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Plant Noise Impact Assessment Report for Planning

ESCP Business School, 527 Finchley Road, NW3 7BG

Report Reference 20635.PNIA-RPT.02

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EXECUTIVE SUMMARY

This report assesses the noise impact of 1 no. external VRV unit, and 2 no. internal heat recovery units, to be installed at ESCP Business School, 527 Finchley Road, NW3 7BG.

An environmental noise survey has previously been undertaken to establish background sound levels representative of the closest noise sensitive receptor locations, the results of which will be used to inform this assessment. The representative background noise level during the hours in which the units could be operational is reported in the assessment summary table below.

Manufacturer's noise data of the proposed plant have been used to calculate expected noise levels at the closest noise sensitive receptors in accordance with BS 4142:2014+A1:2019.

The table below summarises the resultant Rating Levels calculated at the receptors against the background sound level during the hours in which the units could be operational.

Time	**Representative Background Sound Level** **dB $L_{A90, T}$**	**Calculated Specific Sound Level at 1m from Receptor Façade** **dB $L_s = L_{Aeq, Tr}$**	**Calculated Rating Level at 1m from Receptor Façade** **dB $L_{Ar, Tr}$**	**+/- compared against background** **dB**
NSR 1 50 Burrard Road	43	39	39	-4
NSR 2 2 Parsifal Road	43	37	37	-6

The methodology within BS 4142:2014+A1:2019 notes that the initial noise impact can be estimated by comparing the Rating Level due to the sound sources under assessment with the existing background noise level (L_{A90}) when the noise source is not operating. The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context. Note that contextual factors must be considered in order to draw final conclusions on the actual noise impact.

When considering both the comparison of Rating Level vs background sound level, and the contextual factors in this specific scenario, it has been concluded that:

- Noise emissions from the proposed plant would result in a low likelihood of adverse impact.
- Noise emissions from the proposed plant would not result in any adverse impacts on health and quality of life.
- The level at which no effect at all on health or quality of life can be detected is described within the NPSE guidance as NOEL (no observed effect level), which would describe the assessment outcomes in this case.
- Additional mitigation measures would be required to ensure that the amenity of nearby noise sensitive receptors is protected – these have been defined in section 6.

CONTENTS

LIST OF ATTACHMENTS

1 INTRODUCTION

ES Acoustics Ltd has been commissioned by ESCP Europe Business School to prepare a noise impact assessment for the proposed installation of new external VRV and AHU plant at ESCP Business School, 527 Finchley Road, NW3 7BG.

The structure of this report is as follows:

- A review of site context and details of the proposal, including the installation locations of the proposed units, the locations of the closest noise sensitive receptors relative to the plant installation locations, and noise emissions data of the plant;
- A review of national planning policy, local planning policy and acoustic guidance relevant to the proposal;
- Details of the environmental noise survey previously undertaken on site to determine background noise levels at nearby noise sensitive receptor locations; and
- The noise impact assessment in accordance with the requirements of The London Borough of Camden and BS 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'*, including consideration of the contextual factors of the proposal and an assessment of impacts.

2 SITE CONTEXT AND DETAILS OF PROPOSAL

2.1 Site Description

The ESCP Business School is situated on Finchley Road within the West Hampstead area of London.

The Business School is comprised of several interconnected buildings fronting Finchley Road and Parsifal Road, with this report focussing on the Library Lecture Room located to the west corner of the site.

The new classroom block is bounded by residential properties on Burrard Road to the northwest, existing business school buildings to the northeast, a residential property on Parsifal Road to the southeast, and residential gardens to the southwest.

2.2 Proposal

The proposal involves the installation of 1 no. Daikin RYYQ20U (or similar) external VRV unit, with 2 no. Daikin MODULAR_L_SMART AHU ventilating to the south side of the lecture hall.

The closest noise sensitive window to the northwest units to the are on the rear façade of 50 Burrard Road (NSR1), with the closest noise sensitive window to the south on the rear façade of 2 Parsifal Road (NSR2).

Figure 1 shows the location of the plant units, and the closest noise sensitive windows relative to the plant installation locations:

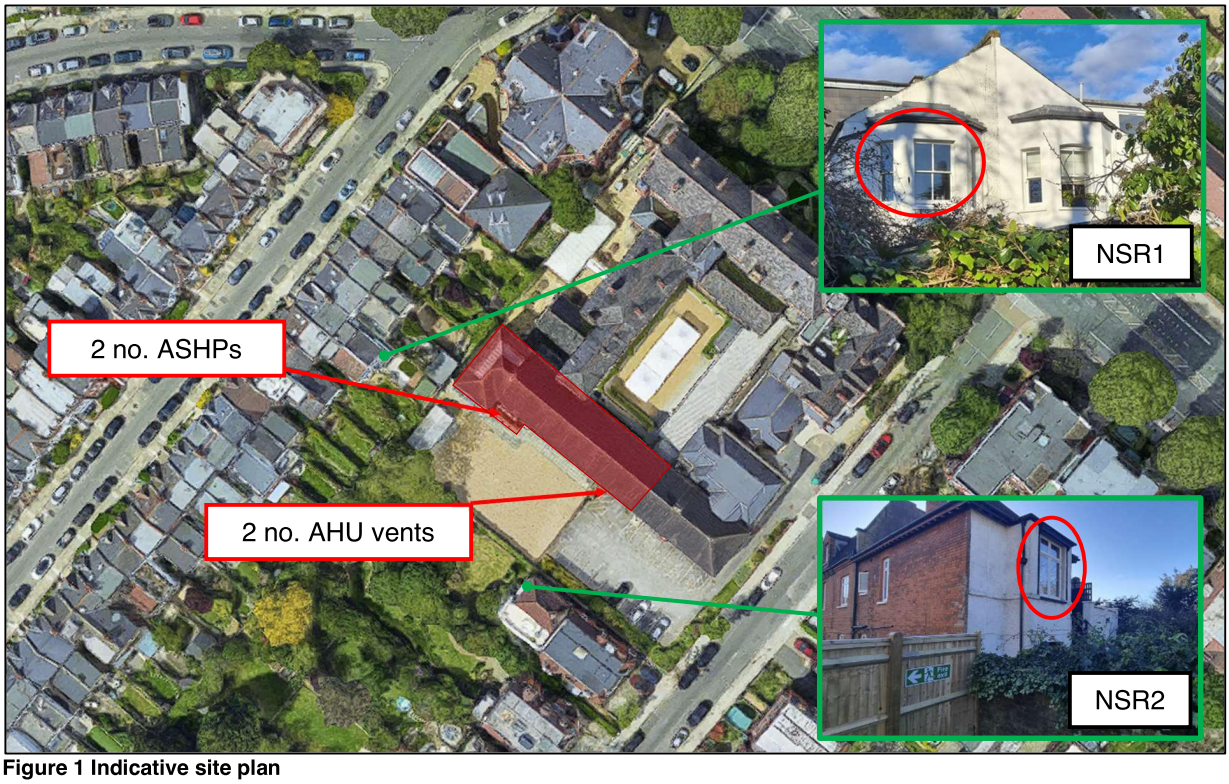


Figure 1 Indicative site plan

Noise emissions data for the units have been sourced from the manufacturer, Daikin, as shown in Appendix B and summarised in Table 1 below.

Plant Unit	Octave band centre frequency, dB								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Daikin RYYQ20U	96	87	86	88	81	76	75	70	88
Daikin Modular Exhaust Fan Outlet	72	74	74	73	72	68	64	58	76
Daikin Modular Supply Fan Inlet	67	69	69	68	67	64	59	53	71

Table 1 Manufacturer stated sound power levels of proposed plant

3 RELEVANT PLANNING POLICY AND GUIDANCE

This section of the report presents the key guidance and legislation relevant to the assessment of noise emissions from proposed installation of new external building services plant.

All italicised text within this section is directly referenced from the document in question.

3.1 National Policy

3.1.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) superseded and replaced Planning Policy Guidance Note 24 (PPG24), which previously covered issues relating to noise and planning in England.

The paragraphs relating to noise state:

180. Planning policies and decisions should contribute to and enhance the natural and local environment by; […]

e) 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

191. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) 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;

b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; […]

193. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

3.1.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) was developed by DEFRA and published in March 2010. The long-term vision of the Government noise policy is to '*Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development*.'

The NPSE vision noted above is supported by the following aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

- *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*

The NPSE outlines observed effect levels relating to the above, as follows:

- *No observed effect level (NOEL): this is the level of noise exposure below which no effect at all on health or quality of life can be detected;*
- *Lowest observed adverse effect level (LOAEL): this is the level of noise exposure above which adverse effects on health and quality of life can be detected;*
- *Significant observed adverse effect level (SOAEL): This is the level of noise exposure above which significant adverse effects on health and quality of life occur;*

Noise effect levels are not set at absolute noise level targets, but instead vary depending on the context and character of the noise and site-specific factors which may impact on the severity of the effect. The NPSE states:

'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 acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'

3.1.3 National Planning Practice Guidance (NPPG)

The NPPG provides practical guidance on how the NPPF should be applied, as well as and guidance on the factors influencing whether noise may be a concern at the planning stage, and how adverse effects can be mitigated. The table below summarises the effect levels presented within the NPSE, as follows:

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

Table 2 Noise exposure hierachy

3.2 Local Policy

3.2.1 The London Plan 2021

Policy D14 'Noise' of the London Plan states the following regarding planning decisions:

Development proposals should seek to manage noise by:

- *Avoiding significant adverse noise impacts on health and quality of life as a result of new development;*
- *Mitigating and minimising the existing and potential adverse impacts of noise on, from, within as a result of or in the vicinity of new development without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens on existing businesses;*
- *Improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity);*
- *Separating new noise sensitive development from major noise sources, such as road, rail, air transport and some types of industrial development) through the use of distance, screening or internal layout – in preference to sole reliance on sound insulation;*
- *Where it is not possible to achieve separation of noise sensitive development and noise sources, without undue impact on other sustainable development objectives, then any potential adverse*

effects should be controlled and mitigated through the application of good acoustic design principles;

- *Having particular regard to the impact of aviation noise on noise sensitive development;*
- *Promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.*

3.2.2 London Borough of Camden

The site falls within the jurisdiction of the London Borough of Camden. The Camden Local Plan is the key strategic document in Camden's development plan, which was adopted on 3 July 2017. It is understood that the Camden Local Plan has replaced the Core Strategy and Camden Development Policies documents and is now the basis for planning decisions and future development in Camden.

Policy A4 Noise and Vibration '*seeks to ensure that noise and vibration is appropriately considered at the design stage and that noise sensitive uses are not negatively impacted by noise and vibration or that existing uses (such as music venues, theatres and some employment uses) are not unduly restricted through the introduction of nearby noise sensitive uses'.*

The Policy and relevant wording are outlined below:

Policy A4 Noise and vibration

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:

a. *development likely to generate unacceptable noise and vibration impacts; or*
b. *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.

With regards to noise from fixed plant and machinery, paragraph 6.99 of the Local Plan states:

Planning conditions will be imposed to require that plant and equipment which may be a source of noise is kept working efficiently and within the required noise limits and time restrictions. Air conditioning will only be permitted where it is demonstrated that there is a clear need for it after other measures have been considered (Policy CC2 Adapting to climate change). Conditions may also be imposed to ensure that attenuation measures are kept in place and are effective throughout the life of the development.

Appendix 3 of the Local Plan presents noise thresholds for various scenarios. The introduction of the section states:

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.*

With regards to 'industrial and commercial noise sources', Appendix 3 states:

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)'* has been reproduced below:

Noise Sensitive Receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOEL (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 57dB L_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dB L_{Amax}

Table 3 Camden Local Plan guidance with regards to noise from plant and machinery

Table 2 Notes:
****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 $L_{eq,5mins}$ 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.

3.3 Best Practice and Guidance

3.3.1 BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

BS 4142:2014+A1:2019 provides a methodology for rating and assessing the impacts of industrial and commercial sound at noise sensitive receptors.

The methodology involves comparing the Rating Noise Level due to the sound source/s under assessment with the existing background noise level (L_{A90}) when the noise source is not operating to estimate the initial impact, as follows (Typically, the greater this difference, the greater the magnitude of the impact):

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

b) *A difference of around +5 dB could be an indication of an adverse impact, depending on the context*

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

The standard notes that a noise source under assessment will have a 'low impact' when the 'rating level' of a noise source is less than the existing background noise. It is also important to note that any quantitative assessment results are assessed considering the context in which the sound occurs.

The standard notes three types of context within Clause 11, which are:

1) *The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

   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.

   Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*

3) *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*

   i. facade insulation treatment;

   ii. ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and

   iii. acoustic screening.

The definitions noted above are described below:

- ***Specific sound*** *– sound source being assessed ($L_s = L_{Aeq,\ Tr}$)*
- ***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 ($L_r = L_{Aeq,\ T}$)*
- ***Ambient sound*** *– totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far ($L_a = L_{Aeq,\ T}$)*
- ***Background level*** *– sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval ($L_{A90,\ T}$)*
- ***Rating level*** *– specific sound level plus any adjustment for the characteristic features of the sound ($L_{Ar,Tr}$)*

With regards to background noise levels, BS 4142:2014+A1:2019 notes:

"In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."

With regards to the 'rating level', the adjustments for the characteristic features of the sound are outlined below:

- *Tonality – +2 dB for a tone which is 'just perceptible' at the noise receptor, +4 dB where it is 'clearly perceptible', and +6 dB where it is 'highly perceptible'*
- *Impulsivity – +3 dB for a tone which is 'just perceptible' at the noise receptor, +6 dB where it is 'clearly perceptible', and +9 dB where it is 'highly perceptible'*
- *Intermittency – +3 dB if the intermittency is readily distinctive against the residual acoustic environment*
- *Other sound characteristics – where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.*

It must be noted that as the rating level is determined at the closest noise sensitive receptor, the acoustic feature corrections should be applied based on the level at receptor location, not at source. This is particularly relevant when noise propagation characteristics cause differences in sound reduction at various frequency bands.

Note that the assessment reference periods that should be considered for daytime and night-time, as defined within the standard, are:

- *One hour period for a sound source operating during daytime hours (07:00-23:00 hours)*
- *Fifteen-minute period for a sound source operating during the night-time (23:00-07:00 hours)*

ES Acoustics Notes regarding Context:

The notes presented below are informed by the BS 4142:2014+A1:2019 Technical Note prepared by the Association of Noise Consultant Good Practice Working Group. Assessment context is often misunderstood or applied incorrectly, and the notes are therefore presented to provide a clear picture on what aspects of context should be considered when assessing the overall impact of a particular scenario:

Subclause 11(1)

The second paragraph notes that absolute levels may be as, or more, important than relative outcomes where background and rating levels are low. It is important to note that both background and rating levels would need to be low for this particular caveat to apply.

BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example, a situation might be considered acceptable where a rating level of 30dB is 10dB above a background sound level of 20dB, i.e. an initial estimate of a significant adverse impact is modified by the low rating and background sound levels. However, there may be situations where the opposite is true, and it is for the assessor to justify any modifications to the initial estimate of impact.

BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$. We would consider that similar values would not be unreasonable in the context of the current edition of BS 4142.

The third paragraph states that "where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts".

In the ordinary application of BS 4142 the residual sound level is not compared with the background sound level to determine the level of impact. The third paragraph is therefore taken to mean that the level of impact caused by the residual level has been determined by professional judgement or with reference to another document, such as the Noise Insulation Regulations 1975 (as amended 1988). Where professional judgement is used, it should be appropriately justified.

Where the residual sound levels are very high, a significant adverse impact might be declared in a situation where the rating level exceeds the background sound level by, say, 4dB, i.e. since the residual sound levels are already considered to cause a significant impact, any worsening of the situation would be considered a significant adverse impact, even if the difference between the rating level and background sound level would not suggest this to be the case.

Subclause 11(2)

The second aspect of context described in BS 4142 relates to the character and level of the specific sound. In essence, whether or not the character of the sound is distinguishable from the character of the ambient or residual acoustic environment or is incongruous.

BS 4142 does not provide instruction as to how to treat the assessment outcomes in these circumstances, nor does it explain how to distinguish between this contextual consideration and the process for applying rating penalties. The latter is itself informed by the distinctive characteristics of the specific sound in the context of the residual sound environment.

Where character-based contextual matters are taken into account, the assessor should make it clear how these matters are distinct from those that informed the rating level corrections, and what the implications of these further character assessments should be. For example; new deliveries on an estate entailing rating penalties for reversing alarms and impulsive noise but these types of noise are already present at other existing premises, so contextually the impact is reduced. Conversely, where the residual level is

largely comprised of natural sounds, such as the sea or birdsong, so the impact from the specific source might be increased.

Subclause 11(3)

The third contextual matter described in Clause 11 relates to the receptor itself. It is important to note that the reference at the start of this section of BS 4142 to 'the sensitivity of the receptor' refers to a generic receptor type, i.e. a dwelling, and not to the particular attitudes or responses of a particular person (although if the residential receptor type is specific it may have a bearing e.g. student accommodation).

The ANC working group notes that this part of BS 4142 allows the internal noise environment to be considered, despite BS 4142 excluding such matters from its Scope (Subclauses 1.1, 1.2 and 1.3). The working group considers that the consideration of the internal noise environment is only valid in a BS 4142 assessment where it relates to the contextual elements of the assessment.

3.3.2 BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings'

Table 4 of BS 8233:2014 (reproduced below) provides guidance on recommended internal ambient noise levels in residential spaces based on World Health Organisation (WHO) research:

Room	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Living Room	≤ 35 dB $L_{Aeq,16hr}$	N/A
Dining Room	≤ 40 dB $L_{Aeq,16hr}$	N/A
Bedroom	≤ 35 dB $L_{Aeq,16hr}$	≤ 30 dB $L_{Aeq,8hr}$

Table 4 BS 8233:2014 indoor ambient noise levels for dwellings

Whilst it is accepted that the levels presented above are for steady external noise sources without a specific character, the guidance provides useful context as to what acceptable internal noise levels are in an ideal situation.

3.3.3 World Health Organization Guidelines

WHO Guidelines for Community Noise (1999) outlines guideline values with respect to critical health effects for residential properties, which are outlined in the table below:

Specific Environment	Critical Health Effects	L_{Aeq} [dB]	Time [hours]	L_{Afmax} [dB]
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	n/a
	Sleep disturbance night-time	30	8	45
Outside bedrooms (from noise sources other than road traffic, railways, aircraft or wind turbines)	Sleep disturbance, window open (outdoor values)	45	8	60

Table 5 Guideline Values from WHO Guidelines for Community Noise (1999)

As with the BS 8233:2014 guidance, while this isn't specifically related to noise from plant installations, the guidance provides useful context as to what acceptable noise levels are in an ideal situation.

4 PREVIOUSLY UNDERTAKEN ENVIRONMENTAL NOISE SURVEY

4.1 Measurement Location and Procedure

An appraisal of the site during the site visit determined the background noise profile to be commensurate to a suburban residential environment. The dominant noise source observed was distant road traffic noise from the surrounding roads.

A noise survey was undertaken on the site as shown in the figure below:

Figure 2 Noise survey measurement location (to the northwest of the new classroom block)

The survey measurement location was selected at the rear of the classroom block to ensure representative levels were captured with respect to both receptor windows (see Figure 1). In addition, the measurement location ensured that noise emissions from existing external building services plant (already permitted and operational) installed towards the northeastern side of the block was inaudible and did not contribute to the measured survey data, therefore ensuring a worst-case scenario with respect to background noise levels.

The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels'*, with automated monitoring undertaken between 18:00 on Friday 26th January 2024 to 19:30 on Sunday 28th January 2024. Note that measurements were undertaken over a weekend period to ensure that the ASHPs under assessment were non-operational, as the new classroom block is not used over the weekend period.

The key acoustic descriptors measured for this assessment are as follows:

- $L_{Aeq,T}$ *(the continuous equivalent A-weighted noise level over a given time period, T); and*

- *$L_{A90,T}$ (the noise level exceeded for 90% of the measurement period T, referred to as the 'background' noise level).*

4.2 Measurement Equipment

The table below presents the equipment used for the baseline noise survey. The equipment calibration was verified before and after use and no abnormalities were observed.

Equipment	Make and Model	Serial Number
Sound Level Meter	Svantek 958 Class 1 Sound Level Meter	69074
Microphone Capsule	ACO Pacific 7052E	19233
Microphone Preamplifier	Svantek SV 12L	25991
Calibrator	Svantek SV33 Class 1 Sound Calibrator	125829

Table 6 Noise survey equipment

4.3 Weather Conditions

Weather conditions during the automated monitoring were generally dry with light winds and therefore suitable for the measurement of environmental noise.

Measurements of temperature and wind speed were undertaken over a 15-minute sample period on both the installation and collection visits. Data on precipitation has been sourced from local weather stations. A summary of the weather data is reported in the table below:

Description	Installation Date 26/01/2024	Collection Date 28/01/2024
Temperature (° Celsius)	9.3*	11*
Wind speed (m/s)	2.1**	3.0**
Wind direction	West	Southwest
Precipitation	0mm	0mm
Presence of damp roads/wet ground	None	None
Cloud cover (Oktas***)	1	2
Presence of fog/snow/ice	None	None

Table 7 Weather conditions
measured during the site visit using a handheld anemometer
****maximum speed measured over 15-minute period during the site visit using a handheld anemometer***
*****An okta is a unit of measurement used to describe the amount of cloud cover at any given location. Sky conditions are estimated in terms of how many eighths of the sky are covered in cloud, ranging from 0 oktas (completely clear sky) through to 8 oktas (completely overcast)***

4.4 Survey Results

An environmental noise time history of the measurement results is presented in Appendix B.

A summary of the measurement results for daytime and night-time are presented in the table below:

Period	Residual Sound Level $L_{Aeq,\,T}$ (dB)	Representative Background Sound Level L_{A90} (dB)
Daytime 07:00-23:00	47	43
Night-time 23:00-07:00	42	39

Table 8 Daytime and night-time noise levels

With regards to the background sound level, BS 4142:2014+A1:2019 notes that *"…it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."*

In terms of quantifying what background sound levels are typical during particular time periods, ESA have derived representative background sound levels as the modal values during the time periods in question.

In terms of particular circumstances and periods of interest, it is assumed that the building and associated units would be used within the main business school operational hours of 08:00-21:30. Furthermore, the units may be operational 2 hours before school operating hours to ensure the classrooms are brought to temperature, which is particularly important in winter months.

In order to ensure a worst-case scenario, we would consider the hours of 06:00-21:30. Noise levels during this time period are shown in the table below:

Period	**Residual Sound Level** $L_{Aeq,\ T}$ **(dB)**	**Representative Background Sound Level** L_{A90} **(dB)**
Operating Hours 06:00-21:30	47	43

Table 9 Measured noise levels during plant operating hours

5 NOISE IMPACT ASSESSMENT

5.1 Specific Sound Levels of Proposed Plant at Closest Receptor Locations

The Specific Sound Level of the proposed plant has been calculated to the closest noise sensitive receptor locations in accordance with the methodology outlined in BS 4142:2014+A1:2019, considering various factors such as attenuation over distance, surface reflections and barrier/screening effects. The calculation considers the silencers proposed in the M&E schedule for the AHU supply and exhaust systems, as well as the treatment of all reflections in the brickwork plant enclosure. These mitigation measures are defined in section 6.

Table 10 summarises the Specific Sound Levels for each assessment scenario, with full calculations presented in Appendix D1-D2.

Receptor	Representative Background Sound Level dB $L_{A90,T}$	Calculated Specific Sound Level at 1m from Receptor Façade dB $L_s = L_{Aeq,Tr}$
NSR 1 50 Burrard Road	43	39
NSR 2 2 Parsifal Road	43	37

Table 10 Summary of the Specific Sound Levels at calculated to closest noise sensitive receptor locations

The London Borough of Camden guidance notes that "*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 $L_{eq,5mins}$ 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.*"

In the interest of providing a clear and robust assessment, Specific Sound Levels are also compared against the NR35 criterion curve in the table below, with green data showing compliance with the NR curve and red data showing non-compliance.

Receptor	Octave band centre frequency, dB							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
NSR1	52	42	39	39	29	22	18	11
NSR2	51	42	39	38	28	21	17	11
NR35 Curve Levels	**63**	**52**	**45**	**39**	**35**	**32**	**30**	**28**

Table 11 Single octave band Rating Sound Levels compared against the NR35 criterion curve

As shown in the table above, resultant Rating Sound Levels at each single octave are compliant with the NR35 criterion curve suggested within The London Borough of Camden guidance.

In the interest of clarity, the resultant levels at NSR1 and NSR2 would be NR35, and NR34, respectively.

5.2 Rating Levels of Proposed ASHP Plant at Closest Receptor Locations

To establish the Rating Level as required by BS 4142:2014+A1:2019, appropriate acoustic feature corrections should be applied to the Specific Sound Level. It must be noted that the acoustic feature corrections are applied based on the level at receptor location, not at source, as they are reflective of the sound perceived by the receptor.

Tonality is commonly defined as being present when a single octave band sound level is 6 dB higher than the adjacent octave bands. As shown in Table 11 and Appendix D, no single octave band level is 6 dB or greater above the adjacent octave bands. Therefore, the sound source would not be considered tonal at the receptor, and therefore no acoustic feature correction for tonality would be applied.

The VRV unit would cycle on and off depending on the cooling/heating load requirement internally, however the absolute level at the receiver is below the representative background level, and therefore no correction is applied.

Operational noise emissions from plant installation would not be considered impulsive and therefore no correction is applied for impulsivity.

Table 12 compares the resultant Rating Levels calculated at the receptors against the background sound level during the hours whereby the ASHPs could be operational. Full calculations are presented in Appendix D.

Time	**Representative Background Sound Level** **dB $L_{A90, T}$**	**Calculated Specific Sound Level at 1m from Receptor Façade** **dB $L_S = L_{Aeq, Tr}$**	**Calculated Rating Level at 1m from Receptor Façade** **dB $L_{Ar, Tr}$**	**+/- compared against background** **dB**
NSR 1 50 Burrard Road	43	39	39	-4
NSR 2 2 Parsifal Road	43	37	37	-6

Table 12 Summary of the Rating Level at receptor

The methodology within BS 4142:2014+A1:2019 notes that the initial noise impact can be estimated by comparing the Rating Level due to the sound sources under assessment with the existing background noise level (L_{A90}) when the noise source is not operating. The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context.

Given that the Rating Level falls below background, this is an initial indication of the plant having a low impact. However, contextual factors must also be considered to draw final conclusions on the actual noise impact.

5.3 Contextual Factors

As outlined in Section 3.3.1, the three types of context which should be considered are:

- *aspects of the absolute level;*
- *aspects of character; and*
- *aspects of the receptor, including physical measures designed to reduce noise.*

With respect to the absolute level, the calculated Rating Levels would be considered objectively low in all assessment scenarios.

The worst-case Rating Level *outside* the residential window is 4dB above the *internal* noise levels typically considered acceptable for daytime resting conditions according to BS 8233:2014. It is widely accepted that a partially open window would typically provide 10-15dB attenuation, resulting in internal noise levels below those normally accepted.

With regards to aspects of character, the immediate locale of the area is one of a quiet suburban environment. The dominant source of the prevailing background noise at the receptor façade is light road traffic noise from the surrounding roads. The remainder of the ESCP building does however feature other plant units, which while very low in level would be expected to, at least marginally, contribute to the noise profile of the area. The addition of low-level noise from the new units would not be expected to present a significant impact on the noise profile of the area.

With regards to aspects of the receptor properties, it is understood that as the properties are of a certain age, the only means to reduce internal heat gains would be via openable windows. In hot summer months where the receptor windows could be open, the occupant/s would be more exposed to noise emissions than if the window were closed. However, as discussed in consideration of the absolute noise levels, the levels received indoors in these scenarios would fall within acceptable internal noise levels.

5.4 Assessment of Impacts

As noted in BS 4142:2014+A1:2019, the overall noise impact can only be established once contextual aspects are considered. Considering the calculated Rating Levels compared to the background sound level, and the context in which the sound occurs, ESA would consider the plant installation proposal to result in a ***low likelihood of adverse impact***.

The London Borough of Camden suggests a LOAEL when the Rating Level is at least 10 dB below the background sound level, and is defined as a suitable criterion for the assessment of external building services plant. The plant Rating Levels would be 4-6dB below the background sound level at NSR1 and NSR2 respectively; however as discussed in Section 5.1, the Rating level falls within the alternative requirement of NR35 at both receiver locations.

Given both the comparison of Rating Level vs background sound level, and the contextual factors in this specific scenario, ESA would consider noise emissions from the proposed plant to result in a low likelihood of adverse impact. Noise emissions from the proposed plant would not result in any adverse impacts on health and quality of life. The level at which no effect at all on health or quality of life can be detected is described within the NPSE guidance as NOEL (no observed effect level), which would

describe the assessment outcomes in this case, whereby the noise may be present, but would not be intrusive.

6 MITIGATION MEASURES

In order to achieve the result defined in the assessment above, the plant would need to be installed considering the following mitigation measures:

6.1 VRV Unit

The VRV unit enclosure would need to be lined on all internal facades by a weatherproof absorptive lining, held in place by a perforated layer such as wire mesh. For this purpose Rockwool RWA45 would be recommended, as a 100mm thick lining. The specific material should be confirmed with the manufacturer to ensure its suitability for use in an environmental setting.

6.2 AHU Vents

The AHU vents should be fitted with the silencers currently specified in the technical submission by Daikin, which provide the following insertion losses:

Unit	Insertion Loss, dB at Octave band centre frequency							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Daikin 900mm silencer	5	9	16	30	39	39	31	26

Table 13 Octave band silencer insertion loss

7 CONCLUSION

An environmental noise survey has been undertaken at ESCP Business School, 527 Finchley Road, NW3 7BG to establish background sound levels representative of the closest noise sensitive receptor locations relative to the proposed plant installation locations for the Library Lecture Hall.

Manufacturer's noise data of the proposed building services plant have been used to calculate expected noise levels at the closest noise sensitive receptors for compliance with the established noise criteria.

It has been concluded that:

- Noise emissions from the proposed plant would result in a low likelihood of adverse impact.
- Noise emissions from the proposed plant would not result in any adverse impacts on health and quality of life.
- The level at which no effect at all on health or quality of life can be detected is described within the NPSE guidance as NOEL (no observed effect level), which would describe the assessment outcomes in this case.
- Additional mitigation measures would be required to ensure that the amenity of nearby noise sensitive receptors is protected – these have been defined in Section 6.

APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

Decibel scale - dB

The decibel (dB) is a relative unit of measurement used in acoustics. The dB is a logarithmic ratio between a measured level and a reference level of 0 dB (i.e the threshold of human hearing). Simply put, the decibel compresses the wide range of sounds we hear into more manageable numbers.

Addition of noise from several sources

Sound produced by multiple sound sources are added logarithmically e.g. power ratio of 2 = 3dB, power ratio of 10 = 10dB. Therefore, two equally intense sound sources operating simultaneously produce a sound level which is 3dB higher than a single source e.g. 60dB + 60dB = 63dB.

Subjective impression of noise

Human response to sound is highly individualized and often based on psychological factors such as emotion and expectation. Sensitivity to sound typically depends on the loudness, pitch, duration of the occurrence, and time of occurrence (e.g. a sound source could cause annoyance during the night where it would not during the day). The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level	Change in perceived loudness
1 dB	Imperceptible
3 dB	Just barely perceptible
6 dB	Clearly noticeable
10 dB	About twice as loud

'A' Weighted Frequency Filter - dB(A)

The human ear is not equally sensitive in all frequencies. The A-weighting filter was devised to take this into account when undertaking noise measurements and allows a sound level meter to replicate the human ears response to sound.

$L_{Aeq, T}$

Sound can fluctuate widely over a given period. L_{Aeq} is the A-weighted equivalent continuous sound level, with T denoting the time period over which the fluctuating sound levels were averaged e.g. $L_{Aeq,16h}$ is the equivalent continuous noise level over an 16 hour period.

L_{A90}

A-weighted sound level exceeded for 90% of the measurement period, calculated via statistical analysis. The L_{A90} descriptor is typically used to establish background sound levels for noise impact assessments

L_{A10}

A-weighted sound level exceeded for 10% of the measurement period, calculated via statistical analysis.

L_{AFmax}

A-weighted sound level maximum sound pressure level that has been measured over a given time period

APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

Octave Bands

The audio or frequency spectrum of the human ear is in the range of 20Hz to 20 kHz. The spectrum tells how the energy of the sound signal is distributed in frequency. Octave bands divides the audio spectrum into 10 equal parts. The International Standards Organisation defines the centre frequency of these bands as 31.5Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1kHz, 2kHz, 4kHz, 8kHz and 16kHz.

Noise Rating (NR) Curves

A method of rating noise using a set of curves relating octave band sound pressure levels. Typically used for building services systems within offices

Airborne sound

Sound radiated from a source into the surrounding air e.g. musical instruments, tv/radio, machinery/equipment. Airborne sound insulation refers to the reduction or attenuation of airborne sound, usually via a solid partition between a source and receiver.

Impact sound

Sound resulting from the impact between colliding objects, e.g. footfall impact upon a floor. Impact sound insulation refers to the resistance of a floor to the transmission of impact sound, typically via the installation of a 'resilient layer'

Flanking sound

The transmission of airborne sound between two adjacent rooms by paths other than via the separating partition between the rooms, e.g. the abutment point of a wall and floor.

Structure-borne noise

Noise caused by the vibration of elements of a structure. This can result in reradiated noise, whereby the vibrating element transmits airborne sound into a space e.g. vibration caused by mechanical plant installed within a plant room which is not adequately isolated from the structure, or construction/demolition work in an adjacent building.

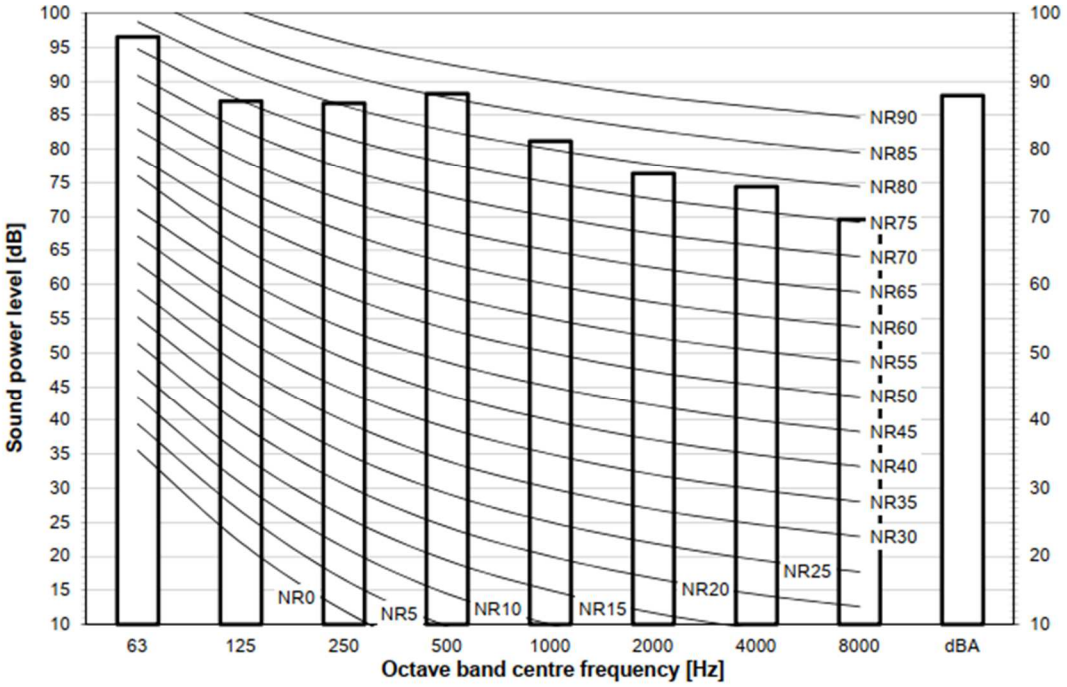
Reverberant sound

Sound in an enclosed space (usually a room), which results from repeated reflections at the boundaries. Reverberation time is the time taken for a steady sound level in an enclosed space to decay by 60dB, measured from the moment the sound source is switched off. A example of a typically reverberant space would be a classic church. Absorptive materials can be used to reduce reflections and reverberation times.

APPENDIX B

MANUFACTURERS NOISE EMISSIONS DATA

REYQ20U
RXYQQ20U
RXYQ20U
RYYQ20U
RYMQ20U



Notes
dBA = A-weighted sound power level (A scale according to IEC).
Reference acoustic intensity 0dB = 10E-6µW/m²
Measured according to ISO 3744

3D119534

APPENDIX B

MANUFACTURERS NOISE EMISSIONS DATA

Sound Report

Supply

Sound Power (dB)	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	AVG dB (A)
Fan Inlet	67	69	69	68	67	64	59	53	72
Fan Outlet	72	74	74	74	72	68	64	58	77
Unit Inlet	67	68	64	53	53	50	38	28	60
Unit Outlet	67	67	62	43	28	30	31	30	55
Airborne	63	64	61	58	53	46	37	26	59
Pressure (1m) *	56	57	54	51	46	38	30	19	52

** Simple source reference value for installation based on directivity factor Q=4 (quarter sphere) and non-reverberant field.Allowances on declared values: +/- 3dB*

Return

Sound Power (dB)	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	AVG dB (A)
Fan Inlet	67	69	69	68	67	63	58	53	71
Fan Outlet	72	74	74	73	72	68	64	58	76
Unit Inlet	62	59	48	22	13	11	6	1	45
Unit Outlet	72	76	77	73	67	68	62	56	75
Airborne	63	64	61	58	52	45	37	26	59
Pressure (1m) *	56	57	54	50	46	38	30	19	52

** Simple source reference value for installation based on directivity factor Q=4 (quarter sphere) and non-reverberant field.Allowances on declared values: +/- 3dB*

Overall

Sound Power (dB)	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	AVG dB (A)
Airborne	66	68	65	61	56	49	41	29	62
Pressure (1m) *	59	61	58	54	49	42	34	22	55

** Simple source reference value for installation based on directivity factor Q=4 (quarter sphere) and non-reverberant field.Allowances on declared values: +/- 3dB*

3) Attenuator Supply

Splitter Number	
Splitters Length	900 mm
Material	TISSUE Galvanized
Pressure Drop	10 Pa
SPL Average Attenuation	43 dB
63 Hz	5 dB
125 Hz	9 dB
250 Hz	16 dB
500 Hz	30 dB
1000 Hz	39 dB
2000 Hz	39 dB
4000 Hz	31 dB
8000 Hz	26 dB

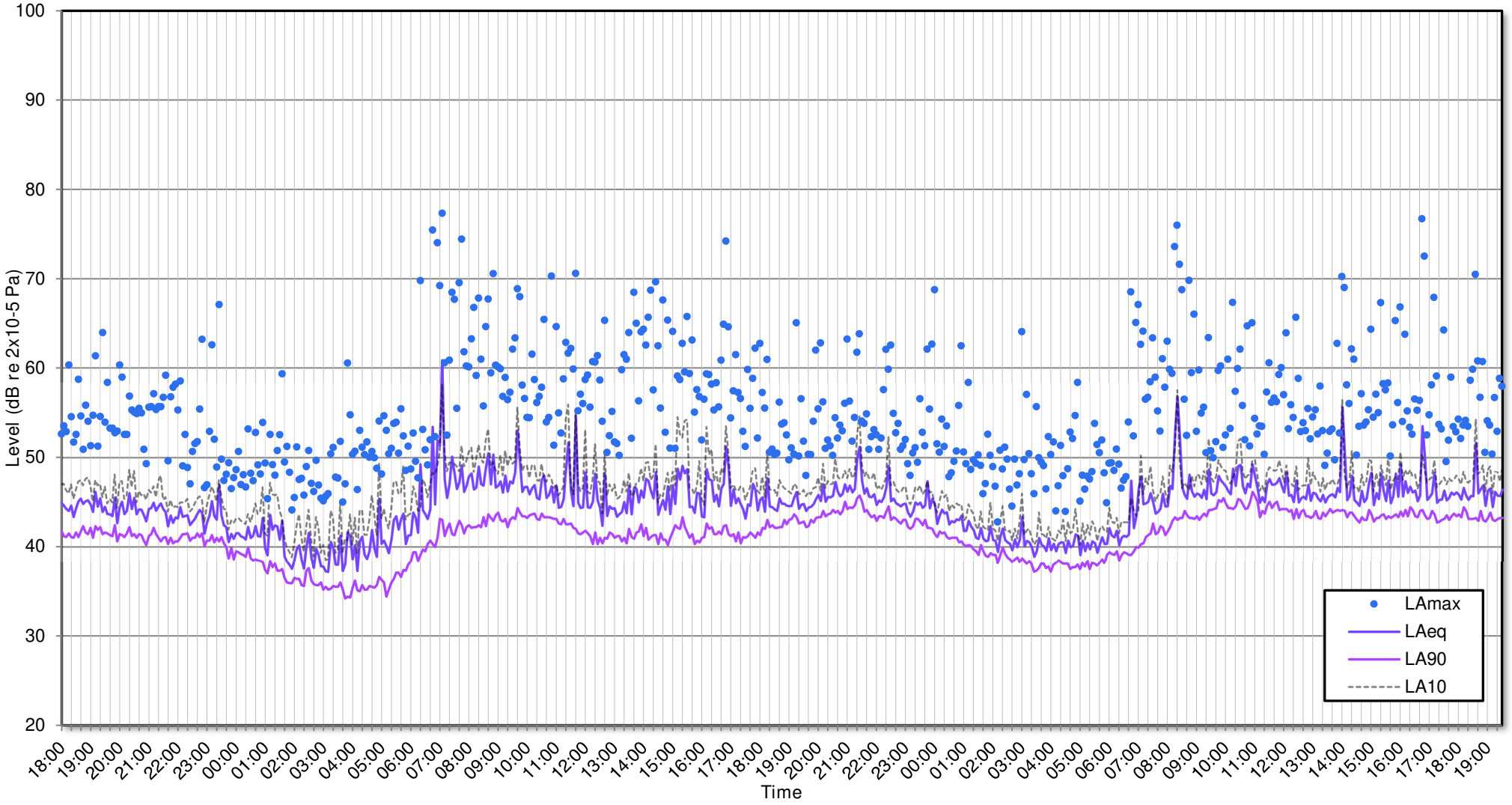
5) Attenuator Return

Splitter Number	
Splitters Length	900 mm
Material	TISSUE Galvanized
Pressure Drop	10 Pa
SPL Average Attenuation	43 dB
63 Hz	5 dB
125 Hz	9 dB
250 Hz	16 dB
500 Hz	30 dB
1000 Hz	39 dB
2000 Hz	39 dB
4000 Hz	31 dB
8000 Hz	26 dB

APPENDIX C

ENVIRONMENTAL NOISE TIME HISTORY GRAPH

20635.PNIA-RPT.01
10:45 on 15th January to 10:30 on 16th January 2024



APPENDIX D1
PLANT NOISE EMISSION CALCULATIONS

es acoustics

Source: Proposed library lecture hall units Receiver: NSR 1, 50 Burrard Road	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
VRV Unit									
Daikin RYYQ20U - Sound Power Level	96	87	86	88	81	76	75	70	
Correction to sound pressure level at 1m (free field), dB	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections at source (3), dB	9	9	9	9	9	9	9	9	
Minimum attenuation provided by distance (22m), dB	-27	-27	-27	-27	-27	-27	-27	-27	
Screening provided by brick wall enclosure, dB	-6	-7	-9	-11	-14	-16	-19	-22	
Attenuation provided by reduction of reflections, 3 no.	-9	-9	-9	-9	-9	-9	-9	-9	
Specific Sound Level at NSR from VRV unit, dB	**52**	**42**	**39**	**39**	**29**	**22**	**18**	**10**	**38**
AHU Units									
MODULAR_L_SMART AHU - Noise Emissions from Air Exhaust Outlet									
Fan Outlet (Sound Power Level)	72	74	74	73	72	68	64	58	
Correction for number of units (2 no.)	3	3	3	3	3	3	3	3	
Attenuation due to duct length (1m), dB	0	-1	0	0	0	0	0	0	
Correction due to duct end reflection, dB	-8	-4	-1	0	0	0	0	0	
Conversion to SPL@1m	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Directivity correction (60 deg.), dB	4	4	5	5	5	5	5	5	
Minimum attenuation provided by distance (44m), dB	-33	-33	-33	-33	-33	-33	-33	-33	
Attenuation provided by Daikin silencer, dB	-5	-9	-16	-30	-39	-39	-31	-26	
Total Noise Emissions from AHU Air Exhaust Outlet, dB	**24**	**26**	**23**	**9**	**0**	**-5**	**-1**	**-2**	**17**
MODULAR_L_SMART AHU - Noise Emissions from Air Supply Inlet									
Fan Inlet (Sound Power Level)	67	69	69	68	67	64	59	53	
Correction for number of units (2 no.)	3	3	3	3	3	3	3	3	
Attenuation due to duct length (1m), dB	0	-1	0	0	0	0	0	0	
Correction due to duct end reflection, dB	-8	-4	-1	0	0	0	0	0	
Conversion to SPL@1m	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Directivity correction (60 deg.), dB	4	4	5	5	5	5	5	5	
Minimum attenuation provided by distance (44m), dB	-33	-33	-33	-33	-33	-33	-33	-33	
Attenuation provided by Daikin silencer, dB	-5	-9	-16	-30	-39	-39	-31	-26	
Total Noise Emissions from AHU Air Supply Inlet, dB	**19**	**21**	**18**	**4**	**-5**	**-9**	**-6**	**-7**	**12**
Specific Sound Level at NSR from AHU, dB	**25**	**28**	**24**	**11**	**1**	**-3**	**1**	**0**	**18**
Total Specific Sound Level at Receptor Façade of all Plant, dB	**52**	**42**	**39**	**39**	**29**	**22**	**18**	**11**	**39**
BS4142 Acoustic Feature Corrections									
Tonality									0
Impulsivity									0
Intermittency									0
Total Rating Noise Level at Receptor Façade, dB									**39**

Notes:
Note 1: Equipment free-field sound pressure levels at 1m sourced from manufacturers data
Note 2: Distances noted are from the centre point of the unit to a central position on the receptor window
Note 3: No directivity correction has been applied as a cautious approach. In reality, directivity would be present thus further reducing the noise level at the receptor location

APPENDIX D2
PLANT NOISE EMISSION CALCULATIONS

es acoustics

Source: Proposed library lecture hall units Receiver: NSR 2, 2 Parsifal Road	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
VRV Unit									
Daikin RYYQ20U - Sound Power Level	96	87	86	88	81	76	75	70	
Correction to sound pressure level at 1m (free field), dB	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections at source (3), dB	9	9	9	9	9	9	9	9	
Minimum attenuation provided by distance (26m), dB	-28	-28	-28	-28	-28	-28	-28	-28	
Screening provided by brick wall enclosure, dB	-6	-7	-9	-11	-14	-16	-19	-22	
Attenuation provided by reduction of reflections, 3 no.	-9	-9	-9	-9	-9	-9	-9	-9	
Specific Sound Level at NSR from VRV unit, dB	**51**	**41**	**38**	**38**	**28**	**21**	**17**	**9**	**37**
AHU Units									
MODULAR_L_SMART AHU - Noise Emissions from Air Exhaust Outlet									
Fan Outlet (Sound Power Level)	72	74	74	73	72	68	64	58	
Correction for number of units (2 no.)	3	3	3	3	3	3	3	3	
Attenuation due to duct length (1m), dB	0	-1	0	0	0	0	0	0	
Correction due to duct end reflection, dB	-8	-4	-1	0	0	0	0	0	
Conversion to SPL@1m	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Directivity correction (60 deg.), dB	4	4	5	5	5	5	5	5	
Minimum attenuation provided by distance (20m), dB	-26	-26	-26	-26	-26	-26	-26	-26	
Attenuation provided by Daikin silencer, dB	-5	-9	-16	-30	-39	-39	-31	-26	
Total Noise Emissions from AHU Air Exhaust Outlet, dB	**31**	**33**	**30**	**16**	**7**	**2**	**6**	**5**	**24**
MODULAR_L_SMART AHU - Noise Emissions from Air Supply Inlet									
Fan Inlet (Sound Power Level)	67	69	69	68	67	64	59	53	
Correction for number of units (2 no.)	3	3	3	3	3	3	3	3	
Attenuation due to duct length (1m), dB	0	-1	0	0	0	0	0	0	
Correction due to duct end reflection, dB	-8	-4	-1	0	0	0	0	0	
Conversion to SPL@1m	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Directivity correction (60 deg.), dB	4	4	5	5	5	5	5	5	
Minimum attenuation provided by distance (20m), dB	-26	-26	-26	-26	-26	-26	-26	-26	
Attenuation provided by Daikin silencer, dB	-5	-9	-16	-30	-39	-39	-31	-26	
Total Noise Emissions from AHU Air Supply Inlet, dB	**26**	**28**	**25**	**11**	**2**	**-2**	**1**	**0**	**19**
Specific Sound Level at NSR from AHU, dB	**32**	**35**	**31**	**17**	**8**	**4**	**7**	**6**	**25**
Total Specific Sound Level at Receptor Façade of all Plant, dB	**51**	**42**	**39**	**38**	**28**	**21**	**17**	**11**	**37**
BS4142 Acoustic Feature Corrections									
Tonality									0
Impulsivity									0
Intermittency									0
Total Rating Noise Level at Receptor Façade, dB									**37**

Notes:
Note 1: Equipment free-field sound pressure levels at 1m sourced from manufacturers data
Note 2: Distances noted are from the centre point of the unit to a central position on the receptor window
Note 3: No directivity correction has been applied as a cautious approach. In reality, directivity would be present thus further reducing the noise level at the receptor location