Noise Impact Assessment:

GB1 Data Centre, Ajax Avenue, Slough

October 2021






Experts in noise and vibration assessment and management

Document Control

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1 Introduction

1.1 Noise Consultants Limited (NCL) have been commissioned to undertake noise assessment of a data centre comprising 3No. buildings that are proposed for 651 - 664 Ajax Avenue, Slough (The site). The site is within the Slough Trading Estate which comprises various industrial and commercial premises including several other data centres.

1.2 The Estate lies within a subject Simplified Planning Zone (SPZ), which potentially means that a Noise Impact Assessment is not required to support a planning application or discharge associated planning conditions1. The SPZ Guidance at Appendix 2 advises Environmental Health issues that "the Local Planning Authority would expect developers to consider when drawing up individual schemes. It is within the best interests of developers to confer with the Borough Council's Environmental Health Division over environmental matters, if in doubt. This may avoid the need for remedial action at a later stage." Appendix 2 identifies "Noise and air pollution emissions from ventilation and arrestment plant, eg. position, height of chimneys and flues" as considerations.

1.3 This report presents the findings of a baseline sound survey and the results of an assessment of noise impacts resulting from the proposed development. This report has been prepared in accordance with national, regional and local legislation, policies, and guidance and by reference to appropriate British and International standards, as detailed in **Appendix A1**.

[1] It is recommended that a qualified Town Planner confirm the requirements and limitations of the SPZ

2 Site and Proposed Development

Current Site

2.1 The application site is a parcel of land of approximately 2 hectares on Ajax Avenue within the Slough Trading Estate which located approximately 1 mile west of the centre of Slough.

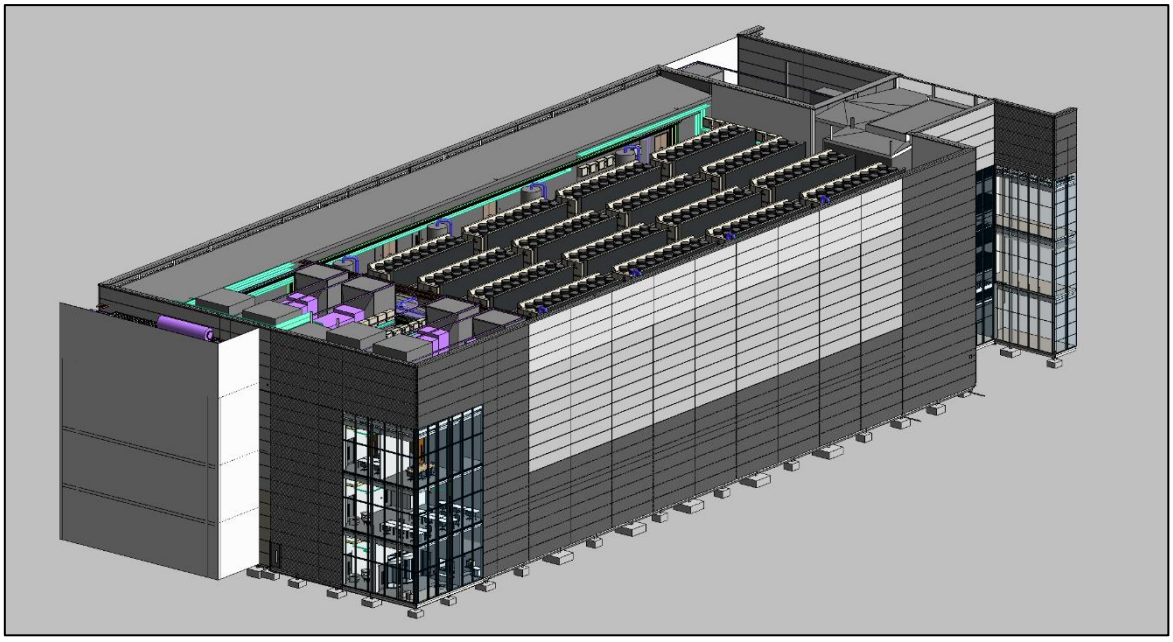
2.2 The site is located in a built-up area which features sites of a commercial/industrial nature as well as busy transportation routes including the A4 (Bath Road), A355 (Farnham Road), the Great Western Mainline railway line. The site is located approximately 1 mile north of the M4 motorway and 6 miles northwest of Heathrow Airport.

2.3 The site is currently occupied by various commercial premises. The wider trading estate includes various commercial uses including offices, retail, logistics centres and data centres.

Proposed Development

2.4 The Proposed Development comprises the construction 3 No. data centres. **Figure 1** presents an illustration of one building. The other 2 buildings are understood to be identical in terms of footprint and layout. **Figure 2** presents the location of the Proposed Development.

Figure 1: Proposed Development



2.5 Sound from operation of the Proposed Development has the potential to result in adverse effects at the nearby sensitive receptors. The following set out the sources of sound, per building, which have been identified as those with the potential to result in such effects based on the information received:

- *16No. 'low-noise' chillers;*

- *43No. direct expansion (DX) air conditioning units;*
- *10No. air handling units (AHUs);*
- *7No. 4.5 MVA emergency generators; and*
- *Sound break-out through building envelope.*

3 Baseline Conditions Assessment

3.1 A baseline sound survey was undertaken from the Tuesday 5th to Wednesday 6th of October 2021. The survey was designed to capture the ambient (L_{Aeq}) and background (L_{A90}) sound levels, in relation to the nearest residential Noise Sensitive Receptors (NSRs) and commercial premises.

Baseline Sound Survey

3.2 Attended sound measurements were made at the following locations:

- *The Astoria Heights apartment building (R1) located approximately 170 m northeast of the site on Farnham Road;*
- *The properties on Hadlow Court (R2) located approximately 260 m southeast of the site boundary;*
- *At locations near to the nearby commercial properties along Ajax Avenue (C1 – C4) and Malton Avenue (C5 – C6).*

3.3 **Figure 2** presents the monitoring locations for the baseline sound survey. The sound level meters (SLMs) were placed in a free-field location (i.e., it was positioned at least 3.5 m from all surrounding reflective surfaces other than the ground), with the microphone at a height of 1.4 m from the ground.

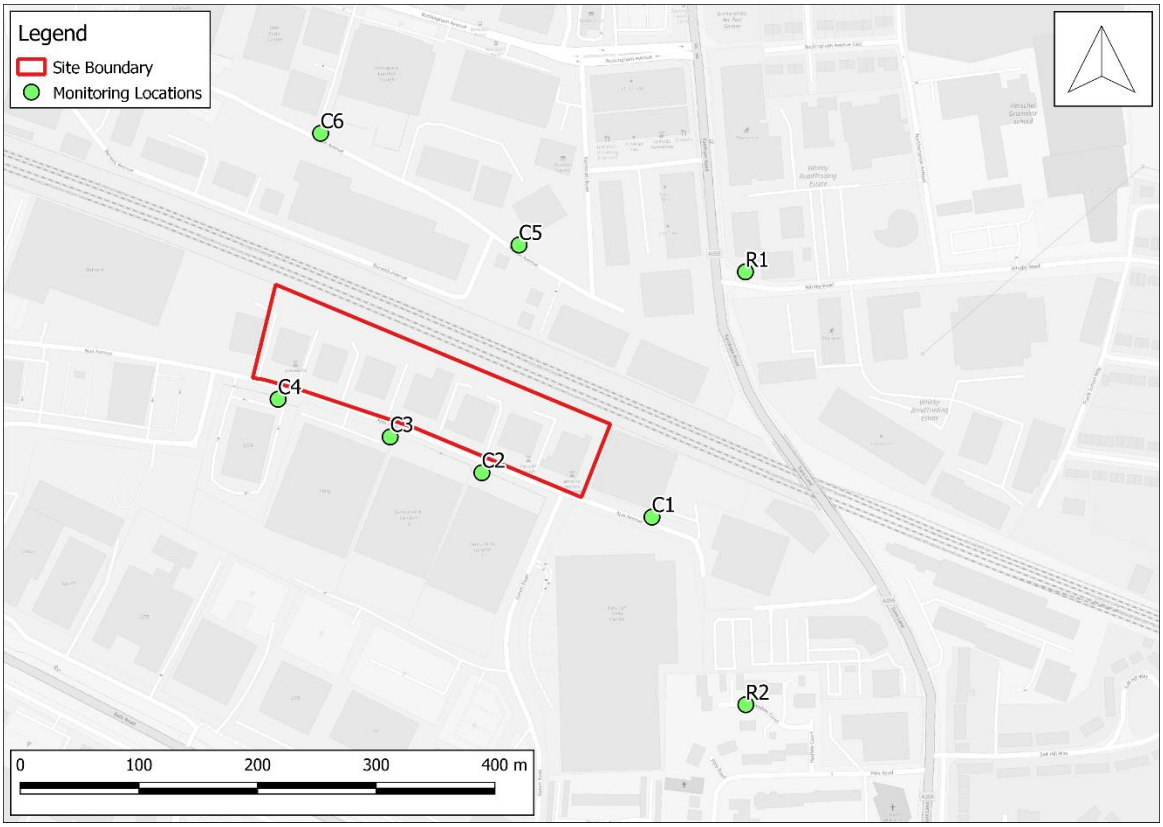
3.4 The calibration levels of the SLMs were checked before and after the measurement, with no significant drift in level recorded. A windshield was fitted to the microphone to minimise the effects of any wind induced sound.

3.5 Calibration details of the monitoring instrumentation can be provided upon request. The instrumentation was configured to report L_{Aeq}, L_{A10}, L_{A90}, and L_{Amax} parameters in 1/3rd octave bands in 15 minutes intervals, and to capture audio.

3.6 All measurements were conducted, where possible, in accordance with BS 7445-1:*2003 'Description and measurement of environmental noise. Guide to quantities and procedures'* (BS 7445, 2003) and BS 4142:2014:2019+A1.

3.7 Observations of the prevailing noise climate were made during the day, evening, and night to obtain a more detailed understanding of noise levels at the NSRs.

Figure 2: Sound Monitoring Locations



(Imagery ©2021 OpenStreetMap)

Survey Observations

3.8 A summary of the observations made by the surveyor when on site are presented in **Table 1**.

Table 1: Survey Observations

Location	Observations
R1	Road traffic noise from Farnham Road was dominant at this location throughout the daytime. Heavy goods vehicle noise was also regular through the day. Rail noise from the nearby railway line was just audible during train pass-bys, which occurred regularly during the day and the night shoulder periods. Aircraft noise was audible during the day. The background sound level was observed to be due to distant road traffic noise was during the daytime and the night-time.
R2	Fixed plant noise emanating from the Barclays Data Centre building immediately west of Hadlow Court was dominant at this location. Road traffic noise was just noticeable. Aircraft noise was also audible at this location.
C1 – C6	Background sound levels generally consist of distant road traffic noise and sounds due to building services equipment. Road traffic noise on local roads dominate the ambient sound levels when present.

Meteorological Conditions During Survey

3.9 The weather conditions during the survey were dry and cloudy with sunny periods in the day and clear at night, with wind speeds less than 5 ms^{-1}. The average temperature was 17 °C (ranging

between 16 °C and 17 °C) during the daytime and 13 °C (ranging between 12 °C and 13 °C) during the night-time measurement periods. The dominant wind direction during the survey was from the northeast.

Survey Results

3.10 The full baseline sound survey data is presented in **Appendix A4** and summarised in **Table 2** (rounded to the nearest decibel). To determine the background sound level ($L_{A90,T}$) to use for the assessment process, the mean levels have been adopted.

Table 2: Baseline Survey Results

Location	Time	dB $L_{Aeq, T}$	dB $L_{AFmax, T}$	dB $L_{A90, T}$ (Mean)
R1	Daytime (07:00 – 23:00 hrs)	67	98	58
	Night-time (23:00 – 07:00 hrs)	65	83	50
R2	Daytime (07:00 – 23:00 hrs)	52	72	48
	Night-time (23:00 – 07:00 hrs)	52	66	47
C1	Daytime (07:00 – 23:00 hrs)	55	73	52
C2	Daytime (07:00 – 23:00 hrs)	65	82	53
C3	Daytime (07:00 – 23:00 hrs)	65	83	52
C4	Daytime (07:00 – 23:00 hrs)	69	92	62
C5	Daytime (07:00 – 23:00 hrs)	66	84	63
C6	Daytime (07:00 – 23:00 hrs)	63	80	59

4 Assessment

Assessment Criteria

4.1 The assessment of noise impact at residential receptors follows the procedure described in British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BS 4142:2014+A1:2019).

4.2 The assessment of noise impact at non-residential receptors is not covered within the scope of BS 4142:2014+A1:2019 so reference has been made to British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings' (BS 8233:2014).

4.3 The assessment considers impact due to normal operations and emergency conditions separately.

Assessment of Normal Operations

Assessment of Impact upon Residential Receptors

4.4 The basic procedure of a BS 4142:2014+A1:2019 assessment is to determine the operational sound levels from the source(s) under assessment, (known as the rating level) at the assessment location(s). This is then compared against the existing acoustic environment (i.e., the background sound level). Noise modelling was therefore completed in relation to the nearest noise sensitive receptors (NSRs). The BS 4142:2014+A1:2019 assessment has been carried with respect to sound levels predictions for NSRs R1 and R2 (see **Figure 2**).

4.5 Specific sound level predictions have been conducted based on sound power data in **Appendix A3.** Based on these predictions, **Table 3** presents the outcomes of the BS 4142:2014+A1:2019 assessment for nearby residential receptors during normal conditions. Importantly, the assessment assumes that plant noise does not contain impulsive components and that potential tonal noise from chillers will not be perceptible at NSRs and therefore does not attract penalties for character corrections.

Table 3: BS 4142:2014+A1:2019 Assessment – Normal Conditions

Description	Sound level (dB)			
	R1 (daytime)	R2 (daytime)	R1 (night-time)	R2 (night-time)
Specific Sound Level dB $L_{Aeq,Tr}$	46	48	46	48
Tonality, dB	0	0	0	0
Impulsivity, dB	0	0	0	0
Other Character Corrections, dB	0	0	0	0

Description	Sound level (dB)			
	R1 (daytime)	R2 (daytime)	R1 (night-time)	R2 (night-time)
Rating Level calculated at the closest proposed dwelling rounded to nearest dB, dB $L_{Ar,Tr}$	46	48	46	48
Background Sound Level, dB L_{A90}	58	48	50	47
Rating Level – Background Sound Level	-12	0	-4	+1
BS 4142:2014+A1:2019 Outcome	Indication of low impact depending on the context	Indication of low impact depending on the context	Indication of low impact depending on the context	Indication of low impact depending on the context

4.6 The table above shows that the rating level is at or below the existing background sound level during the day at both residential receptors. The rating level slightly exceeds the existing night-time background sound level at R2. However, this is considered to be an over-predicted worst-case assessment, as described in **Paragraph A3.2.** Therefore, a BS 4142:2014+A1:2019 outcome of "Indication of low impact depending on the context" is considered appropriate for the residential receptors during both the day and night.

Assessment of Impact upon Commercial Receptors

4.7 **Table 4** presents the predicted daytime ambient sound levels at nearby commercial receptors during normal conditions in addition to a comparison to guideline internal noise levels.

Table 4: BS 8233:2014 Assessment – Normal Conditions

Description	Sound level (dB)					
	C1	C2	C3	C4	C5	C6
Specific Sound Level dB $L_{Aeq,Tr}$	44	61	62	59	42	35
Existing Ambient Sound Level dB $L_{Aeq,T}$	55	65	65	69	66	63
Predicted Future Ambient Sound Level dB $L_{Aeq,T}$	55	67	67	69	66	63
Change in Ambient Sound Level dB $L_{Aeq,T}$	0	+2	+2	0	0	0
Predicted Future Internal Sound Level[2] dB $L_{Aeq,T}$	23	35	35	37	34	31

[2] A modern sealed façade is estimated to afford a 32 dB external-to-internal level difference

4.8 The table above shows that it is predicted that the Proposed Development could result in a 2 dB increase in external daytime ambient sound levels at the nearest commercial receptor during normal operations. However, when considering the typical sound attenuation provided by a modern sealed façade, internal sound levels are expected to be below the guideline internal sound levels of 35 – 40 dB $L_{Aeq,T}$ for an 'executive office' as presented in BS 8233:2014. Therefore, it is considered that impact at the nearest commercial receptors is not significant.

Assessment of Emergency Operations

4.9 During power outages generators will operate in addition to continuously operating plant. The frequency of power outages is anticipated to be very low. However, an assessment of noise impact during these periods has been provided for information purposes.

Assessment of Impact upon Residential Receptors

4.10 Specific sound level predictions have been conducted based on sound power data presented in **Appendix A3.** Based on these predictions, **Table 5** presents the outcomes of the BS 4142:2014+A1:2019 assessment for nearby residential receptors during emergency conditions. Importantly, the assessment assumes that plant noise does not contain impulsive components and that potential tonal noise from chillers will not be perceptible at NSRs and therefore does not attract penalties for character corrections.

Table 5: BS 4142:2014+A1:2019 Assessment – Emergency Conditions

Description	Sound level (dB)			
	R1 (daytime)	R2 (daytime)	R1 (night-time)	R2 (night-time)
Specific Sound Level dB $L_{Aeq,Tr}$	53	51	53	51
Tonality, dB	0	0	0	0
Impulsivity, dB	0	0	0	0
Other Character Corrections, dB	0	0	0	0
Rating Level calculated at the closest proposed dwelling rounded to nearest dB, dB $L_{Ar,Tr}$	53	51	53	51
Background Sound Level, dB L_{A90}	58	48	50	47
Rating Level – Background Sound Level	-5	+3	+3	+4
BS 4142:2014+A1:2019 Outcome	Indication of low impact depending on the context	Indication of adverse impact depending on the context	Indication of adverse impact depending on the context	Indication of adverse impact depending on the context

4.11 The table above shows that the rating level exceeds the existing background sound level during the daytime and the night-time periods. An initial BS 4142:2014+A1:2019 assessment would therefore result in the outcome of 'Indication of adverse impact depending on the context'. However, as stated in **Appendix A1,** a BS 4142:2014+A1:2019 assessment requires "*the margin by which the rating level of the specific sound source exceeds the background sound level"* to be considered in conjunction with *"the context in which the sound occurs"*.

4.12 As stated above, the emergency generators would only be expected to run concurrently during power outages. The frequency of occurrence is therefore anticipated to be very low.

4.13 With regards to routine testing, the above table represents a worst-case assessment because all the generators would not be tested concurrently, and they would be tested at zero load. Importantly testing would be conducted during the day and limited to a maximum of 1 hour per generator.

4.14 Therefore, due to the factors listed above, a BS 4142:2014+A1:2019 outcome of "Indication of low impact depending on the context" is considered appropriate for the residential receptors during both the day and night.

Assessment of Impact upon Commercial Receptors

4.15 **Table 6** presents the predicted ambient sound levels at nearby commercial receptors during emergency conditions along with a comparison with guideline internal noise levels.

Table 6: BS 8233:2014 Assessment – Emergency Conditions

Description	Sound level (dB)					
	C1	C2	C3	C4	C5	C6
Specific Sound Level dB $L_{Aeq,Tr}$	50	64	64	61	51	43
Existing Ambient Sound Level dB $L_{Aeq,T}$	55	65	65	69	66	63
Predicted Future Ambient Sound Level dB $L_{Aeq,T}$	56	67	68	70	66	63
Change in Ambient Sound Level dB $L_{Aeq,T}$	+1	+2	+3	+1	0	0
Predicted Future Internal Sound Level[3] dB $L_{Aeq,T}$	24	35	36	38	34	31

[3] A modern sealed façade is estimated to afford a 32 dB external-to-internal level difference

4.16 The table above shows that it is predicted that the Proposed Development could result in a 3 dB increase in external daytime ambient sound levels at the nearest commercial receptor during emergency operations. However, when considering the typical sound attenuation provided by a modern sealed façade, internal sound levels are expected to be below the guideline internal sound levels of 35 – 40 dB $L_{Aeq,T}$ for an 'executive office' as presented in BS 8233:2014. Therefore, it is considered that impact at the nearest commercial receptors is not significant.

5 Conclusion

5.1 Noise Consultants Ltd (NCL) was instructed to carry out an assessment to identify the potential effects of noise at the nearest noise sensitive receptors (NSRs) resulting from the proposed new data centre on Ajax Avenue, Slough.

5.2 The proposals include the following noise generating sources:

- *16No. 'low-noise' chillers;*
- *43No. direct expansion (DX) air conditioning units;*
- *10No. air handling units (AHUs);*
- *7No. 4.5 MVA emergency generators; and;*
- *Sound break-out through building envelope.*

5.3 A BS 4142:2014+A1:2019 assessment has been conducted in relation to residential receptors which results in, once contextual factors have been considered, an "Indication of Low Impact depending on the context" for the daytime (07:00 – 23:00hrs) and night-time (23:00 – 07:00hrs) during normal and emergency operations.

5.4 Importantly, the assessment assumes that plant noise does not contain impulsive components and that potential tonal noise from chillers will not be perceptible at NSRs and therefore does not attract penalties for character corrections.

5.5 In respect of nearby commercial receptors consideration has been given to BS 8233:2014, by considering future ambient sound levels and potential sound break-in through modern sealed façades. Predicted internal noise levels at neighbouring commercial premises indicate compliance with BS8233 Criteria for an 'executive office'.

5.6 During the daytime and night-time, the predicted operational noise levels are considered to be below LOAEL for all receptors by reference to Planning Practice Guidance-Noise (PPG-N). Under such circumstances PPG-N advises that the action is "No specific measures required".

6 Glossary

dB	Decibel. The logarithmically scaled measurement unit of sound.
A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
$L_{Aeq,T}$	A-weighted equivalent continuous residual sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
$L_{Aeq,Tr}$	A-weighted equivalent continuous sound pressure level at the assessment position produced by the specific noise source over a given reference time interval, Tr.
$L_{A90,T}$	The A-weighted sound level exceeded for 90% of the measurement period. Often referred to as the background sound level.
L_{Amax}	The A-weighted maximum recorded noise level during a measurement period.
$L_{Ar,Tr}$	The rating level at the assessment position. This is the specific level plus any adjustment for characteristic features of the sound.
R_w	The weighted Sound Reduction Index which characterises the airborne sound insulation of a building element over a range of frequencies with a single number quantity.

7 Appendices

A1 Relevant Policy and Guidance

Noise Policy Statement for England (NPSE, 2010)

A1.1 The Noise Policy Statement for England (NPSE, 2010) sets out the Government's Noise Policy Vision to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

A1.2 This long-term vision is supported by three Noise Policy Aims that can be delivered through effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development. These aims are to:

1. *avoid significant adverse impacts on health and quality of life;*
2. *mitigate and minimise adverse impacts on health and quality of life; and*
3. *where possible, contribute to the improvement of health and quality of life.*

A1.3 The explanatory note to the NPSE sets out 'effect levels' which are aligned to the Policy Aims. Drawing upon established concepts from toxicology, the NPSE defines the following noise effect levels:

- NOEL - 'No Observed Effect Level';
- LOAEL - 'Lowest Observed Adverse Effect Level'; and
- SOAEL - 'Significant Observed Adverse Effect Level'.

A1.4 The explanatory note describes SOAEL as the effect level above which significant adverse effects on health and quality of life occur, aligning this level with the first policy aim.

A1.5 LOAEL is described as the level at which adverse effects begin and the second aim of the NPSE refers to a situation where the effect lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8 of the NPSE) however this does not mean that such adverse effects cannot occur.

A1.6 NOEL is described as a level of noise exposure below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life.

A1.7 The third aim seeks, where possible, to positively improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society.

A1.8 The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

A1.9 NPSE states that it is not possible have a single, numerical definition of the SOAEL that is applicable to all sources of noise in all situations, since the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

National Planning Policy Framework (NPPF, 2019)

A1.10 The National Planning Policy Framework (NPPF, 2019) sets out the Government's planning policies for England and how these should be applied. The NPPF provides a framework within which locally-prepared plans for housing and other development can be produced.

A1.11 In relation to noise, it states:

"174. Planning policies and decisions should contribute to and enhance the natural local environment by: …

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

A1.12 The NPPF includes policy which makes reference to 'significant adverse impacts on health and quality of life', as per the NPSE. NPPF policy states:

"185. Planning policies and decisions should aim to 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:

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

Planning Practice Guidance – Noise (PPG-Noise, 2019)

A1.13 The Planning Practice Guidance (PPG-Noise, 2019) provides further detail about how the effects of noise can be described in terms of perception and outcomes. The noise exposure hierarchy is presented in **Table A.1.1**. It is aligned with increasing effect levels as defined in the NPSE but adds a fourth 'Unacceptable Adverse Effect Level' (UAEL).

A1.14 This effect level is higher than the significant adverse effect on health and quality of life (SOAEL) and PPG-Noise requires that unacceptable adverse effects be prevented.

A1.15 This noise exposure hierarchy is based on the principle that once noise or vibration becomes perceptible, the effect on people and other receptors increases as the level increases. PPG-Noise presents example outcomes to help characterise these effects using non-technical language. In general terms, an observed adverse effect is characterised as a perceived change in quality of life for occupants of a building or a perceived change in the acoustic character of an area, whereas a significant observed adverse effect disrupts activities.

Table A.1.1: Planning Practice Guidance – Noise Exposure Hierarchy

Perception	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 or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived 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 and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			

Perception	Examples of Outcomes	Increasing Effect Level	Action
Present and disruptive	The noise causes a material change in behaviour and/or attitude, 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 and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

A1.16 PPG-N does not provide numerical values for the effect levels, instead PPG-N recognises that "*the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation*".

A1.17 These factors include:

- "The source and absolute level of the noise together with the time of day it occurs. Some types and levels of noise will cause a greater adverse effect at night than if they occurred during the day - this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night."
- "For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise."
- "The spectral content of the noise (i.e., whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e., whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area."
- "Consideration should also be given to whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions)"

A1.18 The setting of LOAELs and SOAELs for transportation sources has reached a form of consensus following a number of high-profile infrastructure projects in England, namely HS2 and a series of Highways England road schemes which have been successful through the Government's Hybrid Bill and Development Consent Order (DCO) consenting processes.

A1.19 However, the setting of LOAELs and SOAELs for industrial noise is not well rehearsed. Because the recognised assessment of these types of sources is based on the prominence of the sound source relative to baseline levels, it does not readily lend itself to a single threshold value. In the following section LOAEL values have been selected for these types of noise source based on professional experience and consideration of associated standards and guidance.

A1.20 **Table A.1.2** summarises the proposed threshold levels relating to operational sound.

Table A.1.2: Proposed LOAEL and SOAEL Criteria by reference to BS 4142:2014+A1:2019

Period	LOAEL	SOAEL
Daytime (0700-2300hrs)	Rating level ($L_{Ar,Tr}$) less than or equal to background sound level, $L_{A90,T}$ (with consideration of context)	Rating level ($L_{Ar,Tr}$) +10 dB above background sound level, $L_{A90,T}$ (with consideration of context)
Night-time (2300-0700hrs)		

A1.21 In instances where the predicted rating levels are between the LOAEL and the SOAEL thresholds, this can require some additional quantitative and qualitative considerations. Consideration must be given to the context within which the effect occurs in addition to employing professional judgement. These considerations can include:

- the magnitude of the effect;
- the change in magnitude of the effect;
- the type of effect, including its intermittency;
- the existing ambient environment
- how effective the measures employed to mitigate the effect are, including Best Practicable Means (BPM); and
- the duration of the effect.

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

A1.22 BS 4142:2014+A1:2019 is used to rate and assess sound of an industrial nature including but not limited to assessing sound from proposed, new, modified or additional sources of industrial sound. It contains guidance on the monitoring and assessment of industrial and commercial sound sources

(including fixed installations comprising mechanical and electrical plant and equipment) affecting sensitive receptors.

A1.23 The methodology relies on comparing the operational rating level, $L_{Ar,Tr}$, with the background sound level, $L_{A90,T}$ (i.e. the level that would be present without the development) over a representative time period. BS 4142:2014+A1:2019 provides guidance on the measurement of background sound, the determination of specific sound and calculation of the rating level.

A1.24 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. A character correction should be added to the specific sound level to obtain the rating level, where such features are present at the assessment location. This can be approached in three ways, however the subjective method is considered appropriate for this assessment. This states that the specific sound level should be corrected if a tone, impulse or other characteristic occurs, or is expected to be present for new sound sources.

Tonality

A1.25 A tonal correction between 0 and +6 dB can be applied for sounds that range from not tonal to prominently tonal. Several methodologies are presented in BS 4142:2014+A1:2019 in order to determine the appropriate correction to be applied. **Table A.1.3** presents the subjective assessment method corrections for tonal sounds.

Table A.1.3: Subjective Method – Rating Level Corrections for Tonal Sounds

Subjective assessment of sound source at the receptor	Correction
The tone is just perceptible at the receptor	+2 dB
The tone is clearly perceptible at the receptor	+4 dB
The tone is highly perceptible at the receptor	+6 dB

A1.26 For the purposes of this assessment, it has been assumed that potential tonal noise from the chillers would not be readily perceptible at NSRs. A tonal penalty has therefore not been applied to the specific sound level.

Impulsivity

A1.27 An impulsivity correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. **Table A.1.4** presents the subjective method corrections for impulsive sounds.

Table A.1.4: Subjective Method – Rating Level Corrections for Impulsive Sounds

Subjective assessment of sound source at the receptor	Correction
Impulsivity is just perceptible at the receptor	+3 dB
Impulsivity is clearly perceptible at the receptor	+6 dB
Impulsivity is highly perceptible at the receptor	+9 dB

A1.28 For the purposes of this assessment, it has been assumed that all proposed plant will be suitably designed and that no impulsive sound will be perceptible at the NSRs. No impulsivity penalty has therefore been applied to the specific sound level.

Intermittency and Other Sound Characteristics

A1.29 Where the specific sound level features characteristics that are neither tonal nor impulsive, though otherwise are of an intermittent character, a penalty of +3 dB can be applied. Assuming that the proposed plant is kept well maintained and serviced regularly, no penalty is considered appropriate for other sound characteristics.

Assessment of Impacts

A1.30 BS 4142:2014+A1:2019 states *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."*

A1.31 BS 4142:2014+A1:2019 assessment methodology also states that:

- *"Typically, the higher the rating level is above the background sound level the greater the magnitude of impact;*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and*
- *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."*

British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings'

A1.32 BS 8233:2014 provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use.

A1.33 BS 8233:2014 provides noise guidance for buildings of different uses. With respect to open plan offices, Table 2 of BS 8233:2014 provides guideline internal sound levels of 45 – 50 dB $L_{Aeq,T}$ for open plan offices. With respect to an 'executive office' BS 8233:2014 suggests guideline internal sound levels of 35 – 40 dB $L_{Aeq,T}$.

Local and Regional Policy

Simplified Planning Zone Scheme 2014 – 2024 Slough Trading Estate, Slough (adopted 12 November 2014)

A1.34 The Estate lies within a subject Simplified Planning Zone (SPZ), which potentially means that a Noise Impact Assessment is not required to support a planning application or discharge associated planning conditions4. The SPZ Guidance at Appendix 2 advises Environmental Health issues that "the Local Planning Authority would expect developers to consider when drawing up individual schemes. It is within the best interests of developers to confer with the Borough Council's Environmental Health Division over environmental matters, if in doubt. This may avoid the need for remedial action at a later stage." Appendix 2 identifies "Noise and air pollution emissions from ventilation and arrestment plant, eg. position, height of chimneys and flues" as considerations.

[4] It is recommended that a qualified Town Planner confirm the requirements and limitations of the SPZ

A2 Measured Sound Levels

Table A.2.1: Summary of the Measured Baseline Survey Data at R1

Start	dB $L_{Aeq,15min}$	dB $L_{AFmax,15min}$	dB $L_{A90,15min}$
05/10/2021 14:20:00	71.4	97.6	61.6
05/10/2021 14:50:00	66.1	79.4	58.1
05/10/2021 21:30:00	64.0	76.2	54.8
05/10/2021 21:45:00	64.0	85.2	54.0
05/10/2021 23:45:00	59.7	72.5	50.3
06/10/2021 00:00:00	61.5	83.1	50.6
06/10/2021 00:15:00	57.2	68.9	49.8
06/10/2021 09:50:00	66.8	88.4	59.7
06/10/2021 10:05:00	65.5	78.4	59.1

Table A.2.2: Summary of the Measured Baseline Survey Data at R2

Start	dB $L_{Aeq,15min}$	dB $L_{AFmax,15min}$	dB $L_{A90,15min}$
05/10/2021 15:30:00	50.3	61.2	48.6
05/10/2021 15:45:00	52.6	69.6	48.4
05/10/2021 22:15:00	52.8	63.1	49.0
05/10/2021 22:30:00	53.4	63.1	49.0
05/10/2021 23:00:00	49.4	64.6	46.9
05/10/2021 23:15:00	49.3	64.0	47.4
06/10/2021 00:37:00	48.5	65.5	46.7
06/10/2021 10:36:00	49.6	62.5	47.6
06/10/2021 10:51:00	51.9	69.4	48.0

Table A.2.3: Summary of the Measured Baseline Survey Data at Commercial Receptors

Start	Measurement Duration (minutes)	Location ID	dB $L_{Aeq,10min}$	dB $L_{AFmax,10min}$	dB $L_{A90,10min}$
06/10/2021 11:22:00	10	C1	55.2	73.3	52.1
06/10/2021 15:45:00	10	C2	65.0	81.8	52.7
06/10/2021 22:15:00	10	C3	65.0	83.4	51.7
06/10/2021 22:30:00	10	C4	69.2	91.7	61.5
06/10/2021 23:00:00	10	C5	65.8	84.0	63.0
06/10/2021 23:15:00	10	C6	62.7	79.6	58.5

A3 Commercial / Industrial Sound Assumptions

A3.1 Each building of the Proposed Development comprises sets of sound-generating fixed plant items. Noise modelling has been conducted for the following plant items:

- *16No. 'low-noise' chillers;*
- *43No. direct expansion (DX) air conditioning units;*
- *10No. air handling units (AHUs);*
- *7No. 4.5 MVA emergency generators; and*
- *Sound break-out through building envelope.*

External Plant Items – Normal Conditions

A3.2 Sound power levels and frequency spectra used in the noise modelling of continuously operating rooftop located plant items are presented in **Table A.3.1.** All units have been assumed to operate at the same sound power level during both the day and night. This represents a worst-case as chillers can be expected to operate at a lower duty at night and notably 2 No. of the 16 No. chillers are stand-by units.

Table A.3.1: Externally Located Plant Items (Sound Power Level (L_W) per Unit)

Sound Source	Assumed source height (m, relative to roof level)	Number	Octave band centre Frequency (Hz)								A
			63	125	250	500	1k	2k	4k	8k	
Chiller[5]	3.0	16	97	97	97	97	90	84	77	72	96
DX outdoor Unit[6]	0.7 / 3.0	42	69	67	64	68	58	53	48	46	67
VRV[7]	1.1	1	95	90	86	86	78	75	73	71	87
AHU (Model 250)[8]	3.0	8	88*	84	80	77	73	66	60	54	79

[5] Dimensions obtained from *'FA4117_Special Preliminary.pdf'* datasheet provided by client and sound spectra obtained from email *'FW: GB1 MPA-2203-3C-Chiller LN details'* dated 14/20/2021.

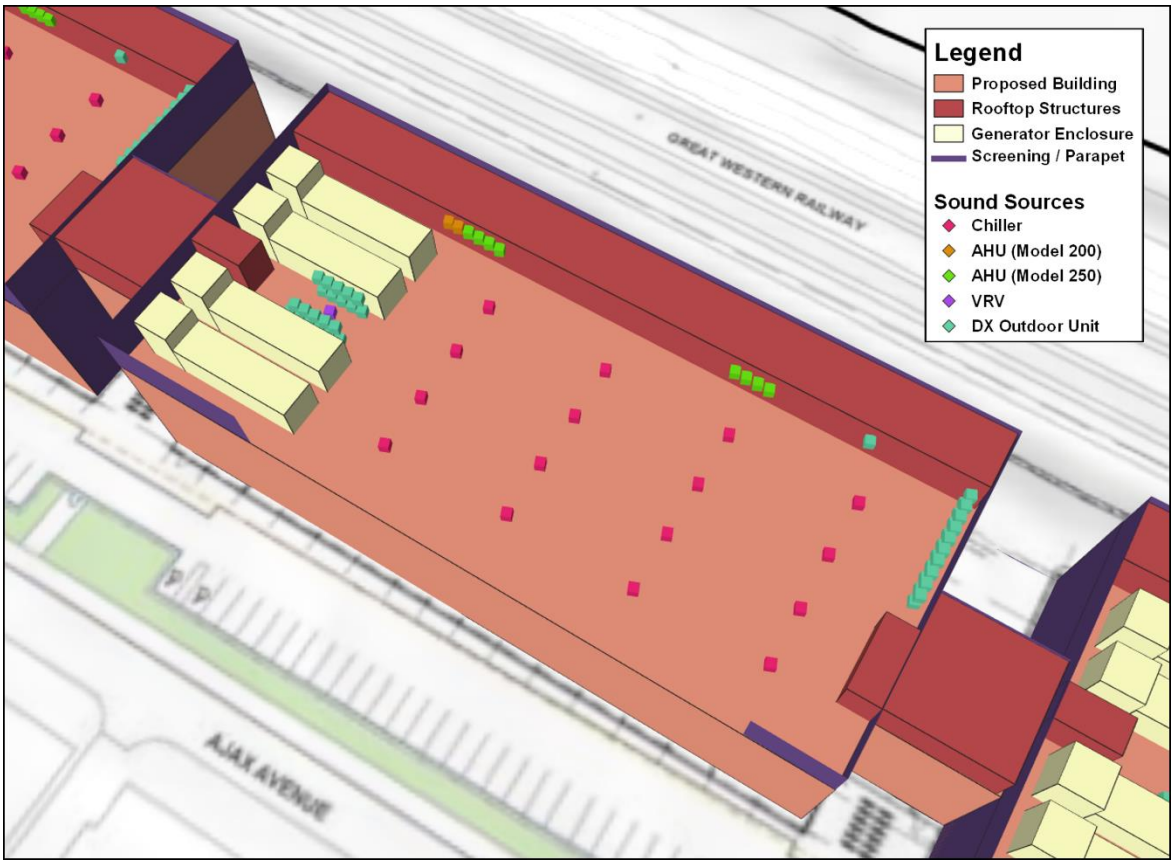
[6] Dimensions and sound spectra obtained from *'RZAG-NV1_EEDEN20_Data Books_English.pdf'*

[7] Dimensions and sound spectra obtain from *'REYQ-U, REMQ-U_EEDEN21_Data Books_English.pdf'*

[8] Dimensions obtained from *'Daikin Applied ERQ Range Brochure.pdf'* and sound spectra obtained from https://www.eceuk.com/assets/Documents/ERQ-AW1_en.pdf.

Sound Source	Assumed source height (m, relative to roof level)	Number	Octave band centre Frequency (Hz)								A
			63	125	250	500	1k	2k	4k	8k	
AHU (Model 200)[9]	3.0	2	88*	84	79	76	73	67	66	62	79
Total (all units)			**109 dB**								

Figure A.3.1: External Plant Items - Sound Source Locations



A3.3 Continuously operating rooftop located plants items have been modelled as shown in **Figure A.3.1**. Sound sources have been modelled as simple omnidirectional point sources located at the highest surface of the plant and placed in their expected location based on a review of the drawings provided[10] and a 3D model[11] of one of the proposed buildings. It has been assumed that each of the three proposed buildings has an identical layout with respect to rooftop located plant. The screening

[9] Dimensions obtained from *'Daikin Applied ERQ Range Brochure.pdf'* and sound spectra obtained from https://www.eceuk.com/assets/Documents/ERQ-AW1_en.pdf.

[10] *'DES-XX-03-DR-M-CWTR-5501 UNCONTROLLED.pdf'* and *'GB1-DES-XX-03-DR-M-HVAC-5502 DRAFT.pdf'*

[11] *'GB1-DES-XX-XX-M3-ME-00001.nwc'*

effects due to the 5.5 m high parapet wall and other rooftop structures has been considered as illustrated in **Figure A.3.1**. The louvre on the southern façade of each building was assumed to be non-acoustic and was therefore modelled by removing a section of the parapet wall.

External Plant Items – Emergency Generator

A3.4 Sound power levels and frequency spectra used in the noise modelling of the emergency generators are presented in **Table A.3.2,** equivalent to 76dBL_{Aeq} at 1 metre**.**

A3.5 4No. of the generators, per building, will be located on the roof will be provided with 'Type 1' containerized enclosures. 3No. of the generators, per building, will be stacked vertically to the side ('side pods') and between the data centre buildings (gantries) in 'Type 2' containerized enclosures and be integrated within the building envelope but designed to the same noise standards.

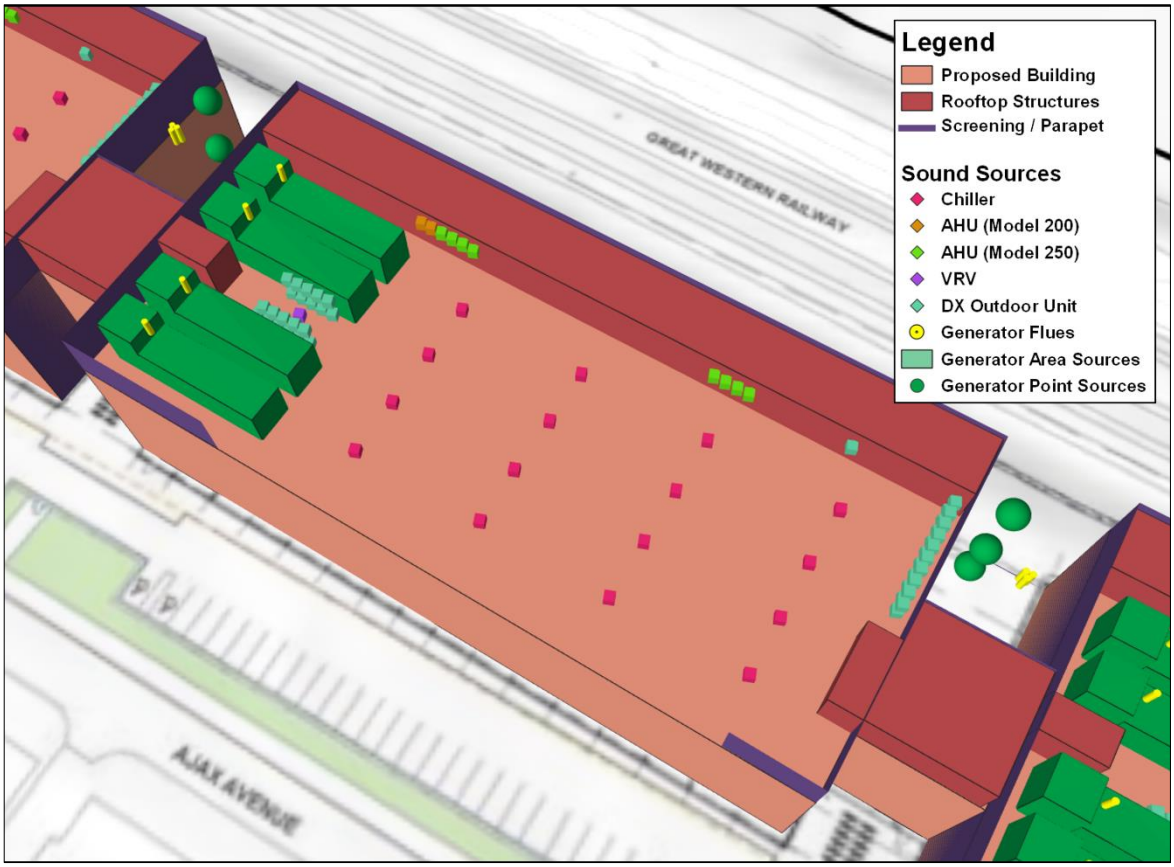
Table A.3.2: Emergency Generator Sound Levels (Sound Pressure Level at 1m)

Sound Source	Octave band centre Frequency (Hz)								A
	63	125	250	500	1k	2k	4k	8k	
Enclosure Type 1									
Front	91	86	72	54	49	54	71	79	**79**
Back	82	87	75	58	54	58	74	81	**81**
Top / sides	85	87	78	65	63	53	60	66	**75**
Flue	99	96	91	69	53	55	67	71	**85**
Enclosure Type 2									
Front	94	88	71	63	63	59	53	67	**75**
Back	90	90	87	71	67	65	60	56	**81**
Top / sides	89	89	76	66	63	53	52	54	**81**
Flue	99	96	91	69	53	55	67	71	**85**

A3.6 The emergency generators have been modelled as shown in **Figure A.3.2**. The generators located within the gantry and 'side pods' have been modelled as simple omnidirectional point sources located at the highest surface of the plant and placed in their expected locations. For the rooftop generators located adjacent to the chillers, a more complex modelling approach has been employed which considers the sound emissions from each side of the enclosure as a vertical area source. This approach allows for more accurate modelling of the directionality of the generators as well as any

self-screening effects provided by the enclosures. Generator flues have been modelled as simple omnidirectional point sources located at the locations of the proposed flue terminations[12].

Figure A.3.2: Emergency Generators - Sound Source Locations



Noise Break-out via Building Envelope

A3.7 With regards to activity within data halls breaking out via building envelope the assumed internal reverberant noise levels are presented in **Table A.3.3** and the sound insulation performance of the building envelope is presented in **Table A.3.4.**

Table A.3.3: Reverberant Internal Noise Levels within Unit (Sound Pressure Level (L_p))

Sound source	Octave band centre Frequency (Hz)								A
	63	125	250	500	1k	2k	4k	8k	
Data Hall Internal Noise Leve	86	89	82	80	81	78	72	63	85

[12] Dwg no. 4640-S1-001 (dated 10-03-21) provided by Langley Hall Associates Ltd.

Table A.3.4: Building Envelope (Sound Reduction Index (R))

Sound source	Octave band centre Frequency (Hz)								R_w
	63	125	250	500	1k	2k	4k	8k	
Roof[13]	20	18	20	24	20	29	39	47	25
Walls[14]	20	15	17	23	18	25	40	46	23

Noise Model

A3.8 The model has been developed using the LimA® computational sound modelling software (v12.0), and has been configured to calculate daytime noise levels in accordance with ISO 9613-2:1996 '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*'.

A3.9 The model takes into account the following factors that have the potential to affect the propagation of sound:

- the location of the sound sources;
- the elevation of the ground, determining the relative heights of sources and receptors;
- the relative distances between the sound sources and receptors; and
- ground cover attenuation effects.

[13] Assumed cladding specifications: Kingspan KS1000 RW 100mm Quadcore Insulated Roof Panel with no internal plasterboard or lining.

[14] Assumed cladding specifications: Kingspan UltraTemp KS1100 CS with no internal plasterboard or lining.

A4 Noise Modelling Results

A4.1 A summary of the worst case predicted results at each receptor is presented in **Table A.4.1.**

Table A.4.1: Predicted Receiver Levels - dB $L_{Aeq,Tr}$ (day or night)

Receptor	Chillers etc only			Emergency Generators only			Chillers etc plus Generator		
	Build. 1 (west)	Build. 2	Build. 3 (east)	Build. 1 (west)	Build. 2	Build. 3 (east)	Build. 1 (west)	Build. 2	Build. 3 (east)
R1	40	42	42	43	47	50	45	48	50
	Total = 46			Total = 52			Total = 53		
R2	38	42	46	40	43	45	42	46	49
	Total = 48			Total = 48			Total = 51		
C1	36	38	41	42	45	45	43	46	47
	Total = 44			Total = 49			Total = 50		
C2	48	55	60	50	54	57	52	58	62
	Total = 61			Total = 59			Total = 64		
C3	57	60	54	54	56	55	59	61	58
	Total = 62			Total = 60			Total = 64		
C4	57	52	47	55	50	48	59	54	51
	Total = 59			Total = 57			Total = 61		
C5	38	37	37	40	46	47	42	47	48
	Total = 42			Total = 50			Total = 51		
C6	32	30	30	40	36	34	40	37	36
	Total = 35			Total = 42			Total = 43		

A4.2 A noise maps at 4 metres height for ‘Normal Operations’ is shown in **Figure A.4.1.**

Figure A.4.1: Noise Map at 4 m – Chillers, DX Units, AHUs and Sound Break-out

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