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The Dairy, London Road Campus

Noise Impact Assessment

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Noise Impact Assessment

Executive Summary

CPW Acoustics have been appointed by The University of Reading to provide acoustic advice in support of new external building services plant being introduced at The Dairy, London Road Campus, Redlands Road RG1 5AQ.

To facilitate this assessment, a baseline noise survey was undertaken over a typical 48-hour period to establish the existing noise climate at the Site and at nearby noise sensitive receptors. Noise monitoring results confirmed that during the daytime the dominant source of noise within the area was road traffic from London Road and Redlands Road. During the night-time period, road traffic noise from the wider road network formed the basis of background noise levels.

Based on the results of the environmental noise survey (Section 4) and the plant noise requirements of Reading Borough Council (Section 2), appropriate maximum plant noise emission limits have been set and are detailed in Section 5.

An assessment of operational plant noise levels for the proposed new plant and equipment selections intended to be installed to serve the building has been undertaken and is detailed in Section 5. The results of the assessment indicate that with all plant operating concurrently during the quietest times of the daytime and night-time period that the Council's noise emission requirements can be achieved without the need for acoustic mitigation measures needing to be incorporated into the inherent design of the scheme.

Noise Impact Assessment

1.0 Introduction

CPW Acoustics has been commissioned by the University of Reading to undertake a noise impact assessment of proposed new building services plant at Building L014 (The Dairy), University of Reading London Road Campus, Reading RG1 5AQ (hereafter referred to as the 'Site').

The proposed works include the installation of an external condenser unit on the rooftop of Building L014 and the installation of a mechanical ventilation and heat recovery unit within the existing kitchen.

This report has been prepared to present the findings of the assessment including review of relevant policy & standard documents, results of a baseline survey undertaken at the Site, calculations of plant noise levels and recommendations of noise mitigation measures, where necessary.

Preparation of this assessment has involved the following works:

- Review of Reading Borough Council's typical planning requirements regarding noise emissions from new building services,
- An environmental noise survey to establish and quantify existing noise levels at nearby noise sensitive properties potentially at risk of exposure to noise from the plant during typical daytime and night-time periods,
- Specification of maximum noise emission limits for new fixed building services plant to adhere,
- Calculation of noise propagation associated with the proposed plant scheme, and
- Recommendation of mitigation measures, where necessary.

The appendices of this report are described as follows:

- Appendix A contains a glossary of common acoustic terminology used within our reports, and
- Appendix B provides a summary of supporting information and documentation regarding planning policy and industry standards.

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2.0 The Site, Setting and Proposed Development

Building L014 (The Dairy) is located centrally within the University of Reading's London Road Campus. Surrounding buildings are generally associated with the University of Reading, including the Museum of English Rural Life (Building L018) and the Institute of Education, Campus Reception and Support Centre (Building L016).

London Road (the A4) to the north of the Site is a busy thoroughfare that experiences high traffic levels during peak times. Redlands Road bounds the Site to the east and connects the A4 to the A327 and the University of Reading White Knights Campus.

The Royal Berkshire hospital is situated immediately opposite Redlands Road to the east of the Site. The nearest residential premises are located approximately 130 metres to the south of Building L014. Housing along Morgan Road (250 metres south) and Kendrick Road (300 metres southeast) are also considered noise sensitive premises in the immediate area.

Proposed works consist of the installation of new building services plant to service the building, including a mechanical ventilation and heat recovery (MVHR) unit and single fan condenser unit. The condenser unit will be located externally on the roof of the building and the MVHR unit will be installed internally with fresh air and discharge air ductwork going to atmosphere.

The nearest identified noise sensitive receptors that have the potential to be impacted by the installation of new plant are identified in Table 3.1. It is considered that if noise from new plant is suitably controlled at the nearest sensitive receptors, then it will be suitably controlled at all other receptors further afield because of distance attenuation.

Table 3.1: Nearby noise sensitive receptors

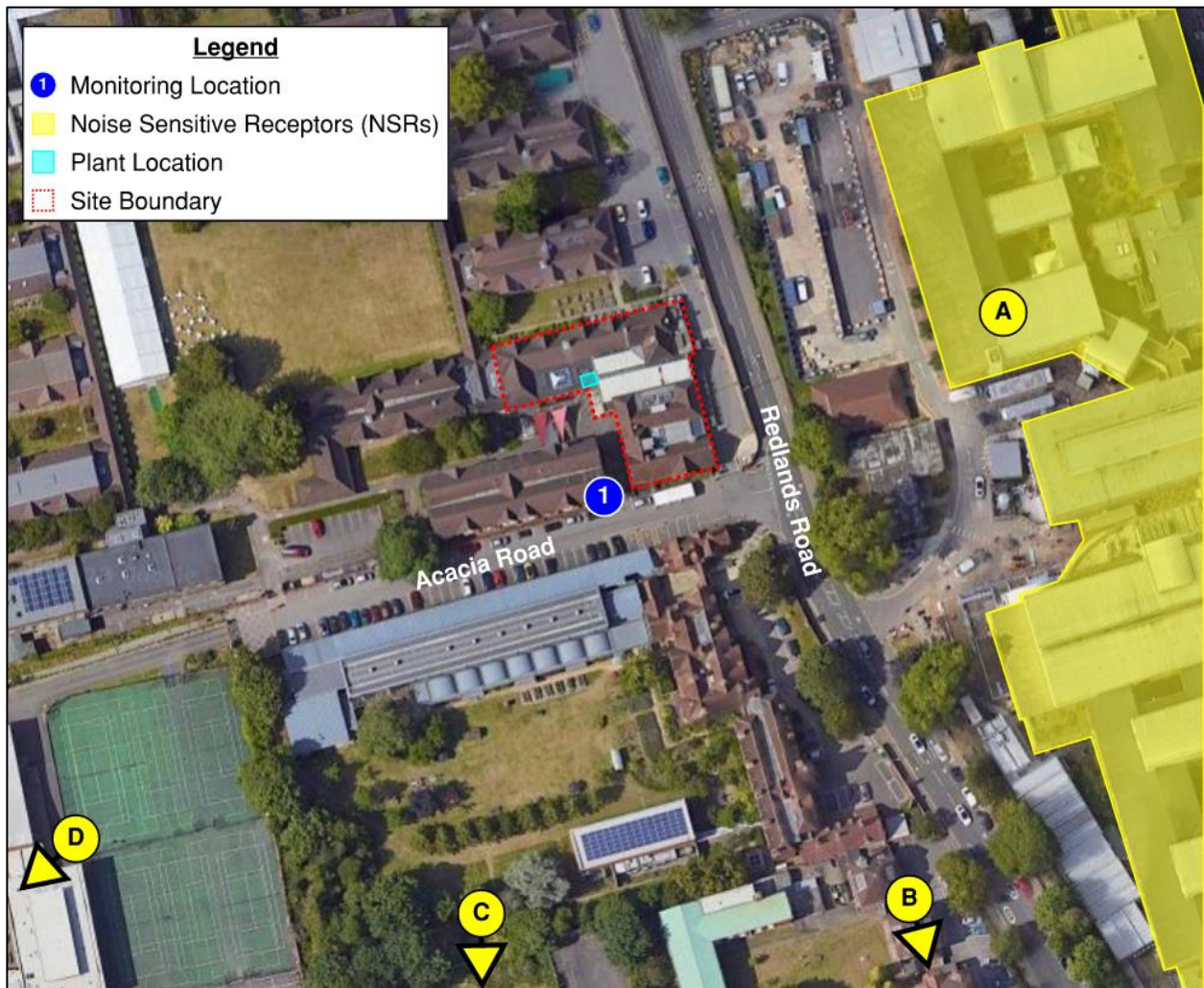
NSR	Address	Approximate Distance from Proposed Plant Location (metres)
A	Royal Berkshire Hospital, London Road, Reading RG1 5AN	50
B	Housing on Redlands Road, RG1 5EX	200
C	Housing on Morgan Road, RG1 5HG	250
D	Housing on Kendrick Road, RG1 5DU	300

Figure 3.1 indicates the location of the Site, proposed new plant location, noise monitoring location and nearest NSRs on an aerial image of the area.

The proposed development consists of the installation of new building services systems, including a condenser unit and an MVHR unit (internally).

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Figure 3.1: Location plan of the Site, new plant area, survey position and nearby noise sensitive receptors



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3.0 Assessment Criteria

Consideration has been given to relevant policy and regulations concerning the development. The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and Noise Planning Practice Guidance provide a framework for how noise should be considered within the planning system. Generally, noise policy and guidance give Local Authorities flexibility to develop specific requirements appropriate to their area and the site in question.

The core aim of these documents is to avoid and reduce significant adverse impacts and other adverse impacts on health and quality of life. A more detailed overview of these documents is included within Appendix B of this document.

3.1 Reading Borough Council Requirements

The Local Planning Authority of Reading Borough Council (RBC) require that noise emissions from new plant are controlled as per policy EN17 of the Local Plan¹. Policy EN17 is presented as follows:

EN17: NOISE GENERATING EQUIPMENT

Where noise generating equipment is proposed, the noise source specific⁶¹ level (plant noise level) should be at least 10dBA below the existing background level as measured at the nearest noise sensitive receptor.

⁶¹ The noise source specific level is the measured noise level, as opposed to the rating level, which is the specific level with correction factors included.

The plant noise emission criteria set in this report have been derived based on Reading Borough Council policy.

3.2 Commercial and Industrial Noise Emissions

BS 4142:2014+A1:2019² provides a method to assess the likelihood of adverse comment caused by noise from new industrial and commercial sources, such as building services equipment. A summary of this industry standard is included within Appendix B of this document.

The objective method within BS 4142 proposes the assessment of noise impacts from industrial and commercial sound sources by subtracting the measured Background Sound Level from the Rating Sound Level. BS 4142 states the following:

- a) Typically, the greater this difference, the greater the magnitude of the impact.
- b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on context.
- c) A difference of around +5 dB is likely to be an indication of a significant adverse impact, depending on the context.
- d) The lower the Rating Level is relative to the measured Background Sound Level, the less likely it is that the Specific Sound source will have an adverse impact or a significant adverse impact. Where the Rating Level does not exceed the Background Sound Level, this is an indication of the Specific Sound source having a low impact, depending on the context.

¹ Reading Borough Local Plan Adopted November 2019

² British Standards Institute BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound.

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Planning Practice Guidance (PPG) provides advice on how to manage potential noise impacts from new development through planning. A short summary of this document is provided in Appendix B, including the noise exposure hierarchy. Achieving a Rating Level below the measured Background Sound Level correlates with the Lowest Observable Adverse Effect Level (LOAEL) in terms of the Noise exposure hierarchy in PPG and is an indication that noise may be audible at the assessment location but does not cause change in behaviour or impact quality of life.

In terms of PPG, targeting a Specific Sound Level ($L_{Aeq,T}$) limit of 10 dB below the Background Sound Level ($L_{A90,T}$) is considered low risk of adverse impact to nearby noise sensitive receptors, providing that the plant does not have any acoustic features (tonality, impulsiveness, intermittency, etc.) that require significant corrections.

The above approach may form the basis of a suitably worded planning condition to regulate noise emissions from new building services plant.

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4.0 Baseline Noise Survey

4.1 Methodology

A noise survey was undertaken at the Site between 12th – 14th July 2023 to measure the existing noise conditions. The purpose of the survey was to establish the existing background noise levels (dB $L_{A90,7}$) at a location representative of the nearest NSRs. The selected survey position is described in Table 4.1 and illustrated in Figure 3.1.

Table 4.1: Description of survey position

Position	Survey period		Description
1	Start	10:30AM 12/07/23	Location representative of the background noise conditions at the nearby NSRs. Unattended measurement at the roadside of Acacia Road. Microphone affixed to a lamp post at approximately 2.5 metres above ground level (AGL).
	End	10:30AM 14/07/23	

Baseline noise monitoring was undertaken in accordance with BS 7445³. Noise monitoring was undertaken with a calibrated, precision grade (Class 1) sound level meter. The sound level meter was set-up to record over 15-minute periods with the A-weighting network over a 125 ms fast response time constant intervals for the duration of the survey. Data collection in one-third-octave band frequency was selected. Details of the survey equipment are provided in Table 4.2. Calibration certificates for all our survey equipment can be provided upon request.

Table 4.2: Details of survey equipment

Equipment	Identity	Calibration Certificate Number	Calibration Certificate Date
NTi XL2 Sound Level Meter	Serial No. A2A-21348-E0	UK-22-111	21/09/22
NTi MA220 Preamplifier	Serial No. 11131	UK-22-111	21/09/22
NTi MC230A Microphone System	Serial No. A23596	UK-22-111	21/09/22
Larson Davis CAL200 Calibrator	Serial No. 20256	44825-20256-CAL200	28/10/22
Bresser Weather Centre 5-in-1	LOT No. 7002510-1274880	N/A	N/A
Accuracy: Sound level meters were field-checked and calibrated at the start and end of the survey periods. No significant drift in calibration was observed.			
Sound calibrator: The accuracy of the sound calibrator used can be traced to National Physical Laboratory Standards.			

Weather conditions at the Site were monitored using a mobile weather station. The weather station was setup to monitor temperature, rainfall, wind direction and wind speed. Typical meteorological conditions were noted to be conducive to the measurement of sound. Weather conditions monitored over the survey period are presented:

Temperature:	12 – 21 (°C)
Rainfall:	0.0 (mm) – light rain showers between 12:00 to 18:00 on 13/07/2023
Wind Direction:	Southwest (predominantly)
Wind Speed:	Up to 4.5 (m/s)

³ British Standard Institution BS 7445-2:1991 Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use

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4.2 Results

A summary of the measured daytime (07:00 to 23:00) and night-time (23:00 to 07:00) noise levels for the survey period are presented in Table 4.1, with the full results displayed graphically in time-history format in Figure 4.1.

Table 4.1: Summary of noise survey results

Location	Time period	Ambient noise level, L_{Aeq}		Background noise level, L_{A90} ¹	
		Average	Range	10 th Percentile	Range
P1	Daytime (07:00 – 23:00)	55	47 – 66	45	44 – 53
	Night-time (23:00 – 07:00)	46	43 – 56	42	42 – 46

Note: ¹ 10th percentile value is considered representative of the quietest hour during the period.

Key observations made during the survey are provided below:

- Road traffic on Redlands Road and London Road (A4) is the dominant source of noise at a position representative of the Site and the nearest NSRs.
- Noise from existing building services plant associated with The Royal Berkshire Hospital is audible, but not intrusive at the Site.
- Noise from pedestrian movements influences noise levels to a degree.

Figure 4.1 presents an overview of ambient (L_{Aeq}), background (L_{A90}) and maximum (L_{AFmax}) sound level results measured over the full duration of the survey and in 15-minute time intervals at the unattended position on Acacia Road. Ambient noise levels drop between 5 – 10 dB during the night-time period - typically between the hours of 23:00PM and 06:00AM which indicates a cyclic diurnal pattern in baseline noise conditions.

Statistical analysis of Background Sound Levels measured during the survey has been undertaken to help establish a representative single-figure daytime and night-time level. The most frequently occurring Background Sound Levels measured during the daytime and night-time period are presented Figure 4.2. The modal (most frequently occurring) value is 47 dB $L_{A90,1hr}$ for the daytime and 43 dB $L_{A90,15min}$ for the night-time. For the assessment, however, the 10th percentile value of measured Background Sound Levels has been selected to reflect a more cautionary approach.

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Figure 4.1: Overview of measured noise levels at the unattended position on Acacia Road (Position 1)

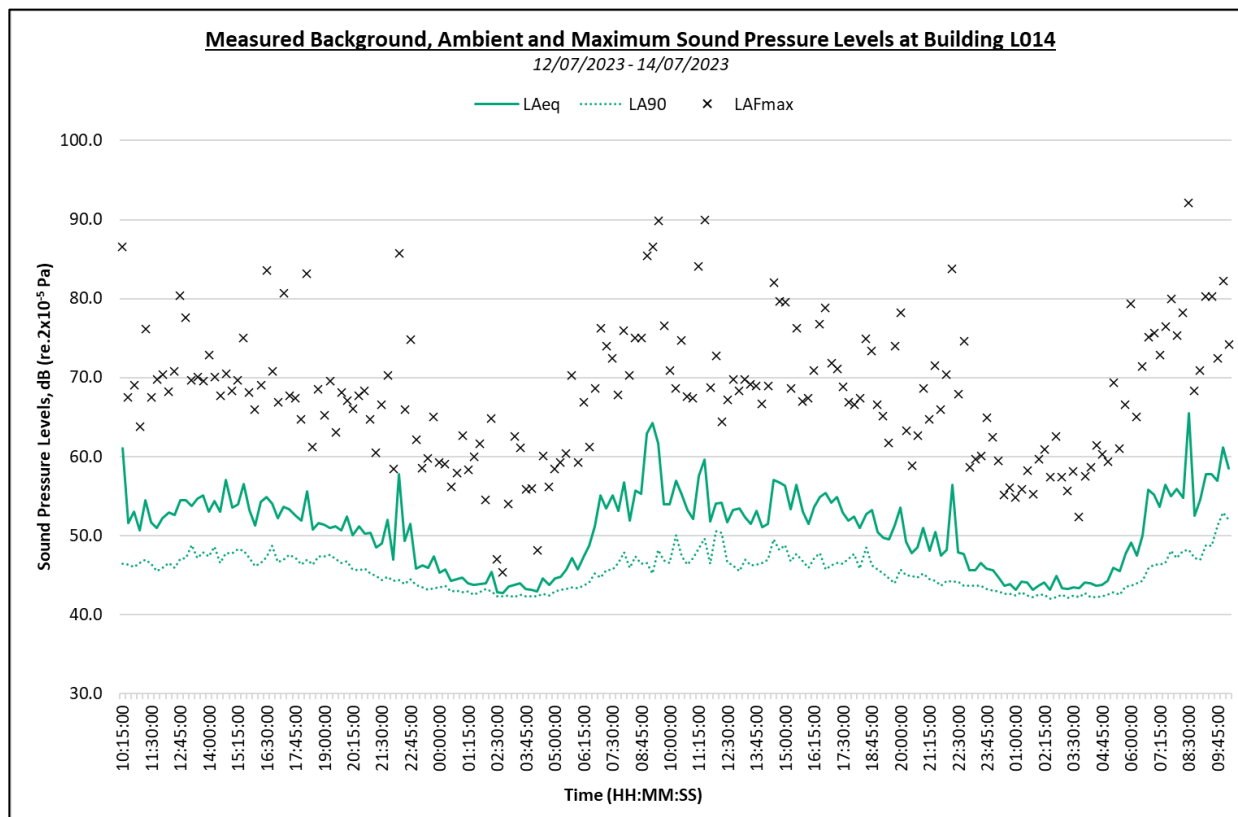
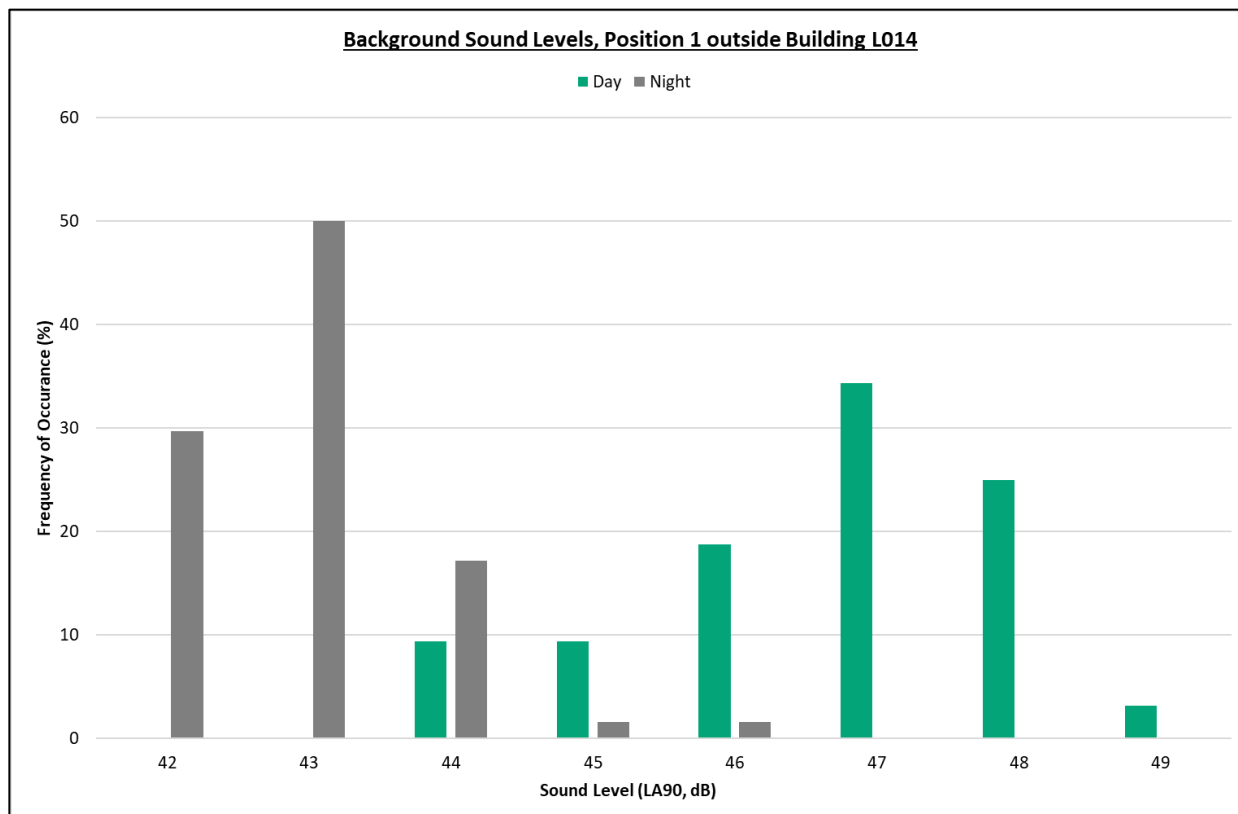


Figure 4.2: Background Sound Level analysis (dB LA90)



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5.0 Noise Impact Assessment

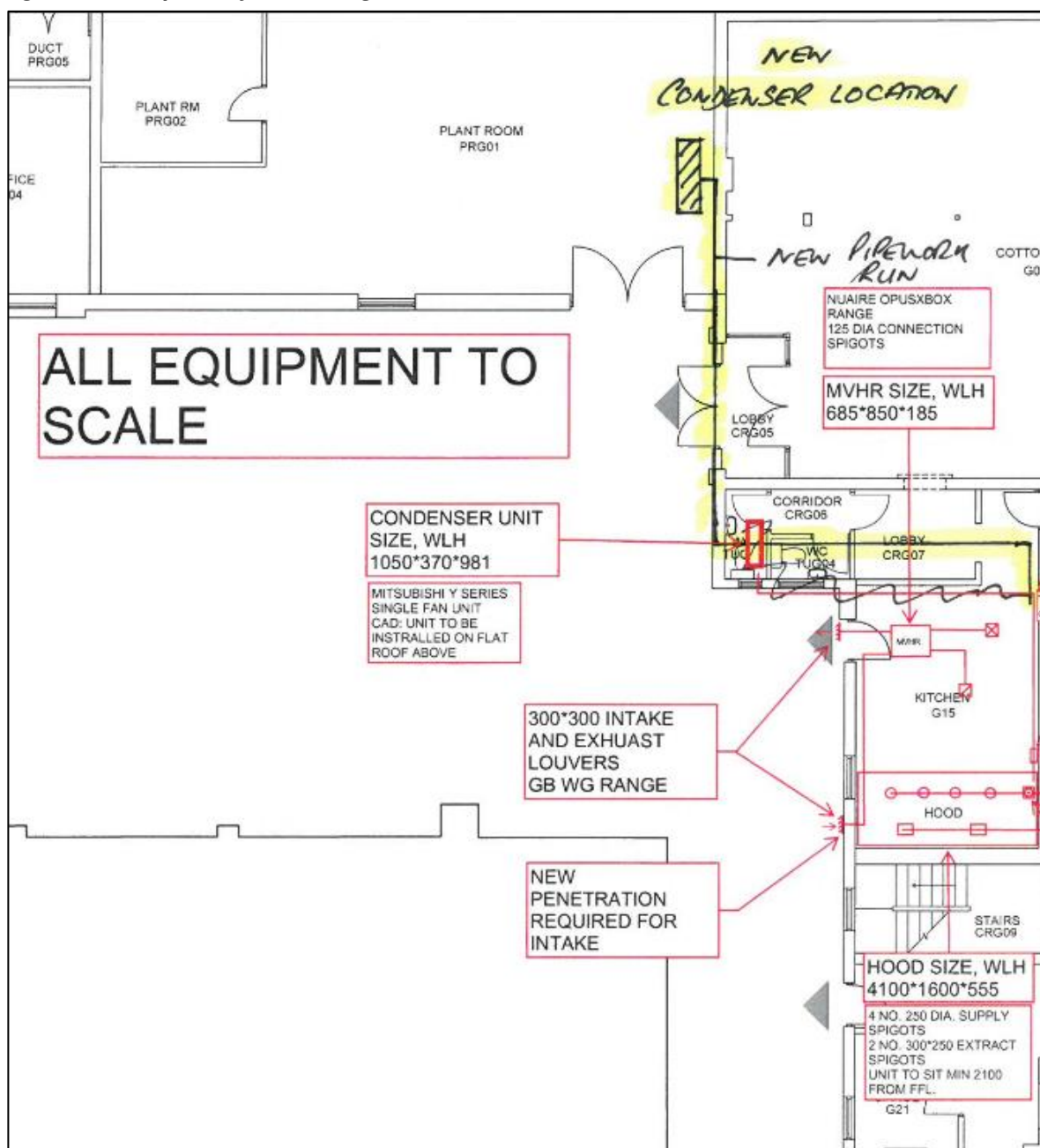
5.1 Proposals

The proposed plant area is understood to consist of the following items:

- 1no. Mitsubishi Electric Series Y Single Fan Condenser Unit: PUMY-SP140VKM
- 1no. Mechanical Ventilation and Heat Recovery Unit: Nuaire OPUSXBOX

The MVHR unit will service the kitchen of The Dairy and will be located internally. However, the MVHR will have an air intake and exhaust duct terminating to atmosphere. These have been included within the assessment alongside the rooftop condenser unit. A layout drawing of the proposed plant is presented in Figure 5.1.

Figure 5.1: New plant layout drawing



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Manufacturer sound level data for the proposed items of plant are provided in Table 5.1 as single figure A-weighted values. The octave band values have been estimated based on measured field data from similar equipment and adjusted to match the manufacturer's single figure A-weighted levels.

Table 5.1: Indicative plant sound levels

Description	Parameter	Sound power level per octave band centre frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Condenser (Heating)	Sound Pressure Level, L_p	63	58	56	53	52	47	40	33	56
Condenser (Cooling)		57	57	55	51	49	45	38	30	54
Opusxbox (Supply)	In-duct Sound Power Level, L_w	-	55	57	54	41	42	33	25	54
Opusxbox (Extract)		-	61	65	69	60	60	52	42	68

5.2 Operational Plant Noise Level Limits

Based on our understanding, the MVHR unit will operate during the opening hours of The Dairy comprising:

- Monday – Friday: 8am – 12am
- Saturday: 11am – 12:30pm
- Sunday: 11am – 11pm

Suitable noise emission limits have been derived based on the plant noise requirements of RBC and the measured background sound level in the area. Table 5.3 presents the cumulative noise limits applicable to all proposed building services to be installed. The plant noise limits apply to the total contribution of noise from all new plant items associated with the Proposed Development that may run during any period. The limits are to be met 1 m from the nearest habitable window of NSRs.

Table 5.3: Reading Borough Council - building services plant noise level limit (dB)

NSR (see Figure 3.1)	Background Sound Level, dB $L_{A90,T}$		Specific Sound Level, dB $L_{Aeq,Tr}$	
	Daytime (07:00-23:00)	Night-time (23:00 – 07:00)	Daytime (07:00-23:00)	Night-time (23:00 – 07:00)
All NSRs	45	42	35	32

In circumstances where air intake/exhaust systems open on to public or private spaces, it is recommended that noise is limited to NR40 dB (~48dB L_{Aeq}) at 1.5 metres as not to materially impact or inconvenience the user's amenity.

5.3 Noise Modelling

A model has been prepared in CadnaA noise mapping software to calculate the propagation of noise from the proposed new plant equipment, in general accordance with BS 9613⁴. The model has been constructed based on the proposed plant units and open-source map data (Google maps 2022 & OpenStreetMaps 2022). The parameters chosen for the modelling are described in Table 5.4.

⁴ British Standards Institute BS 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'

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Table 5.4: List of global modelling configuration parameters and values

Parameter	Value
Industry standards	ISO 9613
Co-ordinates system	British Transverse Mercator co-ordinates
Max order of reflections	3
Default ground absorption	0.2
Building absorption	0.21

Each plant item was assigned a source power level in the model and placed in a position representative of the proposed plant layout. An image showing the modelling results for the assessment is provided in Figure 5.2.

The results from the noise model have been used to determine the overall Specific Sound Level (dB $L_{Aeq,Tr}$) at the assessment locations for the daytime and night-time period. The results have been compared with the Council's plant noise limits in Table 5.5. Only assessment location A is presented since this is the nearest sensitive building to the proposed plant location. It is found that all other NSRs will not be impacted by the proposed installation given the considerable distance between them.

Table 5.5: Noise impact assessment results

NSR	Time	Background Sound Level dB L_{A90}	Specific Sound Level Limit dB $L_{Aeq,Tr}$	Predicted Specific Sound Level dB $L_{Aeq,Tr}$	Compliance with RBC requirements
A	Daytime (07:00-23:00)	45	35	22	Yes
	Night-time (23:00-07:00)	42	32		Yes

Furthermore, predicted noise levels from plant within the rear courtyard area are up to 47 dB L_{Aeq} and on that basis the noise level requirements have been achieved.

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Figure 5.2: Daytime predicted specific sound levels (dB $L_{Aeq,T,r}$)



5.4 Discussion & Recommendations

It is the responsibility of the Mechanical Engineer to select appropriate equipment to meet the Council's noise emission requirements (See Section 2.1). The Council's requirements can be achieved through limiting the Specific Sound Level from proposed plant to 35 dB during the daytime (07:00 to 23:00) and 32 dB during the night-time (23:00 to 07:00) when assessed at a position 1.0 metre outside an NSR.

It has been demonstrated through this assessment that compliance with the Local Planning Authority noise emission requirements can be achieved, providing the final plant selections do not have a higher noise level than the assessed plant. It is considered that noise emission from the proposed plant scheme is not likely to result in adverse impact to quality of life at NSRs in the area.

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Appendix A – Glossary of Acoustic Terminology

This appendix provides a non-specialists explanation of common acoustics terms that may occur in reports and technical notes. It is intended to give a brief overview of the term only.

Term	Definition
Decibel, dB	Is a unit of measurement of sound and is expressed on a logarithmic (base 10) scale. The human ear has a large dynamic range in sound reception, the logarithmic scale is a convenient way of compressing a range of sound pressures into a smaller range of numbers.
Sound Pressure Level, L_p	$L_p = 20 \log_{10} \left(\frac{P_{rms}}{P_{ref}} \right) dB$ This is the pressure deviation against a reference pressure caused by a passing sound wave. Where P_{rms} is the root mean square measured pressure and P_{ref} is the reference pressure, which is 2×10^{-5} pascals for air.
Sound Power Level, L_w	$L_w = 10 \log_{10} \left(\frac{P}{P_0} \right) dB$ This is the total sound energy radiated from a given source. P_0 is the reference sound power level (1×10^{-12}) and the measured power.
Noise Rating Level, NR dB	Commonly used when describing noise from building services systems. This is a single figure value derived by plotting a noise spectrum against a set of curves. The lowest curve under which the level fits is the resulting NR level. The overall NR value is the highest of the individual NR values for each frequency band.
Frequency, Hz	$f = \frac{1}{T} = \frac{v}{\lambda}$ Where f is the frequency, T is the time to complete one cycle, v is the speed of sound and λ is the wavelength of a given sound pressure wave. Different frequencies are divided into octave and one third octave bands.
Frequency Weightings	Weightings are often applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions. Weightings are often used to present a single figure value from a spectrum of sound.
A-weighted sound pressure level, L_{pA}	The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.
Measurement Time Weightings, Fast, Slow	Depending upon the measurement in question the time response of a sound level meter can be adjusted. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.

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Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	An energy average and defined as the level of sound which, through a given period of time (T) would equate to the same A-weighted sound energy as the actual measured fluctuating sound.
Octave Band	A frequency band where the upper frequency of the band is twice the frequency of the lower limit.
Maximum noise Level, L_{AFmax}	With the meter set with a fast time response, F, this is the maximum instantaneous noise level measured during a given period of time.
Percentile level, $L_{AN,T} (L_{A90,T}, L_{A10,T})$	A sound pressure level which is exceeded for a given N% of a specified time period with an A-weighting and measured with a fast time response.
Background Sound/Noise Level, L_{A90}	Typically, these are amongst the lowest noise levels referenced over a given period and act to describe the noise level that is consistently exceeded 90% of the time. The background sound level excludes short term, intermittent noise sources and often acts to describe noise sources that operate consistently through a given period.
Ambient Noise Level	The most commonly used value to describe the ambient noise level the L_{Aeq} . It is the noise level in a given environment whilst it is subject to all of its normal sources of noise.
Rating Level, $L_{Ar,Tr}$	As defined in BS 4142. The equivalent continuous A-weighted sound pressure level that includes corrections for the presence of any acoustic characteristics such as tonality, impulsivity and intermittency.
Reverberation Time, T	The time needed for the sound pressure level to decrease by 60 dB after the sound source has stopped, often written RT60. T is often followed by descriptors to present type of reverberation time value. For example, a T_{mf} is the mid-frequency (500 Hz – 2 kHz) reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Absorption, A	$A = \alpha S$ This is a measure of how much sound energy is absorbed by a material rather than reflected. Acoustic absorption is derived from the multiplication of the absorption coefficient by the surface area, $S \text{ m}^2$ of a given material.
Absorption Class, A - E	The process of classifying materials into discreet Classes A-E, with Class A having the highest level of absorption. Each class band has upper and lower reference curve for absorption coefficients between 200 Hz and 5 kHz. Materials should be tested in accordance with BS EN ISO 354 and classified according to BS EN ISO 11654.
NRC	A single-number value ranging from 0 (no absorption) – 1 (100% absorption) describing the absorption performance of a material. NRC of a material is calculated by averaging its Sound Absorption Coefficients between 250 Hz – 2 kHz.

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Sound Insulation	The capacity of building elements to reduce sound transmission between spaces across a range of frequencies.
Sound Reduction Index, R	$R = L_1 - L_2 + 10 \log_{10} \left(\frac{S}{A} \right) \text{ dB}$ A laboratory measure of the sound insulation performance of a material in a given frequency band or range. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room, S is the area of the tested element and A is the equivalent sound absorption area.
Weighted Sound Reduction Index, R_w	A single figure value derived from a range of frequencies that characterises the sound reduction of a material. A reference curve is compared to the measured sound reduction indices and is adjusted until the total of unfavourable deviations below the reference curve is as close to but does not exceed 32.
Weighted Level Difference, D_w	$D = L_1 - L_2$ The difference in noise level between a source room and a receive room. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room. The difference is then weighted and stated as a single figure.
Standardized Weighted Level Difference, $D_{nT,w}$	$D_{nT} = D + 10 \log_{10} \left(\frac{T}{T_0} \right) \text{ dB}$ Where D is the measured level difference standardised for the reference reverberation time, T_0 and then weighted.
Weighted, Normalised Flanking Level Difference, D_{nFw}	The level difference via a flanking element, such as a mullion or ceiling detail, which is normalised and weighted.
Weighted, Normalised Element Level Difference, D_{new}	The level difference through a small element such as a trickle ventilator, which is normalised and weighted.
C_{tr}	A spectrum adaption term applied to the sound insulation single-number values (R_w , D_w , and $D_{nT,w}$). The C_{tr} adaption term acts to describe the performance of an element in the context of low frequency noise, such as that generated by traffic.
Impact Sound	Is the noise generated by an impact on a structure, such as walking or weight drops.
Weighted standardized impact sound pressure level, $L_{nT,w}$	$L_{nT} = L_i - 10 \log_{10} \left(\frac{T}{T_0} \right) \text{ dB}$ Where L_i is the measured impact sound pressure level standardised for the reference reverberation time, T_0. It is used to describe the impact sound insulation performance of a floor. This is a measured noise level in a receive room generated by a standardised impact source in the room above.
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence. A dynamic insertion loss, DIL, would include the impact of any regenerated noise.

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Cross-talk	This references noise transmission via ventilation duct or similar air path between rooms.
Vibration	The vibratory motion of a surface can be described by the displacement (m), velocity (m/s) or the acceleration (m/s²) of its oscillation. Depending upon the circumstance it is often useful to quantify the magnitude of vibration in a range of ways, including Peak to Peak, Peak, r.m.s. and dB. A reference level of 10-6 m/s² r.m.s. is usually used for acceleration.
Ground borne noise	Where the noise propagation path from a source is transmitted through the ground into a structure and is radiated via the structure, such as noise experienced from an underground train within a building above ground.
Structure borne noise	Noise caused by vibrating of elements of a structure, the source of which is within a building or structure with common elements.
Vibration Dose Value, VDV	$VDV = (\int_0^T a^4(t) dt)^{\frac{1}{4}}$ Where a(t) is the frequency weighted acceleration (m/s²), T is the total measurement period in seconds, VDV is the Vibration Dose Value (m/s^{1.75}) and is the dose a person is expected to be exposed to over the course of the day or night.
Estimated Vibration Dose Value, eVDV	$eVDV = k \cdot a_{rms} \cdot t^{0.25}$ Where k is a constant for crest factors (typically 1.41), a_{rms} is the weighted rms acceleration and t is the cumulative time of the period Typically used on short duration measurements of transients with known durations and occurrences

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Appendix B – Summary of Relevant Planning Policy and Guidance

National Planning Policy Framework, 2021

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other developments can be produced.

One of the stated aims of the NPPF is to conserve and enhance the natural environment, as part of this new and existing developments should be prevented from contributing to or being put at risk from or being adversely affected by unacceptable levels of noise pollution. Planning policies and decisions should aim to mitigate and reduce to a minimum potential adverse impact resulting from noise or resulting from noise associated with a new development.

The NPPF refers to the Noise Policy Statement for England.

Noise Policy Statement for England, 2010

The aim of the NPSE is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.

The following are the general national noise policy 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.

To define and quantify noise impacts the NPSE presents the following measures:

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.

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.

Planning Practice Guidance, Noise 2019

The Planning Practice Guidance provides an online resource appraising when noise is relevant to the planning process, its relationship with other planning concerns and how noise impacts can be determined. The resource references the NPSE and its approach for determining whether significant adverse effects are likely to occur.

The document presents a noise exposure hierarchy which is a useful framework for assessing the likely responses elicited by noise and whether action should be taken to mitigate. The noise exposure hierarchy is provided in the following figure.

The guidance document seeks to explain the subjective nature of noise and the factors that apply when determining the level of impact experienced.

The document also outlines how planning and design can address the adverse effects of noise.

Noise Impact Assessment

Figure B.1: Noise exposure hierarchy from PPG

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
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
Lowest Observed Adverse Effect Level			
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 and reduce to a minimum
Significant Observed Adverse Effect Level			
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

Noise Impact Assessment

British Standard 4142 2014 – Methods for rating and assessing industrial and commercial sound

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- a) sound from industrial and manufacturing processes;
- b) sound from fixed installations which comprise mechanical and electrical plant and equipment;
- c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial Site.

BS 4142 is applicable to the determination of the following levels at outdoor locations:

- a) rating levels for sources of sound of an industrial and/or commercial nature; and
- b) ambient, background and residual sound levels, for the purposes of:
 - 1) investigating complaints;
 - 2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and
 - 3) assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 defines the following terms:

Rating Level, $L_{Ar,Tr}$

Is the specific sound level plus any adjustment for the characteristic features of the sound. Characteristic features include tonality (up to +6 dB correction), impulsivity (up to + 9 dB correction) and intermittency (up to + 3 dB correction). For corrections of + 3 dB can be applied should any other characteristics be present that are distinctive against the residual acoustic environment.

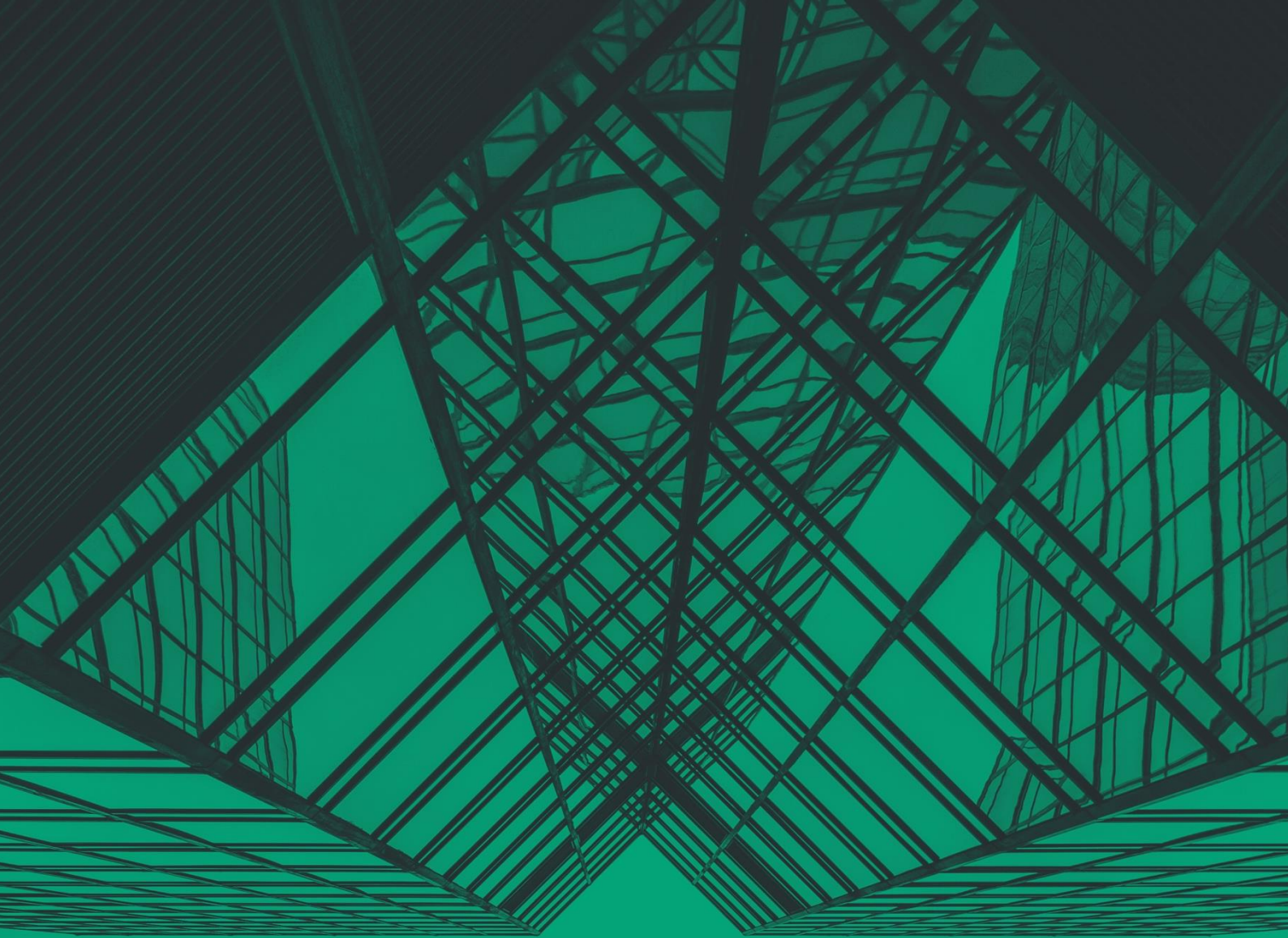
Residual Sound, L_r

Is the 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.

Specific Sound Level, $L_s = L_{Aeq,Tr}$

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

BS 4142 presents a range of methods and examples on how ratings and assessments can be carried out.



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