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Kilburn Grange Children's Centre

Acoustic Impact Assessment

Camden Council

3 April 2019

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1. Introduction

Atkins Acoustics, Noise and Vibration (Atkins ANV) has been commissioned by Camden Council to undertake an assessment of the acoustic impact from new/repositioned air conditioning and ventilation plant proposed as a part of refurbishment and extension works to the office areas at Kilburn Grange Children's Centre (KGCC), Camden.

The purpose of this assessment is to support the planning application for the project. The assessment has been carried out in accordance with the requirements of Camden Council, and it is based on an environmental noise survey carried out on site.

A glossary of acoustic terminology used in this report is provided in Appendix A.

2. Planning Policy, Standards and Guidance

The national and local planning policy documents pertinent to this assessment are the National Planning Policy Framework (NPPF), the National Policy Statement for England (NPSE), and Camden Local Plan (2017). The relevant technical guidance is provided in British Standard 4142:2014 "Methods for rating and assessing industrial and commercial sound" (BS 4142). A detailed summary of the relevant sections of these documents is included in Appendix B, with an outline provided below. Further guidance has been provided at the pre-planning stage by Camden Council, as detailed further below.

2.1. National Planning Policy Framework

NPPF provides the basis for the production of local development plans by local authorities. In relation to noise, the plans should include provisions for the developments to achieve the following aims:

- Mitigate and reduce to a minimum, potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

The terms 'adverse impacts' and 'significant adverse impacts' are defined within the explanatory note of the Noise Policy Statement for England (NPSE).

2.2. National Policy Statement for England

NPSE provides guidance on the underlying principles and aims related to management of noise within the context of the Government's policy of sustainable development. The NPSE defines the following key concepts related to noise impacts:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

The policy does not define a single object noise-based measure of SOAEL – this level has to be identified taking into account the type of sound sources, type of receptors and times of exposure.

2.3. Camden Local Plan 2017

The current planning requirements for new industrial and commercial (non-anonymous) noise sources proposed within the Camden area are specified in Appendix 3: Noise thresholds of Camden Local Plan 2017. The relevant day-time design period requirements for dwellings are summarised below:

- It is recommended that the current BS 4142 guidance is used as a reference standard when assessing non-anonymous sound of industrial or commercial nature.
- A rating level of at least 10 dB below background sound level at the existing sensitive receptors such as residential dwellings should be considered as the acoustic design criterion, unless the assessed sound contains audible tonal elements in which case a 'rating level' of 15 dB below the background sound level should be used. These thresholds are classified as the Lowest Observed

Adverse Effect Levels (LOAELs), at which noise is considered to be acceptable ('Green' design criterion).

- A rating level between 9 dB below and 5 dB above background sound level is classified as being between the LOAEL and the Significant Observed Adverse Effect Level (SOAEL), where noise is observed to have an adverse effect level but may be considered acceptable when assessed in the context of other merits of the development ('Amber' design criterion).
- A rating level greater than 5 dB above background is classified SOAEL, where noise is observed to have a significant adverse effect ('Red' design criterion).
- The potential sensitive receptors include residential gardens and habitable residential rooms (living or dining rooms, bedrooms). For daytime operation (between 0700 and 2300) the noise should be assessed in gardens if used for main amenity, and outside the windows of any habitable rooms.

2.4. BS 4142

BS 4142 refers to the sound produced by an assessed source at a noise 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' ($L_{Aeq,T}$).

Where certain acoustic features are present in the source's sound 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".

The procedure contained in BS 4142 assesses the significance of sound by determining the margin by which the rating level of the specific sound sources exceeds the background sound level, and by examining 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.

2.5. Pre-Planning Guidance

Further guidance in relation to noise emissions from the proposed plant has been provided at the pre-planning stage by Laura Hazelton, a Senior Planning Officer at Camden Council. The guidance was included in an e-mail dated 30/10/2018, which states the following:

"During our site visit, it was mentioned that the existing external air conditioning unit would need to be moved as a result of the works. Development involving the installation, alteration or replacement of plant, ventilation, extraction or air conditioning equipment, will require a noise, vibration and ventilation assessment to be submitted with your planning application. This should include the following information:

- *existing background noise levels measured over a 24-hour period (including the cumulative noise levels of all existing units)*
- *proposed background noise levels (including the cumulative noise levels of all proposed units)*
- *any proposed measures to reduce noise, fume emissions and vibration*

- *the system manufacturers specification of the proposed equipment to be installed, altered or replaced*
- *details of the method used to compile the report and examples of the calculations and assumptions made.*

The noise impact assessment must demonstrate that the new plant would comply with Camden's noise standards (policy A4) which state that the external noise level emitted from plant, machinery or equipment shall be lower than the lowest existing background noise level by at least 10dBA, or by 15dBA where the source is tonal, as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises (with all machinery operating together at maximum capacity). If this is not achievable, then the Council would expect suitable noise attenuation measures to reduce the noise levels of the proposed plant. Details of any necessary mitigation measures should also be supplied with the full planning application."

3. Baseline Conditions

3.1. Site Overview

A plan of the site and the neighbouring properties is shown in Figure 3-1 below.

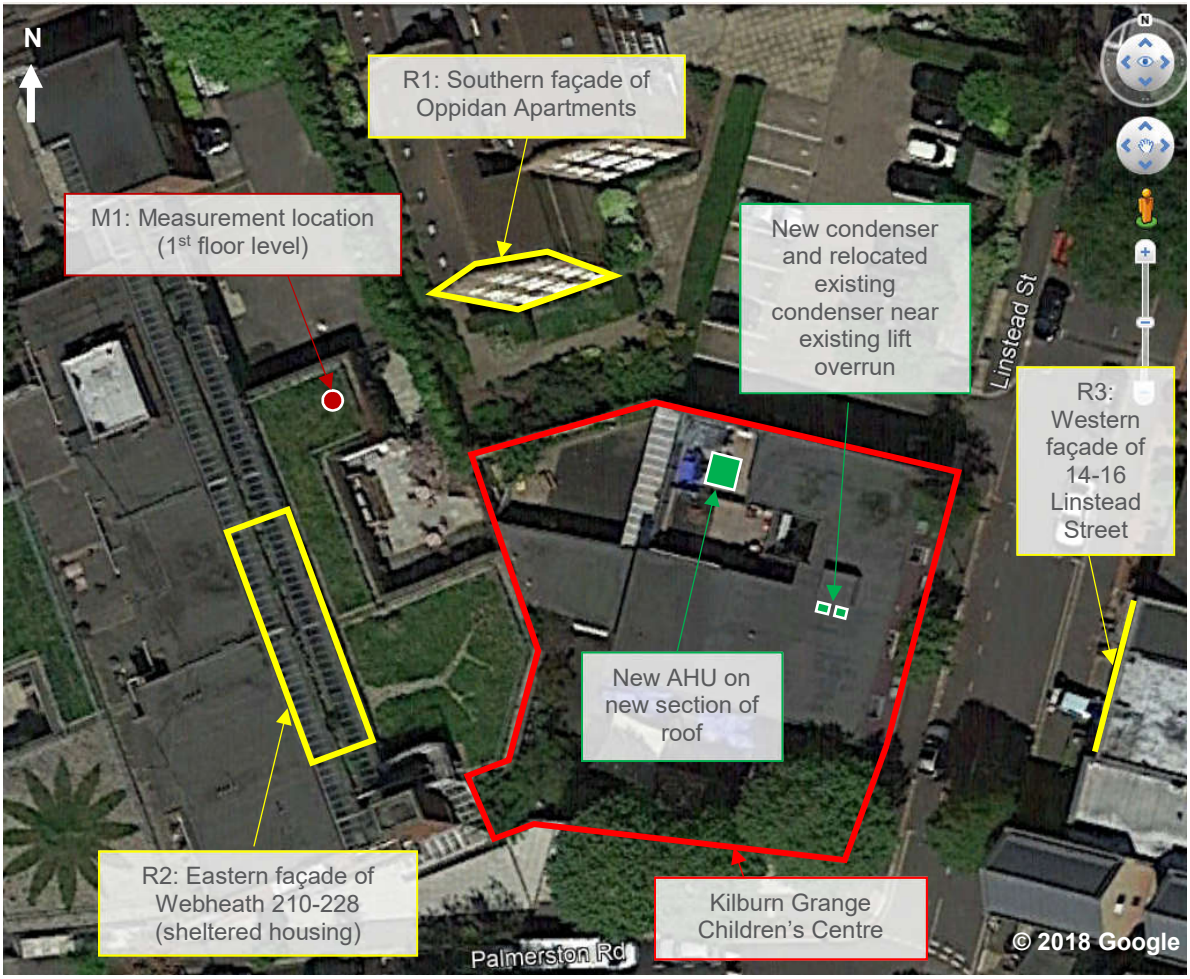


Figure 3-1 – Site plan

KGCC is located in a predominantly residential area of Camden.

The project proposals include relocation of a condenser located on the existing roof terrace at the northern boundary of the site to the main building roof by the lift overrun. An additional condenser is proposed to be positioned alongside the relocated unit. A new air handling unit (AHU) is also proposed on the new section of the roof. The detailed plant layouts on the roof are shown in Figure C-1 and Figure C-2 in Appendix C.

It is understood that the plant will be operational between 0800-1800 on weekdays only.

Sensitive receptors that have the potential to be most affected by sound from the condensers will be as follows:

- Receptor R1: 1st and 2nd floor windows on the southern façade of Oppidan Apartments, a three-storey residential building, located to the north from the proposed plant.
- Receptor R2: 2nd floor windows on the eastern façade of the sheltered housing of 210-228 Webheath, a residential complex occupying the first and second floors of a three-storey building, located to the west from the proposed plant.

- Receptor R3: 2nd floor windows on the western façade of a three-storey residential building of 14-16 Linstead Street, located to the east from the proposed plant.

The proposed condensers will be acoustically screened by the lift overrun with respect to receptor R1. In all other instances, the proposed plant will be within the line of sight to the above receptors.

All other sensitive receptors will be subject to lower levels of sound from the proposed plant as they will be located further afield from the plant items and benefit from additional acoustic screening.

3.2. Acoustic Measurements

To provide the basis for the assessment, an acoustic survey has been carried out at the site. The measurement methodology and results are presented below.

3.2.1. Measurement Methodology

The purpose of the measurements was to obtain ambient and background sound data that is representative of the closest noise sensitive receptors R1, R2 and R3, expressed in terms of $L_{Aeq,1hour}$ and $L_{A90,1hour}$ indices respectively, during the proposed period of plant operation.

Unattended measurements were undertaken during a typical weekday period between approximately 1000 hours on Thursday 27th September 2018 and approximately 1600 hours on Friday 28th September 2018. The measurements were carried out at a location indicated in Figure 3-1 above, described as follows:

- Position M1: on the first-floor level roof terrace, approximately 10-15 metres from receptors R1 and R2.

The microphone was located approximately 1.5 metres above the mounting surface and more than 3.5 metres from any other significant reflecting surface. The measurements thus represent free-field conditions.

The weather was suitable for sound measurements, with conditions being dry with low winds throughout the survey.

3.2.2. Measurement Instrumentation

The instrumentation used for the measurements is listed in Table 3-1 below. All equipment has Class 1 accuracy and holds the current UKAS calibration certificates (available upon request). An acoustic calibrator was used before and after the measurements to calibrate the sound level meter, with no significant differences noted in levels.

Table 3-1 – Instrumentation used for sound measurements

Equipment item	Type	Serial number	Date of calibration	Calibration certificate
Sound Level Meter	01dB FUSION	11200	27/10/2016	CV-DTE-L-16-PVE-43994
Microphone	GRAS 40CE	226400	27/10/2016	CV-DTE-L-16-PVE-43994
Pre-amplifier	01dB Pre No22	1605098	27/10/2016	CV-DTE-L-16-PVE-43994
Calibrator	01dB CAL21	2385276	01/02/2018	03629/1

3.2.3. Measurement Results

The most significant sound sources on site were as follows:

- Local and distant road traffic;
- Rail traffic along the line approximately 100 metres to the north from the measurement location;
- Intermittent day-time children's activity on the KGCC playgrounds.

Table 3-2 below shows the results of the sound measurements for the relevant period of plant operation, between 0800-1800 hours. The lowest background sound level of 43 dB $L_{A90,1hour}$ was recorded between 1700-1800 hours.

A full history of the measured levels in tabular and graphical forms is included in Appendix D.

Given the proximity of receptors R1 and R2 to the measurement location, they will be exposed to similar sound sources and levels. Receptor R3 is located further away from the measurement location, but it will be subject to similar levels given the noise climate does not vary significantly around the building.

The measurements are therefore considered representative of all the receptors.

Table 3-2 – Measured ambient and background sound levels at position M1

Date / time	Ambient sound $L_{Aeq,1hour}$ (dB)	Background sound $L_{A90,1hour}$ (dB)
27/09/2018 10:00	54	47
27/09/2018 11:00	52	46
27/09/2018 12:00	51	44
27/09/2018 13:00	52	46
27/09/2018 14:00	55	46
27/09/2018 15:00	49	44
27/09/2018 16:00	50	44
27/09/2018 17:00	51	43
28/09/2018 08:00	52	44
28/09/2018 09:00	54	48
28/09/2018 10:00	55	47
28/09/2018 11:00	56	47
28/09/2018 12:00	57	47
28/09/2018 13:00	53	46
28/09/2018 14:00	56	46
28/09/2018 15:00	52	45

4. Acoustic Impact Assessment

4.1. Plant Specification

The assessed plant items are as follows:

- Existing relocated condenser: Mitsubishi PUHZ-P100VHA4;
- Proposed new condenser: Mitsubishi PUHZ-RP100YKA3;
- Proposed new AHU: Nuaire XBC45-H-NCO.

The sound levels for the above plant items, as published by the manufacturers, are included in Appendix E.

Based on the available octave-band sound pressure/power data and previous experience with similar types of condensers, the selected plant items are considered not to have any distinctive tonal characteristics. The AHU noise will not have any tonal characteristics at the receptors, as the unit will be fitted with high performance sound attenuators which will attenuate any potential spectral peaks in the fan sound (see Section 4.3 below).

The plant sound will also not be impulsive. The units are inverter controlled, which eliminates the stop-start cycles that could attract attention due to distinctive intermittent operation.

No acoustic feature corrections will therefore be applied to the calculated specific sound levels.

The condensers are proposed to be used both for cooling and heating.

4.2. Assessment Criteria

Based on the above acoustic characteristics, in accordance with the Camden Council guidance, the plant items must not exceed the cumulative sound level of -10 dB below the lowest existing background sound level at the closest or most affected receptors to satisfy the 'Green' design criterion. The required plant sound rating level limit is shown in Table 4-1 below. The limit is based on the lowest background sound level recorded within the proposed plant operation period.

Table 4-1 – Cumulative plant sound level limit based on the Camden Council's 'green' design criterion

Background sound level at receptors R1-R3, $L_{A90,1hour}$	'Green' design criterion	Plant sound rating level limit at receptors R1-R3, $L_{Ar,1hour}$
43 dB	-10 dB	33 dB

4.3. Acoustic Mitigation

To meet the above criterion at the receptors, acoustic mitigation is required to nullify the effect of reflections from the nearby walls on the condenser sound levels. This will be achieved by applying a Class A acoustically absorptive wall lining to the wall immediately behind the condensers, as indicated in Figure C-1 in Appendix C. The wall lining should cover the entire wall area. Typical products to achieve the required acoustic performance are 50-100 mm thick.

To control the AHU fresh air inlet and exhaust noise, in-line attenuators are included in the external ductwork as shown in Figure C-1 in Appendix C. These attenuators will provide between 15-26 dB of

sound attenuation. Attenuators are also included in the supply and extract ducts to control the noise from room-side duct terminations.

4.4. BS 4142 Assessment

Tables in Appendix F show the summary plant sound level calculations at receptors R1, R2 and R3. The calculations include the effect of acoustic mitigation specified in Section 4.3, and are based on the worst-case assumptions:

- Condensers operating in the heating mode (higher sound levels compared to the cooling mode);
- All plant items operating simultaneously at full capacity, and continuously throughout the 1-hour reference period;

Table F-3, Table F-6 and Table F-9 in Appendix F show the cumulative sound levels at receptors R1, R2 and R3, respectively. A BS4142 assessment of these levels is shown in Table 4-2, Table 4-3 and Table 4-4 below.

In accordance with BS 4142, a one-hour reference period is used. As per discussion in Section 4.1, no acoustic feature corrections have been applied to the calculated specific sound levels to obtain the sound rating levels.

Table 4-2 – BS4142 assessment of the worst-case sound rating level at receptor R1

Description	Results
Specific sound level at the receptor, $L_{Aeq,1hour}$	26 dB
Acoustic feature correction	0 dB
Rating level at receptor, $L_{Ar,1hour}$	26 dB
Background sound level at the receptor, $L_{A90,1hour}$	43 dB
Excess of rating level over background level	(26 – 43) dB = -17 dB
Assessment result at the receptor	Assessment indicates low acoustic impact

Table 4-3 – BS4142 assessment of the worst-case sound rating level at receptor R2

Description	Results
Specific sound level at the receptor, $L_{Aeq,1hour}$	28 dB
Acoustic feature correction	0 dB
Rating level at receptor, $L_{Ar,1hour}$	28 dB
Background sound level at the receptor, $L_{A90,1hour}$	43 dB
Excess of rating level over background level	(28 – 43) dB = -15 dB
Assessment result at the receptor	Assessment indicates low acoustic impact

Table 4-4 – BS4142 assessment of the worst-case sound rating level at receptor R3

Description	Results
Specific sound level at the receptor, $L_{Aeq,1hour}$	33 dB
Acoustic feature correction	0 dB
Rating level at receptor, $L_{Ar,1hour}$	33 dB
Background sound level at the receptor, $L_{A90,1hour}$	43 dB
Excess of rating level over background level	(33 – 43) dB = -10 dB
Assessment result at the receptor	Assessment indicates low acoustic impact

It can be seen from the tables above that the predicted worst-case plant sound rating levels are significantly below the lowest existing background sound level at the most affected residential receptors, which indicates low acoustic impact according to BS 4142. As shown in Table 4-5 below, the rating levels are also below or equal to the 'Green' design criterion. At these levels noise is considered to be at an acceptable level and remains below the Lowest Observed Adverse Effect Level (LOAEL). The predicted sound levels therefore satisfy the Camden Council's planning requirements.

Table 4-5 – Comparison of the predicted worst-case sound rating level with Camden Council's planning requirements

Receptor	Predicted sound rating level $L_{Ar,1hour}$	Sound rating level limit, $L_{Ar,1hour}$
R1	26 dB	33 dB
R2	28 dB	
R3	33 dB	

4.5. Uncertainty

The level of uncertainty in the above results is low. There is some inherent uncertainty in the following:

- Specific and rating sound level predictions.
- Establishing background sound levels at the receptors.

The effect of these uncertainties on the assessment results has been minimised by the following:

- Considering the worst-case plant operation and assessment locations and applying conservative sound reduction values. The rating levels were established considering the plant's technical features, based on previous experience with similar units.
- Measurements were undertaken at a suitable representative location, which was selected taking into account all sources of noise that have a significant effect on the measured background sound levels. The measurement period covered two typical working days to reduce the effect of background sound level variability on the result. The assessment was based on the lowest background noise level recorded in the proposed period of plant operation to represent the worst-case.

5. Conclusions

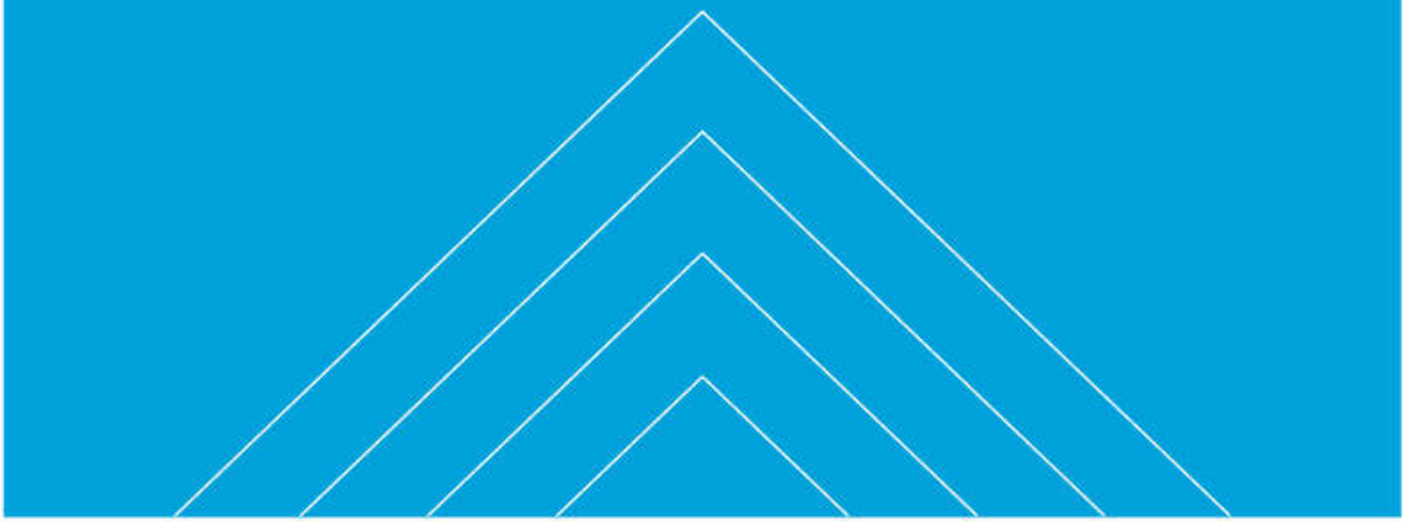
Atkins ANV has been commissioned to assess the acoustic impact from repositioned/new plant proposed as a part of planned office refurbishment and extension works at Kilburn Grange Children's Centre.

The assessment serves to support the planning application for the project and has been undertaken in accordance with the requirements of Camden Council. The assessment was carried out using the BS 4142 methodology, based on the results of an acoustic survey undertaken on site.

For the plant noise to satisfy the planning requirements of Camden Council, acoustic mitigation in the form of an acoustic lining applied to the external wall behind the condensers is proposed. Sound attenuators are also proposed to be included in the AHU's ductwork. With this mitigation in place, the BS 4142 assessment of the predicted worst-case plant sound levels indicates low acoustic impact at the nearest residential receptors. Furthermore, the predicted sound levels remain below the Lowest Observed Adverse Effect Level (LOAEL) with respect to Camden Council's planning requirements, thus satisfying the 'Green' design criterion where sound is considered to be at an acceptable level.

It can therefore be concluded that, with the proposed acoustic mitigation in place, sound emissions should not constitute a constraint with regards to the planning application for the proposed plant.

Appendices



Appendix A. Acoustic Terms

Decibel (dB)

The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear. The threshold of hearing is 0 dB and the threshold of pain is 120 dB. In practical terms these limits are seldom experienced and typical levels lie within the range 30 dB (a quiet night time level in a bedroom) to 90 dB (at the kerbside of a busy city street).

A-weighting

An electrical frequency weighting used to represent the response of the human hearing mechanism to sound. A-weighted sound level is indicated either by placing the capital letter A after the letters dB to get dB(A) or it may be added as a subscript to the sound level parameter as in $L_{Aeq,T}$.

Percentile Level (Statistical Sound Level Indices, L_{AN}, L_{A10}, 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 sound level. L_{A10}, the level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise.

Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$)

Equivalent continuous A-weighted sound pressure level is the steady sound level that has the same sound energy as the fluctuating A-weighted sound pressure level occurring over the same time period and at the same location.

Free-Field (acoustical)

Free-field means a position far away from any reflecting surfaces other than the ground. Several standards and guidelines recommend that to achieve free field conditions the microphone should be positioned at least 3.5 metres from any reflecting surfaces, other than the ground.

Facade Sound Level

A facade sound level is determined 1 metre in front of the most exposed window or door in a building facade. Sounds reflect on the façade of the building back towards the point 1 metre in front. The effect of the reflection is to produce a slightly higher (+2.5 dB) sound level than it would be if the building was not there.

Appendix B. Planning Policy, Legislation and Guidance

B.1. National Planning Policy Framework, 2019

The National Planning Policy Framework (NPPF), which reflects the Noise Policy Statement, was introduced by the Department of Communities and Local Government (DCLG) in March 2012 and subsequently revised. The document sets out the Government's planning policies for England and how these are expected to be applied.

The NPPF provides for the production of distinctive local and neighbourhood plans by local authorities, in consultation with local people, which should be developed to reflect the needs and priorities of their communities.

The NPPF includes the following statements relating to noise and the requirement to take it into account in the planning process:

Section 170 indicates that the planning system should contribute to and enhance the natural and local environment by:

"*preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans*;"

Section 180 is specifically related to noise, according to which, planning policy decisions should aim to:

- Mitigate and reduce to a minimum, potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

The terms 'adverse impacts' and 'significant adverse impacts' are defined within the explanatory note of the Noise Policy Statement for England (NPSE).

B.2. National Policy Statement for England, 2010

The Noise Policy Statement for England (NPSE) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace. The Government recognises that the effective management of noise requires a co-ordinated and long-term approach that encompasses many aspects of modern society.

The long-term vision of Government noise policy is set out: "Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

This long-term vision is supported by three aims:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and,

- where possible, contribute to the improvement of health and quality of life.

In its aims the NPSE uses the key phrases “significant adverse” and “adverse”. The NPSE states in its explanatory note that “there are two established concepts from toxicology that are currently being applied to noise impacts, for example by the World Health Organisation (WHO). They are:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

- The NPSE then extends this concept to include:

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

The policy notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is therefore necessary for the project to identify relevant SOAELs taking account of the different sources of exposure and different receptors.

B.3. Camden Local Plan 2017

The Camden Council’s planning noise requirements pertinent to this application are included in *Appendix 3: Noise thresholds* of Camden Local Plan 2017 which has been adopted by the council on 3 July 2017. The relevant sections of this appendix are presented below.

“The significance of noise impact varies dependent on the different noise sources, receptors and times of operation presented for consideration within a planning application. Therefore, Camden’s thresholds for noise and vibration evaluate noise impact in terms of various ‘effect levels’ described in the National Planning Policy Framework and Planning Practice Guidance:
• NOEL – No Observed Effect Level
• LOAEL – Lowest Observed Adverse Effect Level
• SOAEL – Significant Observed Adverse Effect Level
Three basic design criteria have been set for proposed developments, these being aimed at guiding applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The design criteria outlined below are defined in the corresponding noise tables. The values will vary depending on the context, type of noise and sensitivity of the receptor:
• Green – where noise is considered to be at an acceptable level.
• Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
• Red – where noise is observed to have a significant adverse effect.”

*“**Industrial and Commercial Noise Sources***
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 (15dB if tonal components are present) should be considered as the design criterion.

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*	*Day*	*'Rating level' 10 dB* below background*	*'Rating level' between 9 dB below and 5 dB above background*	*'Rating level' greater than 5 dB above background*
*Dwellings***	*Outside bedroom window (façade)*	*Night*	*'Rating level' 10 dB* below background and no events exceeding 57 dB L_{Amax}*	*'Rating level' between 9 dB below and 5 dB above background or noise events between 57 dB and 88 dB L_{Amax}*	*''Rating level' greater than 5 dB above background and/or events exceeding 88 dB L_{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 (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area."

B.4. BS 4142:2014 “Methods for rating and assessing industrial and commercial sound”

This assessment has been undertaken with reference to British Standard 4142: 2014 “Methods for rating and assessing industrial and commercial sound” (BS 4142).

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of noise amounting to a nuisance is beyond the scope of the standard.

The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level and the context in which the sound occurs/will occur.

The reference time interval for the specific sound source ‘Tr’ is 60 minutes during the daytime and 15 minutes during the night. The reduced reference time at night reflects the increased sensitivity to noise during this period.

The assessment method considers the characteristics of the sound, such as tonality, impulsivity and intermittency. Corrections are applied to the specific noise source to account for these characteristics in order to obtain the rating noise level; the corrections account for acoustic features which have the potential to increase disturbances.

An initial estimate of the impact of the sound source is obtained by subtracting the measured background sound level from the rating level and considering the following:

- Typically, the greater this difference, the greater the magnitude of the impact.
- 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.

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, the standard requires a character correction to be added to the specific sound level to obtain the rating level. Character corrections can be included for tonality, impulsivity, other sound characteristics that make it “readily distinctive”, and intermittency.

Appendix C. Detailed Plant Locations

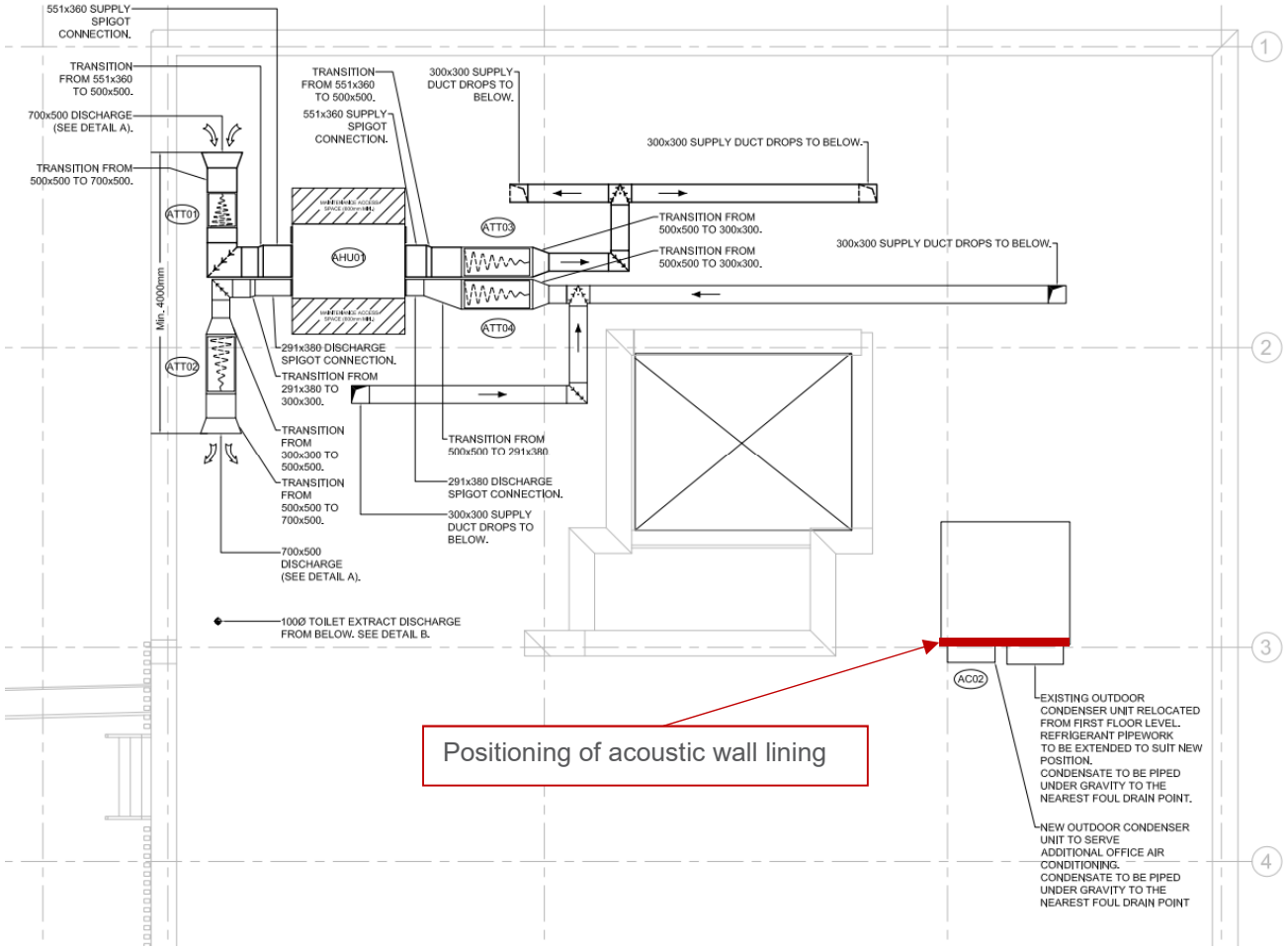


Figure C-1 – Roof plan showing the proposed condensers and AHU, and positioning of the acoustic wall lining

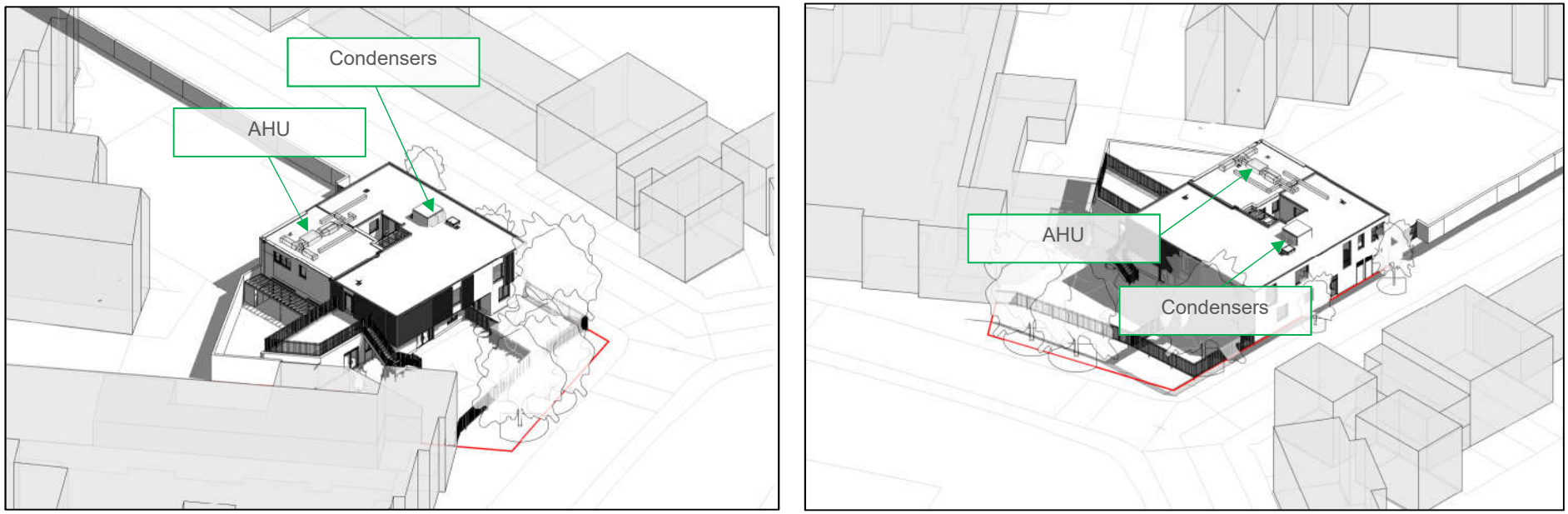


Figure C-2 - Isometric views of the refurbished building showing the proposed condensers and AHU

Appendix D. Sound Level History at Measurement Position M1

Table D-1 – Sound level history at measurement position M1, 1-hour data periods

Date / time	Ambient sound $L_{Aeq,1hour}$ (dB)	Background sound $L_{A90,1hour}$ (dB)
27/09/2018 10:00	54	47
27/09/2018 11:00	52	46
27/09/2018 12:00	51	44
27/09/2018 13:00	52	46
27/09/2018 14:00	55	46
27/09/2018 15:00	49	44
27/09/2018 16:00	50	44
27/09/2018 17:00	51	43
27/09/2018 18:00	49	42
27/09/2018 19:00	49	42
27/09/2018 20:00	50	43
27/09/2018 21:00	48	42
27/09/2018 22:00	48	41
27/09/2018 23:00	48	40
28/09/2018 00:00	46	39
28/09/2018 01:00	45	37
28/09/2018 02:00	43	36
28/09/2018 03:00	43	36
28/09/2018 04:00	46	37
28/09/2018 05:00	44	37
28/09/2018 06:00	49	40
28/09/2018 07:00	51	42
28/09/2018 08:00	52	44
28/09/2018 09:00	54	48
28/09/2018 10:00	55	47
28/09/2018 11:00	56	47
28/09/2018 12:00	57	47
28/09/2018 13:00	53	46
28/09/2018 14:00	56	46
28/09/2018 15:00	52	45

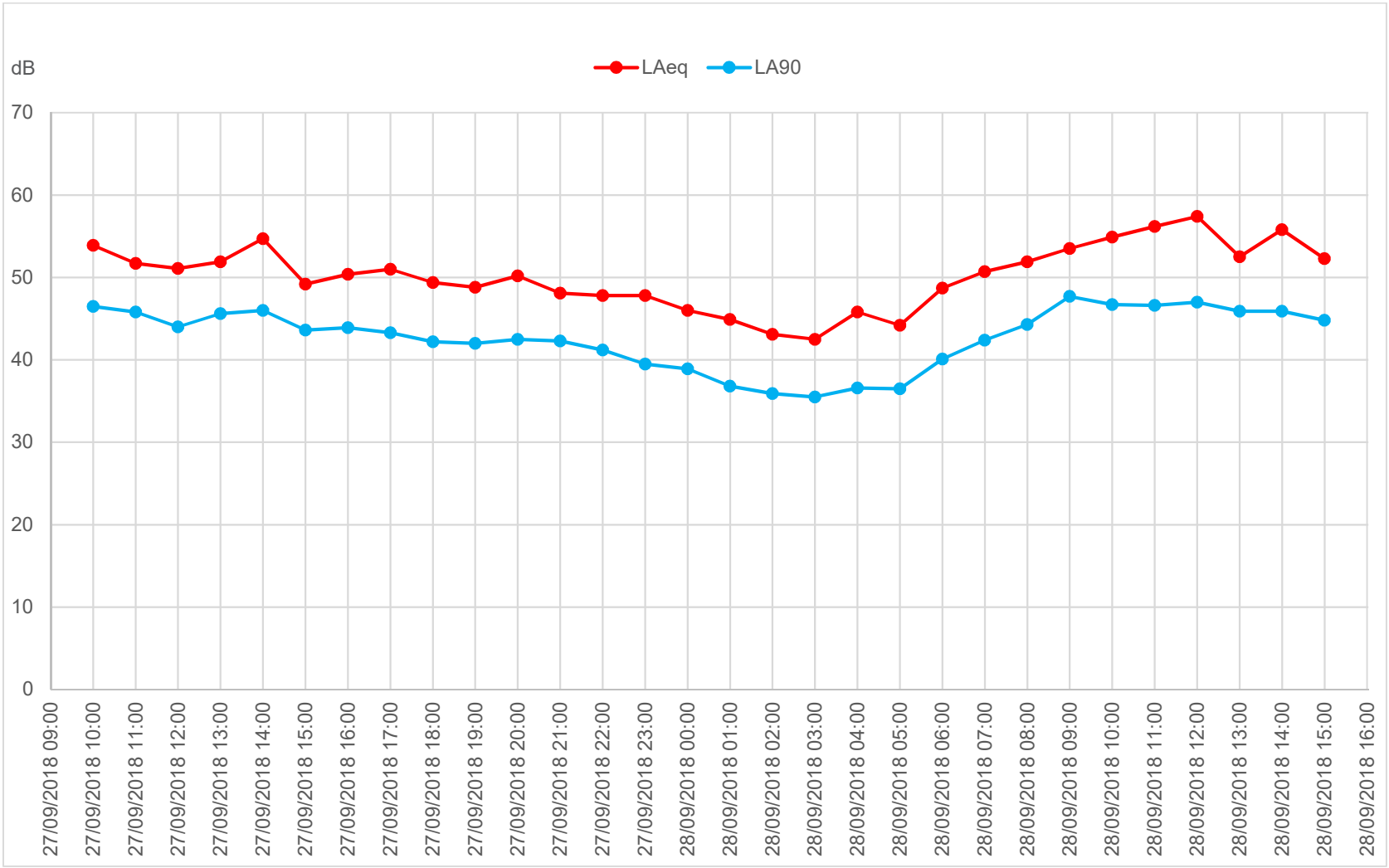


Figure D-1 – Sound level history at measurement position M1, 1-hour data periods

Appendix E. Published Plant Sound Levels

Table E-1 – Sound pressure levels at 1 metre from the existing condenser unit, Mitsubishi PUHZ-P100VHA4, as published by the manufacturer

Mode	63	125	250	500	1k	2k	4k	8k	dB(A)
Cooling	62	53	49	47	45	41	38	30	50
Heating	57	56	55	49	50	45	42	33	54

Table E-2 – Sound pressure levels at 1 metre from the proposed condenser unit, Mitsubishi PUHZ-RP10YKA3, as published by the manufacturer

Mode	63	125	250	500	1k	2k	4k	8k	dB(A)
Cooling	53	52	49	47	44	41	33	27	49
Heating	58	59	51	48	46	40	34	28	51

Table E-3 – Sound power levels from the proposed air handling unit, Nuaire XBV45-H-NCO, as published by the manufacturer

Sound source	63	125	250	500	1k	2k	4k	8k	dB(A)
Fresh air connection	78	70	70	59	59	57	49	40	66
Supply air connection	82	75	80	66	67	66	61	57	75
Extract connection	79	70	71	58	59	58	48	39	66
Exhaust air connection	83	76	80	66	67	67	61	59	75
To surroundings	69	60	57	42	40	39	35	24	52

Appendix F. Plant Sound Level Calculations at Receptors R1- R3

Summaries of the worst-case plant sound level calculations at receptors R1, R2 and R3 are shown in the tables below.

Table F-1 – Summary condenser sound level calculation at receptor R1

Item	Calculation	
	Existing relocated condenser	Proposed new condenser
Specific sound level at 1 m from the condenser, $L_{Aeq,1hour}$	54 dB	51 dB
Acoustic screening by the lift overrun	-5 dB	-5 dB
Attenuation over distance to the receptor, 30 m (conformal area method)	-26 dB	-25 dB
Specific sound level at the receptor, $L_{Aeq,1hour}$	**23 dB**	**21 dB**

Table F-2 – Summary AHU sound level calculation at receptor R1

Sound source	Item	Calculation
Casing	Radiated sound power level, L_{wA}	52 dB
	Attenuation over distance to the receptor, 16 m (conformal area method)	-35 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	17 dB
Exhaust air duct termination	In-duct sound power level, L_{wA}	75 dB
	System losses (duct run, bends, end reflection)	-1 dB
	Acoustic mitigation – attenuator (1200 mm L)	-26 dB
	Directivity correction – radiation 150° off-axis	-1 dB
	Attenuation over distance, 19 m (spherical spreading)	-37 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	10 dB
Fresh air duct termination	In-duct sound power level, L_{wA}	66 dB
	System losses (duct run, bends, end reflection)	-2 dB
	Acoustic mitigation – attenuator (600 mm L)	-15 dB
	Directivity correction – radiation 45° off-axis	+4 dB
	Attenuation over distance, 15 m (spherical spreading)	-35 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	18 dB
All sources	**Total specific sound level at the receptor, $L_{Aeq,1hour}$**	**21 dB**

Table F-3 – Cumulative plant sound level at receptor R1

Plant item	Specific sound level at receptor, $L_{Aeq,1hour}$
Existing relocated condenser	23 dB
Proposed new condenser	21 dB
Proposed new AHU	21 dB
All items	**26 dB**

Table F-4 – Summary condenser sound level calculation at receptor R2

Item	Calculation	
	Existing relocated condenser	Proposed new condenser
Specific sound level at 1 m from the condenser, $L_{Aeq,1hour}$	54 dB	51 dB
Reflections from the lift overrun wall	+3 dB	+3 dB
Acoustic mitigation – Class A acoustically absorptive wall lining	-3 dB	-3 dB
Attenuation over distance to the receptor, 37 m (conformal area method)	-28 dB	-27 dB
Specific sound level at the receptor, $L_{Aeq,1hour}$	**26 dB**	**24 dB**

Table F-5 – Summary AHU sound level calculation at receptor R2

Sound source	Item	Calculation
Casing	Radiated sound power level, L_{wA}	52 dB
	Attenuation over distance to the receptor, 31 m (conformal area method)	-41 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	11 dB
Exhaust air duct termination	In-duct sound power level, L_{wA}	75 dB
	System losses (duct run, bends, end reflection)	-1 dB
	Acoustic mitigation – attenuator (1200 mm L)	-26 dB
	Directivity correction – radiation 60° off-axis	+3 dB
	Attenuation over distance, 29 m (spherical spreading)	-40 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	11 dB
Fresh air duct termination	In-duct sound power level, L_{wA}	66 dB
	System losses (duct run, bends, end reflection)	-1 dB
	Acoustic mitigation – attenuator (600 mm L)	-15 dB
	Directivity correction – radiation 135° off-axis	-2 dB
	Attenuation over distance, 32 m (spherical spreading)	-41 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	7 dB
All sources	**Total specific sound level at the receptor, $L_{Aeq,1hour}$**	**15 dB**

Table F-6 – Cumulative plant sound level at receptor R2

Plant item	Specific sound level at receptor, $L_{Aeq,1hour}$
Existing relocated condenser	26 dB
Proposed new condenser	24 dB
Proposed new AHU	15 dB
All items	**28 dB**

Table F-7 – Summary condenser sound level calculation at receptor R3

Item	Calculation	
	Existing relocated condenser	Proposed new condenser
Specific sound level at 1 m from the condenser, $L_{Aeq,1hour}$	54 dB	51 dB
Reflections from the lift overrun wall	+3 dB	+3 dB
Acoustic mitigation – Class A acoustically absorptive wall lining	-3 dB	-3 dB
Attenuation over distance to the receptor, 20 m (conformal area method)	-23 dB	-22 dB
Specific sound level at the receptor, $L_{Aeq,1hour}$	**31 dB**	**29 dB**

Table F-8 – Summary AHU sound level calculation at receptor R3

Sound source	Item	Calculation
Casing	Radiated sound power level, L_{wA}	52 dB
	Attenuation over distance to the receptor, 31 m (conformal area method)	-41 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	11 dB
Exhaust air duct termination	In-duct sound power level, L_{wA}	75 dB
	System losses (duct run, bends, end reflection)	-1 dB
	Acoustic mitigation – attenuator (1200 mm L)	-26 dB
	Directivity correction – radiation 90° off-axis	+1 dB
	Attenuation over distance, 32 m (spherical spreading)	-41 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	8 dB
Fresh air duct termination	In-duct sound power level, L_{wA}	66 dB
	System losses (duct run, bends, end reflection)	-2 dB
	Acoustic mitigation – attenuator (600 mm L)	-15 dB
	Directivity correction – radiation 100° off-axis	0 dB
	Attenuation over distance, 32 m (spherical spreading)	-41 dB
	Specific sound level at the receptor, $L_{Aeq,1hour}$	8 dB
All sources	**Total specific sound level at the receptor, $L_{Aeq,1hour}$**	**14 dB**

Table F-9 – Cumulative plant sound level at receptor R3

Plant item	Specific sound level at receptor, $L_{Aeq,1hour}$
Existing relocated condenser	31 dB
Proposed new condenser	29 dB
Proposed new AHU	14 dB
All items	**33 dB**

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