of the roof, north of the existing plant room facing Holborn station and the opposite side of Southampton Place. These locations were chosen to measure noise levels representative of those at the nearest/worst affected noise sensitive receptors. The measurement microphone in each case was positioned at a height of approximately 2m above the roof level and 1m away from the roof edge, each location was considered to be under free field conditions, The measurement positions are shown in Error! Reference source not found.**, B.2 and B.3** in **Appendix B**.

The noise monitors were set up to automatically store statistical and spectral data every 15 minutes during the measurement period. Continuous road traffic noise from High Holborn (A40) to the south and Bloomsbury Square to the north were observed to be the dominant noise sources. Occasional traffic moved along Southampton Place and sirens were heard to the west and on High Holborn during installation and collection of the monitors.

4.2 Equipment

The measurement equipment used is detailed in **Table 4.**. The microphones were fitted with a windshield and appropriate corrections applied. Field calibration checks were carried out prior to and post measurement with no significant variation was observed. Calibration certificates are available upon request.

Table 4.1 - Survey Equipment

Manufacturer	Item	Type	Serial Number
RION	Sound Level Meter	NL-52	00410086
RION	Sound Level Meter	NL-52	00510141
RION	Calibrator	NC-74	34936353

4.3 Meteorological Conditions

To verify that periods of adverse weather conditions did not significantly impact the results, the local precipitation and wind speed levels were collected using Wundermap[5] weather data from weather station ILONDO341, 1.75 km from Norfolk House.

Appendix E shows the L_{A90} results and the precipitation and wind speed data for the duration of the survey. Wind speeds remained at or below the recommended maximum limits of 5 m/s set out in British Standard 4142 (BS 2014+A1:2019). It was established there were no periods of heavy precipitation during the survey and no data has been removed.

[5] Weather Underground https://www.wunderground.com/weather/gb/london-city/EGLC

5.0 Noise Survey Results

5.1 Unattended Measurement Results

In line with BS 4142:2014+A1:2019, representative typical background sound levels have been determined using statistical analysis of the continuous measurements. Day and night-time $L_{A90,15min}$ representative background sound levels measured during the unattended survey for each measurement position are presented in **Table 5.1.**

Table 5.1 - Representative typical background sound levels.

Measurement Position	Representative Receptor	Daytime $L_{A90, 15mins}$	Night-time $L_{A90, 15mins}$
MP1	Dwellings above Princess Louise	51dB	48dB
MP2	Southampton Place	51dB	49dB

6.0 Plant Noise Assessment

Due to the distance separation, screening from the building edge, and various types of plant, a 3D CadnaA noise model was prepared to predict the resultant noise levels at the identified sensitive receptors.

Calculations for the condenser units have been based on the manufacturer's measured octave band sound pressure level data at 1m.

Table 6.1 - BS4142 assessment of residential receptors above the public house, from MP1

Results		**dB (day)**	**dB(night)**	
Background Sound Level	$L_{A90,15mins}$	51	48	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, 15 minutes.
Assessment made for seven consecutive days; reference time interval is 15mins. The plant is proposed to be used at full capacity during office hours and reduced capacity for out of office hours as described in Section 3.0.				
Distance Attenuation	N/A	N/A	N/A	Considered in noise modelling software
On Time Correction	N/A	N/A	N/A	Considered in noise modelling software
Specific Sound Level	$L_{Aeq,T}$	41	25	Specific sound level at worst affected receptor calculated in CadnaA.
Acoustic feature correction	Tonality	0	0	1/3rd Octave band data not available.
	Intermittency	0	0	Normal use of the plant means that it is on constantly. As such, it is assumed that correction is not required.
	Impulsivity	0	0	Temple was not provided with information that the proposed plant will have impulsive sound features, but experience of similar equipment indicates that this is unlikely to be the case.
	Other Sound Characteristics	0	0	No other sound characteristics are known at this stage of the assessment.
Rating Level		41	25	Rating level including acoustic feature corrections
Excess of rating level over background sound level		-10	-23	The rating level is 10dB and 23dB below the day and night-time background sound levels respectively. The assessment indicates that the specific sound source is likely to have a low impact in accordance with BS4142 and is below the LOAEL during both the day and the night.
It should be noted that the above assessment assumes no correction for tonality, impulsivity, other distinctive acoustic character, or intermittency. Consequently, all sources should be controlled so that these issues are not present at noise sensitive locations or else corrections will need to be applied.				

Calculations undertaken have assumed omnidirectional radiation from all condenser units and therefore provide a worst-case assessment. In practice, the specific sound level is likely to be lower than stated at the nearest sensitive receptors due to the directionality of the units (which we were unable to account for in the model) and their layout (perpendicular to the nearest sensitive receptors).

7.0 Conclusion

Temple Group has been appointed by Thornton Reynolds Ltd to undertake a preliminary plant noise assessment for equipment proposed as a part of the redevelopment of Norfolk House.

Temple has carried out an unattended noise survey and calculations of the rating noise level of the proposed mechanical plant, which have been used to assess the effects of the noise levels on the nearest noise sensitive receptors. This has been assessed in line with the Camden Council guidance and relevant national standards.

The assessment indicates that the predicted rating noise level of the mechanical plant will be 10dB and 23dB below the typical background sound level at the nearest noise sensitive receiver during the day and night-time respectively. This equates to a low impact in accordance with BS 4142 and complies with the Camden Council criteria.

Appendix A. Acoustic Terminology

Noise/Sound

Noise and sound need to be carefully distinguished. Sound is a term used to describe wave-like variations in air pressure that occur at frequencies that can stimulate receptors in the inner ear and, if sufficiently powerful, be appreciated at a conscious level. Noise implies the presence of sound but also implies a response to sound: noise is often defined as unwanted sound.

Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic, and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 20 µPa) and the threshold of pain is around 120 dB.

Frequency, Hz

Frequency is the number of occurrences of a repeating event per unit second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is usually divided up into octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency. The bands are described by their centre frequency value. In environmental acoustics the ranges typically used are from 63 Hz to 8 kHz.

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Ambient sound

Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.

Ambient sound level ($LA_{eq,T}$)

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.

Background sound level ($LA_{90,T}$)

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90 % of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

Rating level

Specific sound level plus any adjustment for the characteristic features of the sound.

Reference time interval

Specified interval over which the specific sound level is determined. This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.

Residual sound

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Residual sound level ($LA_{eq,T}$)

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.

Specific sound level

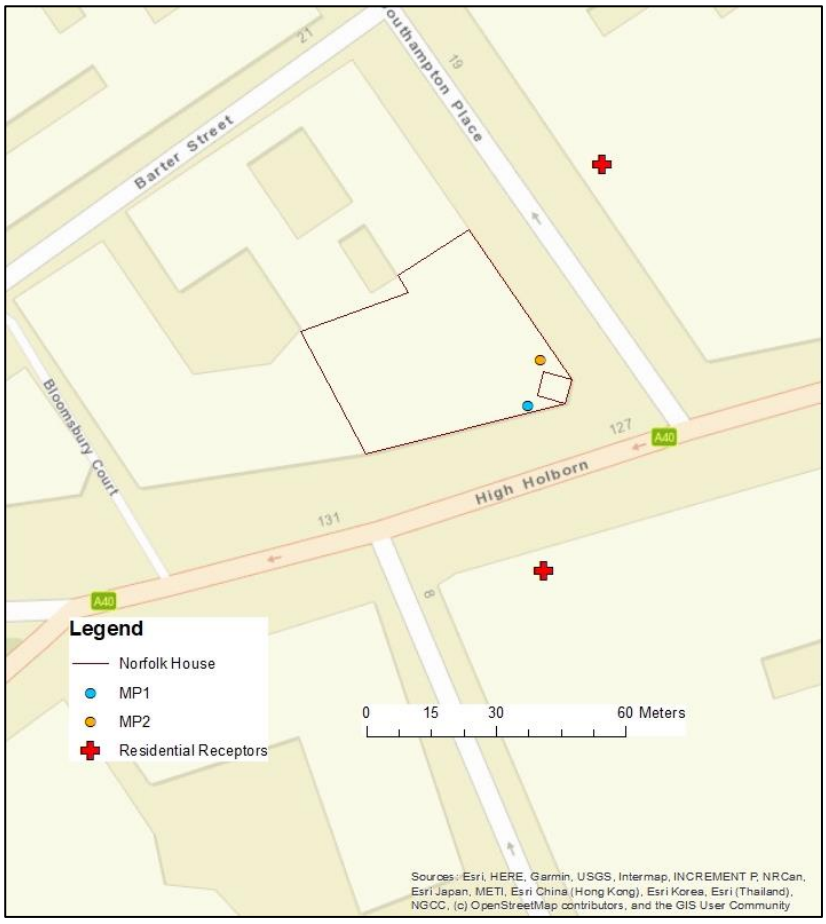
Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval.

Specific sound source

Sound source being assessed.

Appendix B. Current Site Layout and Measurement Positions

Figure B.1 Current site layout and survey locations.



Approximate position of the nearest noise sensitive receptors; properties above the Princess Louise and the other side of Southampton Place, are marked with a red cross.

Figure B.2 Measurement Position 1 (MP1), Southern boundary of Norfolk House facing the residential receptors on the opposite side of High Holborn above the Princess Louise Public House.

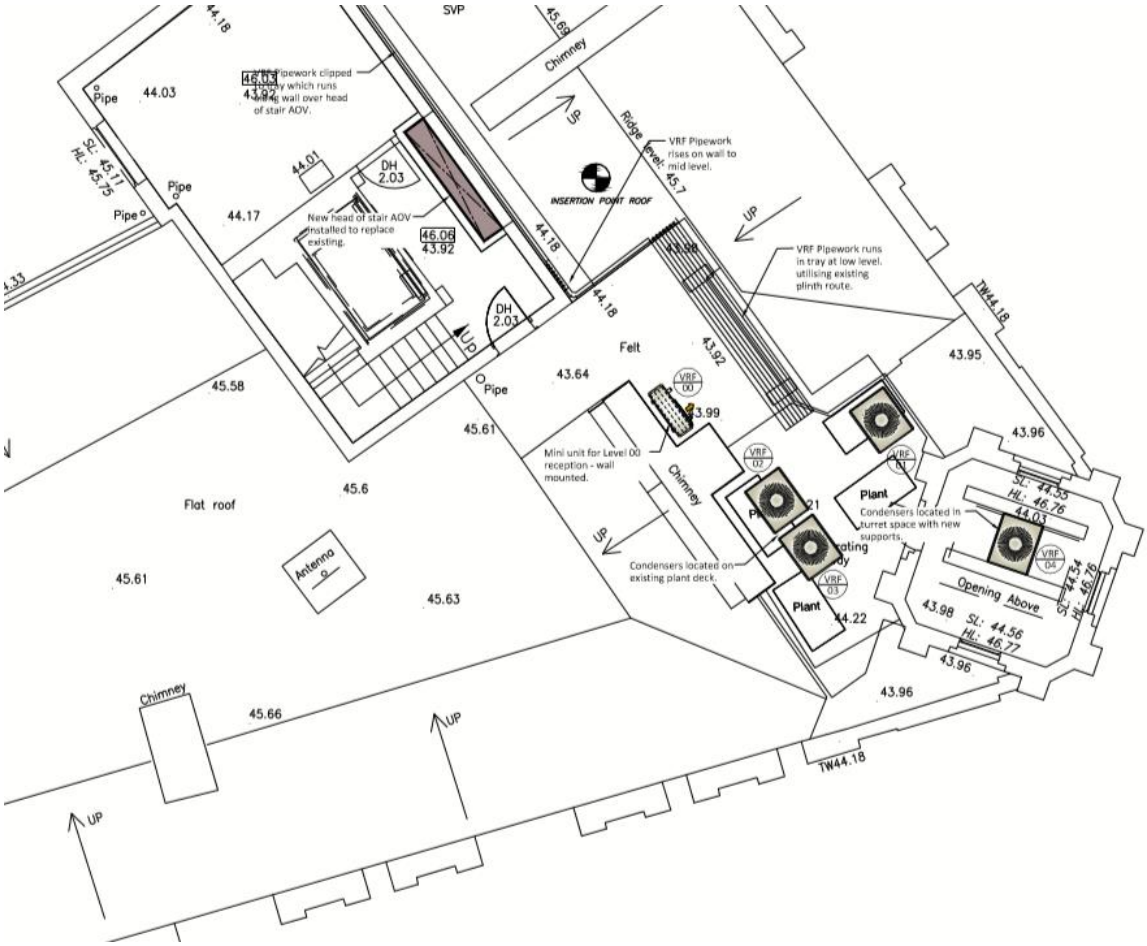
Existing plant shown in figure above was switched off throughout the survey period.

Figure B.3 Measurement Position 2 (MP2), Eastern boundary of Norfolk House facing the residential receptors on the opposite side of Southampton Place.

Existing plant shown in figure above was switched off throughout the survey period

Appendix C. Layout of Proposed Plant

Figure C.1 – Proposed Plant



Appendix D. Preliminary Plant Data

Figure D.1 P300 Condensers

SPL (dBA)

	Fan Speed Setting	Capacity	P200		P250		P300		P350		P400		P450		P500		P550	
			SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling
Foot Print (W x D) mm			920 x 740		920 x 740		920 x 740		1240 x 740		1240 x 740		1240 x 740		1750 x 740		1750 x 740	
Cooling	100%	100%	59	20	60.5	25.1	61	30	62.5	35.8	65	40.3	65.5	44.8	63.5	50.1	66	56.4
	85%	90%	52	18	54.5	22.6	55.5	27	57	32.2	58	36.3	59.5	40.3	58	45.1	59.5	50.8
	70%	75%	47.5	15	50.5	18.8	51.5	22.5	54	26.9	54	30.2	55	33.6	55	37.6	56	42.3
	60%	70%	45	14	47.5	17.6	48.5	21	51.5	25.1	53	28.2	54	31.4	54	35.1	54	39.5
	50%	60%	44	12	45	15.1	47	18	49	21.5	52	24.2	53	26.9	53	30.1	53	33.8

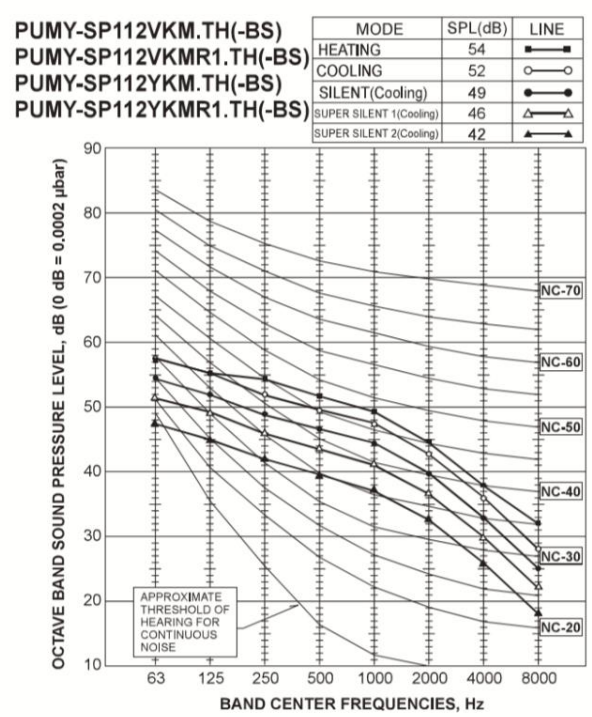
	Fan Speed Setting	Capacity	P200		P250		P300		P350		P400		P450		P500		P550	
			SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling	SPL (dBA)	kW cooling
Foot Print (W x D) mm			920 x 740		920 x 740		920 x 740		1240 x 740		1240 x 740		1240 x 740		1750 x 740		1750 x 740	
Heating	100%	100%	59	22.8	61	28.7	67	34.1	64	41	69	43	70	48.2	64.5	54.2	70	59.3
	85%	90%	55.5	20.5	57	25.8	59.5	30.7	62	36.9	61	38.7	64	43.4	62	48.8	63.5	53.4
	70%	75%	52.5	17.1	55.5	21.5	55.5	25.6	58	30.8	56	32.3	57.5	36.2	58.5	40.7	59.5	44.5
	60%	70%	50	16.0	53.5	20.1	53	23.9	55.5	28.7	52.5	30.1	54	33.7	56	37.9	57	41.5
	50%	60%	44	13.7	48	17.2	50.5	20.5	52	24.6	52	25.8	53	28.9	53.5	32.5	53.5	35.6

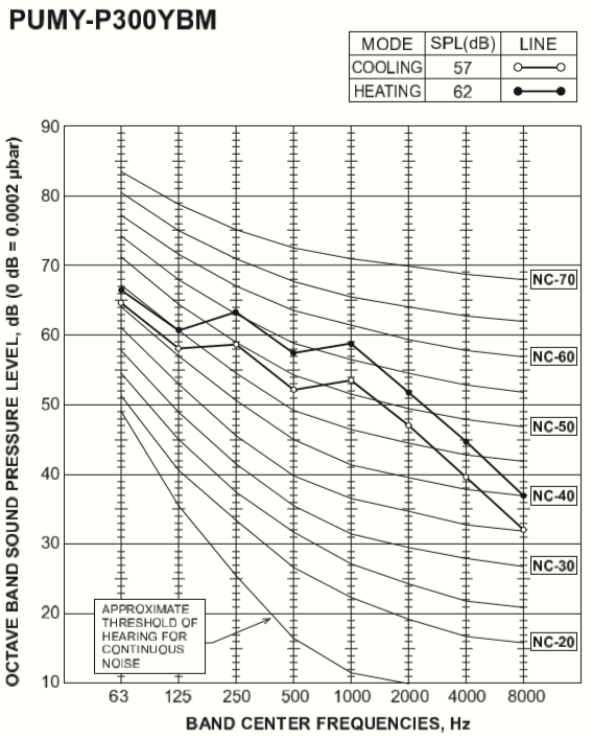
PWL (dBA)

	Fan Speed Setting	Capacity	P200		P250		P300		P350		P400		P450		P500		P550	
			PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling
Foot Print (W x D) mm			920 x 740		920 x 740		920 x 740		1240 x 740		1240 x 740		1240 x 740		1750 x 740		1750 x 740	
Cooling	100%	100%	76	20	78.5	25.1	80	30	81	35.8	83	40.3	83	44.8	82	50.1	83.5	56.4
	85%	90%	71	18	73.5	22.6	74.5	27	76	32.2	77	36.3	78.5	40.3	76.5	45.1	78	50.8
	70%	75%	66.5	15	69.5	18.8	70.5	22.5	73	26.9	73	30.2	74	33.6	73.5	37.6	74.5	42.3
	60%	70%	64	14	66.5	17.6	67.5	21	70.5	25.1	72	28.2	73	31.4	73	35.1	73	39.5
	50%	60%	63	12	64	15.1	66	18	68	21.5	71	24.2	72	26.9	72.5	30.1	72.5	33.8

	Fan Speed Setting	Capacity	P200		P250		P300		P350		P400		P450		P500		P550	
			PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling	PWL (dBA)	kW cooling
Foot Print (W x D) mm			920 x 740		920 x 740		920 x 740		1240 x 740		1240 x 740		1240 x 740		1750 x 740		1750 x 740	
Heating	100%	100%	78	22.8	80	28.7	86.5	34.1	83	41	88	43	89	48.2	84	54.2	89	59.3
	85%	90%	74.5	20.5	76	25.8	78.5	30.7	81	36.9	80	38.7	83	43.4	81	48.8	82.5	53.4
	70%	75%	71.5	17.1	74.5	21.5	74.5	25.6	77	30.8	75	32.3	76.5	36.2	77.5	40.7	78.5	44.5
	60%	70%	69	16.0	72.5	20.1	72	23.9	74.5	28.7	71.5	30.1	73	33.7	75	37.9	76	41.5
	50%	60%	63	13.7	67	17.2	69.5	20.5	71	24.6	71	25.8	72	28.9	73	32.5	73	35.6

Figure D.2 Condensers





Appendix E. Measurement Data and Weather Data

Figure E.1 - Wind Speed and Precipitation Values for the period 28/04/21 - 04/05/21

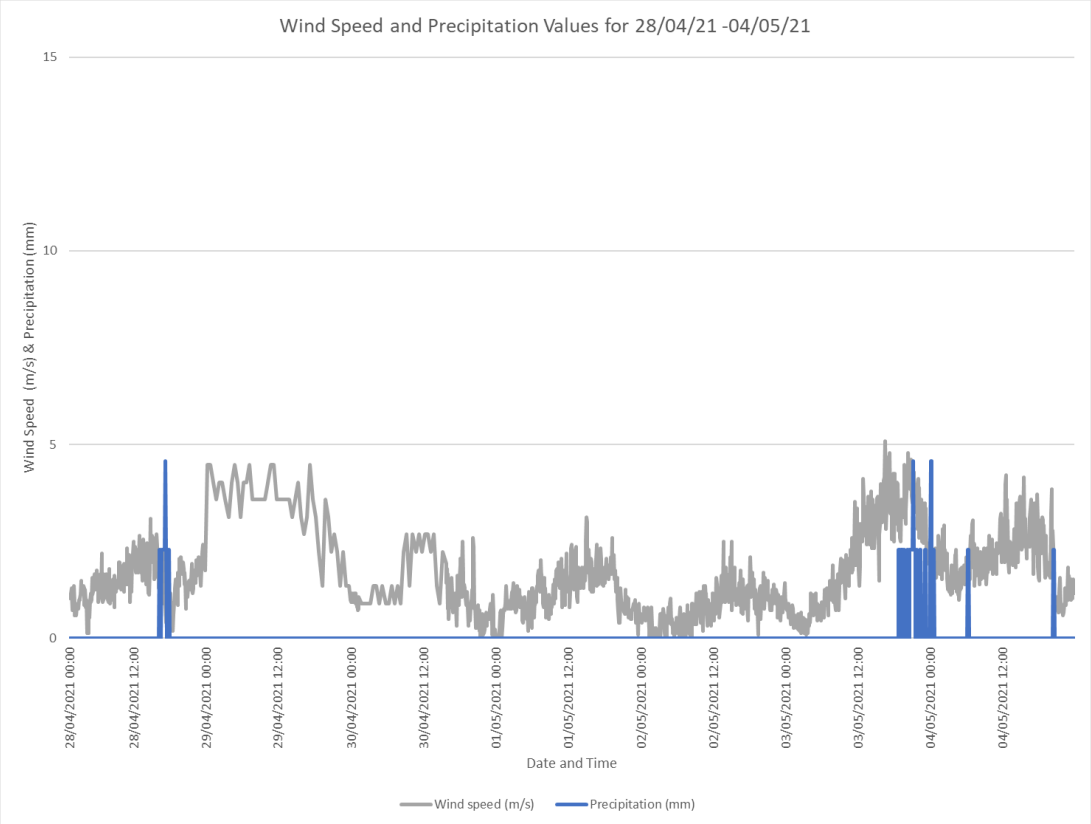
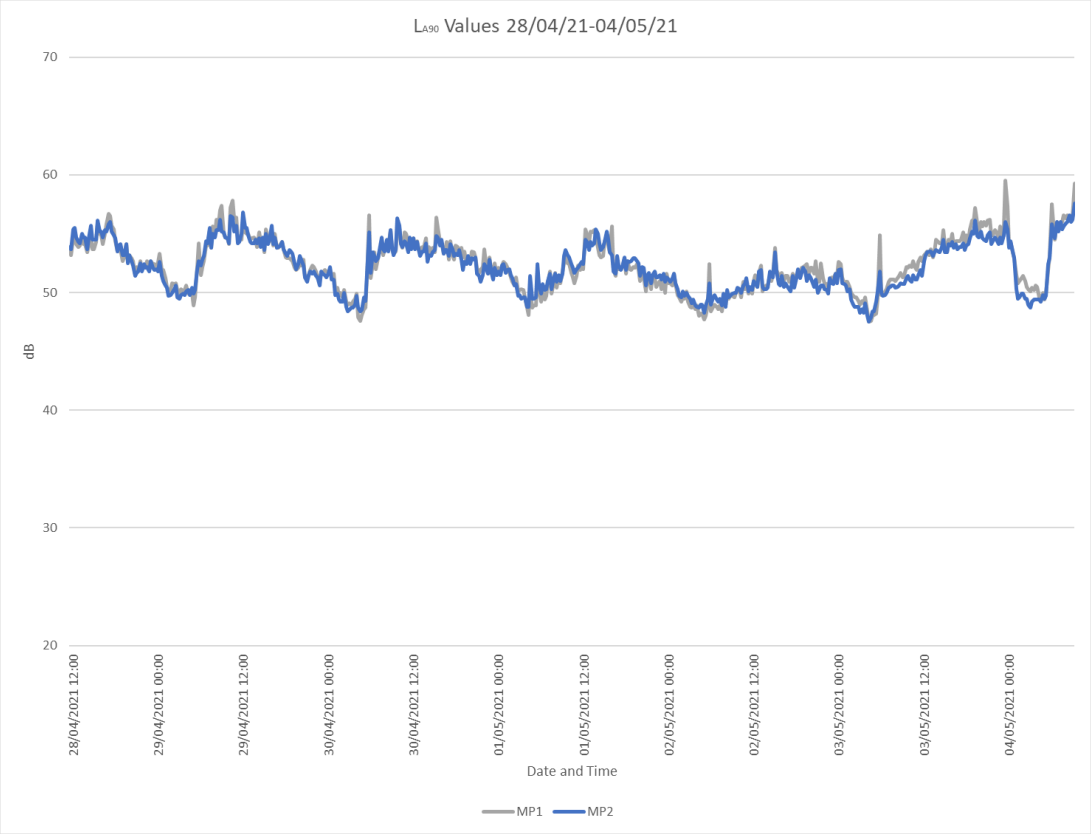


Figure E.2 - L_{A90} Values for the period 28/04/21 - 04/05/21



Appendix F. $L_{A90,\ 15mins}$ Statistical Analysis

Figure F.1 - Statistical analysis of the daytime (07:00-23:00) L_{A90} measurements to determine background sound level at MP1.

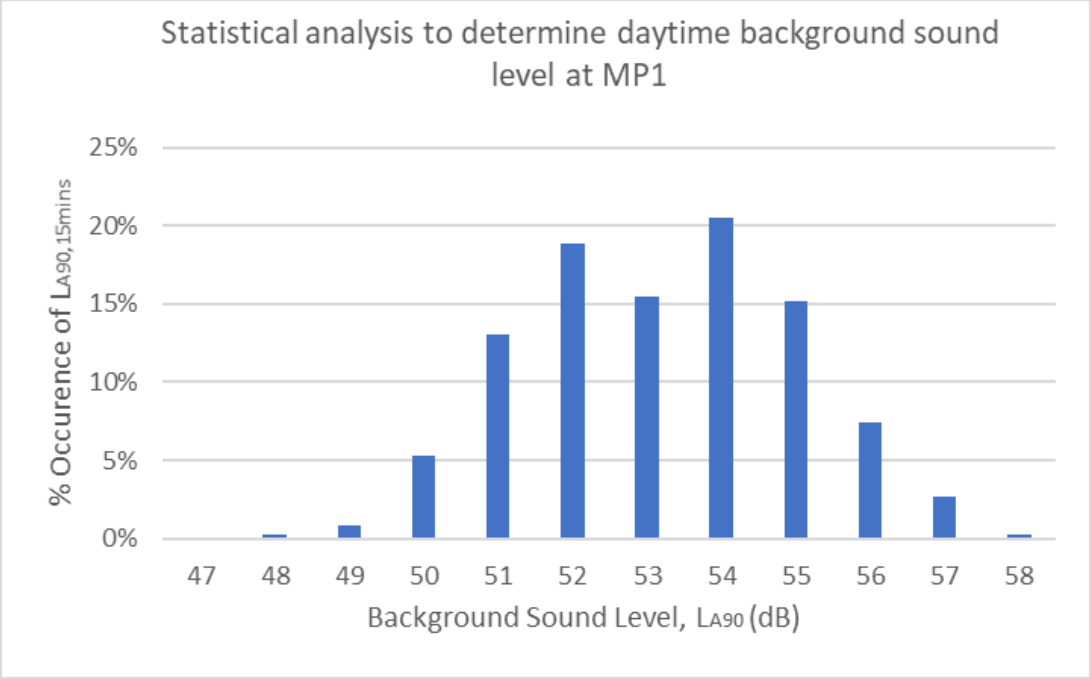


Figure F.2 - Statistical analysis of the night-time (23:00-07:00) L_{A90} measurements to determine background sound level at MP1.

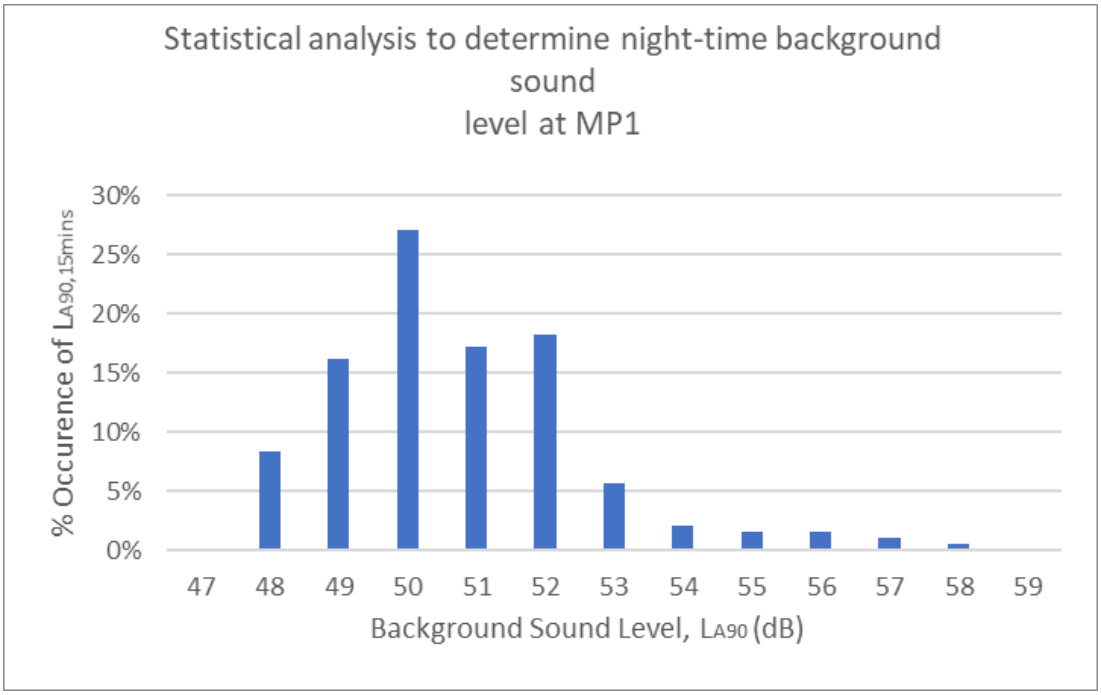


Figure F.3 - Statistical analysis of the daytime (07:00-23:00) L_{A90} measurements to determine background sound level at MP2.

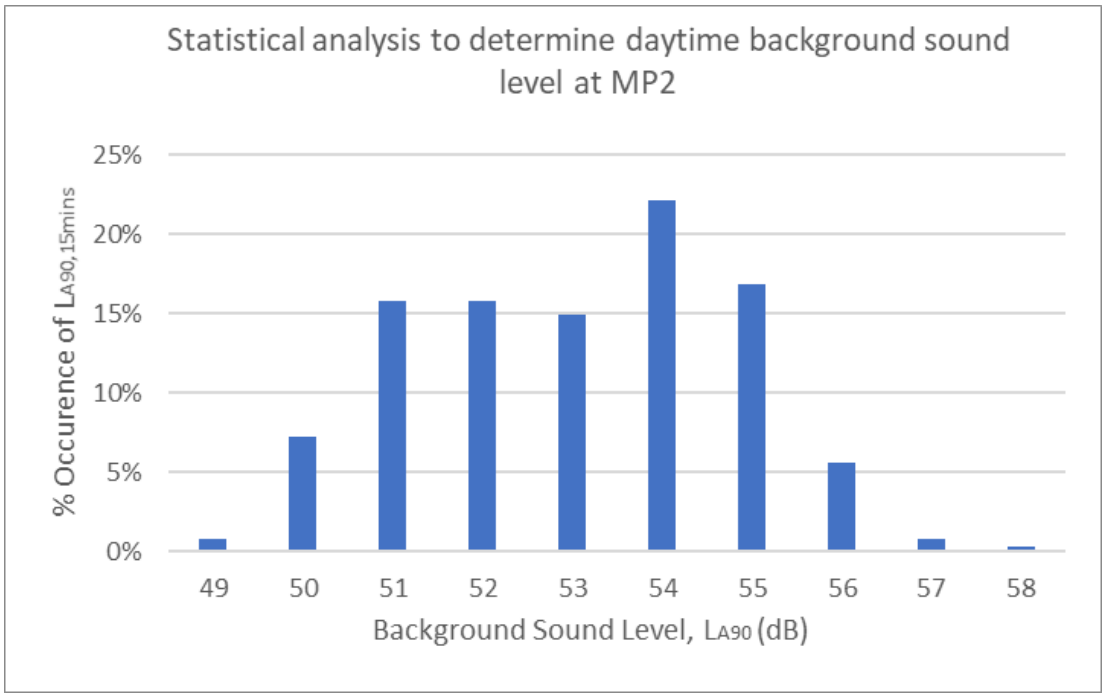
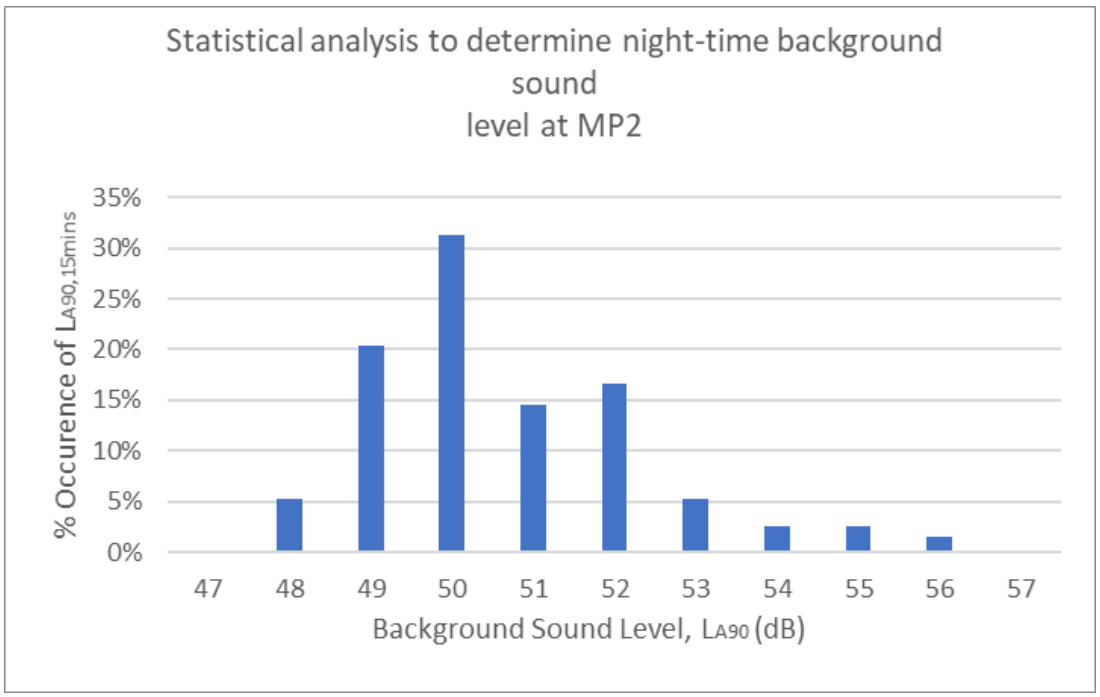


Figure F.4 - Statistical analysis of the night-time (23:00-07:00) L_{A90} measurements to determine background sound level at MP2.



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