BREEAM Pol 05 & Condition 9 Discharge

Tribe Hotel, Chicago Avenue, Manchester Airport, Manchester, M90 3RA

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1 Introduction

Sweco UK have been appointed by MY Construction Limited to undertake post-installation noise measurements of the external building services systems installed at Tribe Hotel, Chicago Avenue, Manchester Airport, Manchester, M90 3RA, and to provide an updated plant noise impact assessment for the development.

This report presents the results of the post-installation measurements and impact assessment in order to discharge Condition 9 of the Planning Permissions (Manchester City Council application reference 125848/FO/2020) and to demonstrate compliance with BREEAM UK New Construction[1] (BREEAM UK NC) 2018 policy Pol 05 *Reduction of noise pollution.*

This report summarises the permitted design targets set out in the planning stage Noise Impact Assessment[2], the results of the post-installation measurements and updated assessment, demonstrating compliance with the above standards.

Whilst every effort has been made to ensure that this report is easily understood, it is technical in nature; a Glossary of Terms is included in Appendix A to assist the reader.

[1] BREEAM UK New Construction *Non-domestic Buildings (United Kingdom) Technical Manual SD5078: BREEAM UK New Construction 2018 2.0*, 2018, BRE Global Ltd

[2] 102945-MLM-ZZ-XX-RP-YA-0001 C03 *Noise Impact Assessment (RIBA Stage 2)*, 2019, MLM Consulting Engineers Ltd

2 Design Requirements

2.1 Manchester City Council

Condition 9 of the planning permissions states:

"9) Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location.

The scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site. The approved scheme shall be completed before the premises is occupied.

Upon completion of the development a verification report will be required to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria has been met. Any instances of nonconformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria."

2.2 BREEAM UK NC 2018 Pol 05

BREEAM UK NC Pol 05 requires that:

"The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5dB lower than the background noise throughout the day and night [when assessed according to BS 4142:2014[3]]*".*

In this instance, the requirements of Manchester City Council and BREEAM UK NC Pol 05 align, therefore compliance with one will demonstrate compliance with the other by default,

2.2.1 Statement of Qualification

BREEAM requires that acoustic assessments are undertaken by a Suitably Qualified Acoustician (SQA). The author of this report has 6 years' experience in environmental and architectural acoustics and has successfully delivered consultancy, design, and post-completion testing on numerous prestigious commercial and prime-residential schemes. The author has a MSc in Applied Acoustics, is a registered Incorporated Engineer (IEng) with the Engineering Council and is a corporate member of the IOA (MIOA).

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

3 Site Location and Approved Development

3.1 Site Description

Tribe Hotel, Chicago Avenue, Manchester Airport, Manchester, M90 3RA is a newly constructed hotel premises located in a mixed-use area of Manchester, approximately 300m north-east of Manchester Airport. The site comprises lobby, reception, restaurant and admin areas at ground floor, with 412 hotel bedrooms provided between first and eighth floors. The primary external plant areas to which this report pertains are located externally at Level 08 and Level 09.

The site is immediately bound by the M56 motorway to the north, with existing hotel and office premises in all other directions. The site falls within the jurisdiction of Manchester City Council.

The nearest existing Noise-Sensitive Receptors (NSR) have been identified as:

- DoubleTree by Hilton hotel, approximately 170m to the east;
- Raddison Blu hotel, approximately 200m to the south; and
- Ibis Budget hotel, approximately 130m to the west.

However, given that the site falls within the wider Masterplan of the Airport City development, there is potential for new hotels or other noise-sensitive developments to be constructed in closer proximity than the existing NSRs identified above.

As such, it was proposed at the Planning stage that plant noise emissions should be assessed at locations representative of these potential future developments; plot H2 to the east, plots H5 and H6 to the south, plot G2 to the west, and plot E1 to the north. To provide a robust and coherent assessment, this approach has been maintained in this Condition Discharge report.

3.2 External Plant Installations

The primary external building services plant installations at the site are located on the external flat-roof areas at Level 08 and Level 09 roof level. The installations can be summarised as follows (further details on plant type and location are provided in Section 5):

Level 08:

- VRF condenser units providing heating and cooling to the bedrooms
- Bedroom supply & extract Air Handling Units (AHUs)
- Boiler and pump plantroom
- The Level 08 plant area is surrounded on all sides by a solid parapet wall approximately 8m tall. The outside elevations of this parapet wall contain louvered openings to promote airflow. Each louvred opening is approximately 1.5m x 1.5m and contains an acoustic louvre for noise attenuation.

Level 09:

- Kitchen supply and extract Air Handling Units (AHUs)
- Kitchen Supply DX Condenser units (3 No.)

- Dishwasher extract fan.
- The Level 09 plant area is surrounded on all sides by a 1.2m tall solid parapet wall. It was noted that all ducts and duct terminations were installed below this height.

The plant layouts are provided in Figure 1 (Level 08) and Figure 2 (Level 09) below.

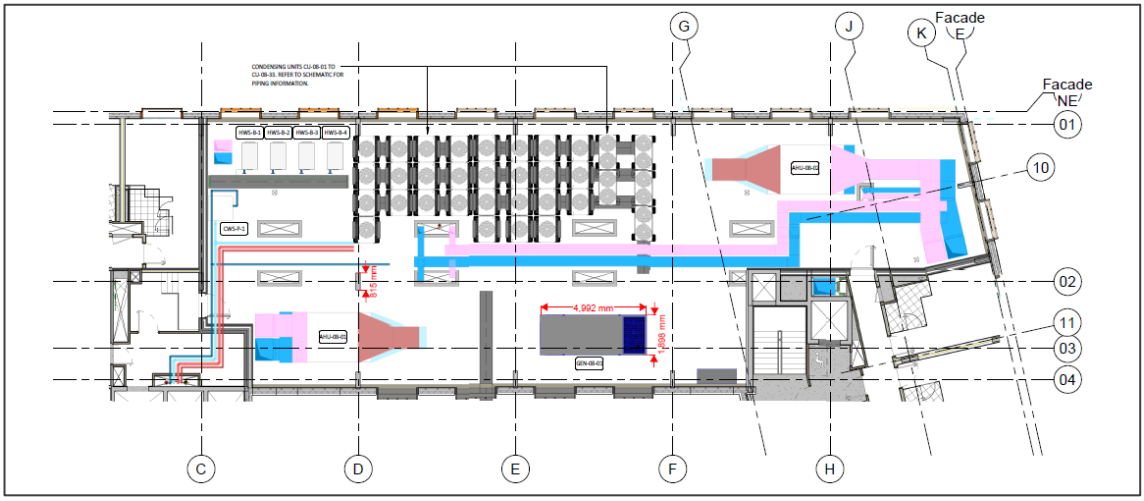

Figure 1: Level 08 Plant Layout Drawing

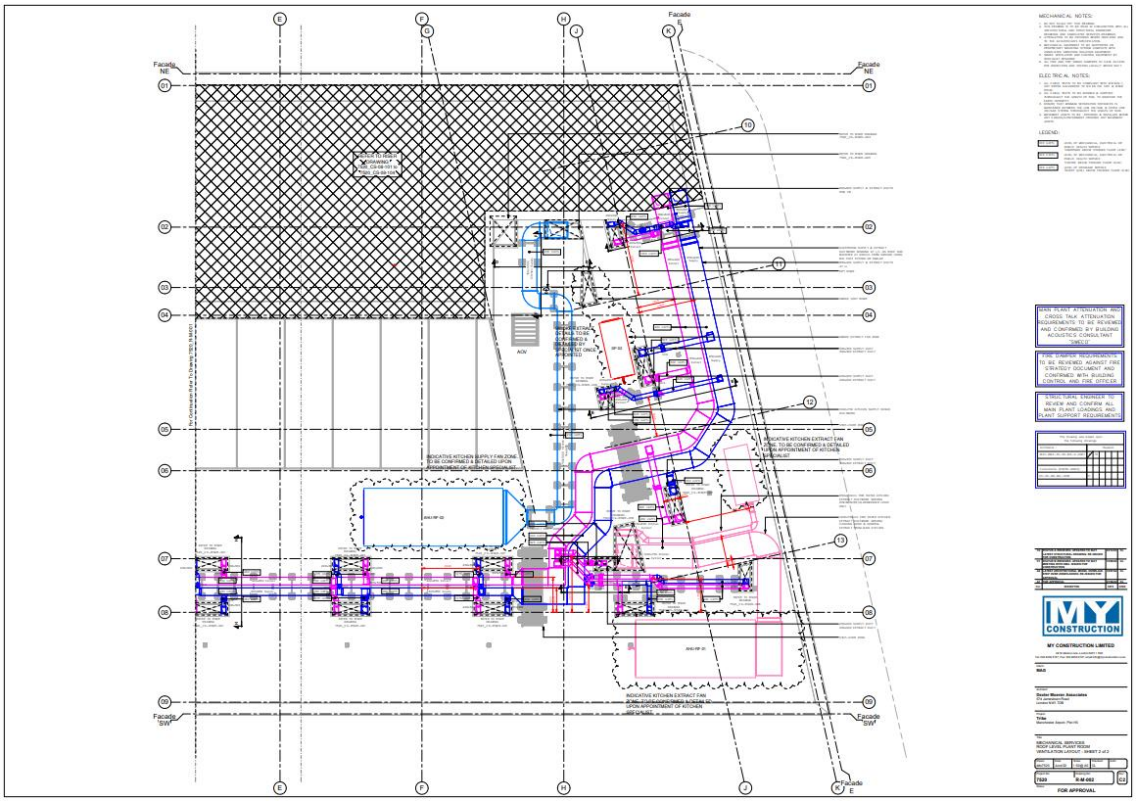

Figure 2: Level 09 Plant Layout Drawing

The wider plant installation at the Site includes an emergency generator located at Level 08 and smoke extract fans located at Level 09. Given that these items of plant will only operate for short-periods during testing or in emergency conditions, it is considered that these are not included in the requirements of Condition 9.

The emergency plant is therefore not discussed further within this report.

4 Limits on Building Services Noise

4.1 Overview

Limits on building services noise were set out in the planning stage noise impact assessment for these works following an extended environmental noise survey at the site.

Full details of the noise survey methodology and results can be found in the above referenced planning stage report.

Building services noise limits were determined and set based on the results of the environmental noise monitoring and the typical requirements of Manchester City Council.

Noise limits were set such that operational noise emissions did not exceed 5 dB below the existing typical background $L_{A90,T}$ noise level when assessed according to BS 4142. This approach aligns with the requirements of Condition 9 and BREEAM UK NC Pol 05, and as such it is considered robust for these previously determined noise limits to apply to the finished development assessed herein.

The limiting noise criteria set out in Table 1 have been reproduced from the planning stage assessment and are considered to apply at all NSRs in the vicinity.

Table 1: Plant Noise Emission Limits

Time Period	Typical Measured Background Noise Level, dB $L_{A90,T}$	Rating Noise Level Limit, dB $L_{Ar,Tr}$
Day 07:00 – 23:00	58	53
Night 23:00 – 07:00	53	48

These building services noise limits apply to the cumulative level of sound from all building services systems associated with the Proposed Development that is measured or predicted at a position 1 metre from the nearest window to sensitive uses at each receptor.

5 Building Services Noise Impact Assessment

5.1 Overview

This section presents an assessment of noise emissions from the installed building services systems, based on measurements undertaken at the site to quantify the actual noise emissions from the in-situ equipment. These measurements have been used to carry out a noise assessment according BS 4142 in order to demonstrate compliance with Condition 9 and BREEAM UK NC Pol 05.

5.2 Methodology

5.2.1 Measurement of Noise Emissions

A series of short-term measurements were undertaken at the site to quantify the noise emissions from each item of plant. The measurements were typically undertaken at a distance of 1m from the specific plant item. Measurements were taken on-axis to the noisiest elevation of each item, with the plant orientation noted for inclusion into the noise model.

Care was taken to ensure that each measurement was representative of the plant under test, with contributions from the wider plant scheme minimised as much as practicable. However, given the nature of the site, some contamination of results from adjacent plant was unavoidable; in practice, this will result in a marginal over-estimation of resultant noise rating levels and so is still considered a robust worst-case approach.

In all cases, the plant noise emissions at the measurement position dominated the local acoustic environment and so no background noise corrections have been applied in this instance.

Full details of the post-installation noise survey and results can be found in Appendix B.

5.2.2 Noise Propagation Modelling

To predict the propagation of noise from the installed equipment, the sound propagation model of the development was updated to include the results of the post-installation noise surveys in place of manufacturer's published data. The model was then calibrated such that a maximum deviation of ± 1 dB was predicted at each measurement position.

The model was then used to predict the cumulative specific level of sound from the installed equipment at the facades of the surrounding noise sensitive receivers.

It is not possible or practicable to measure the specific noise level at each receiver location in this instance and, as such, the adopted approach following guidance in BS 4142, is considered a reasonable and robust method for demonstrating compliance with Condition 9 and BREEAM NC UK Pol 05.

The sound propagation model was constructed using the Datakustik Cadna/A software package and applies the ISO 9613-2:1996 *Acoustics – Attenuation of sound*

during propagation outdoors Part 2: General method of calculation[4] ('ISO 9613-2') methodology for point and line sound sources. ISO 9613-2 provides a more general outdoor sound propagation model accounting for factors including geometric attenuation, ground and air absorption and screening and reflections due to buildings and structures. The use of these methods is standard UK industry practice.

The sound propagation model allows for the specific sound level to be predicted at each assessment location, considering factors such as geometric spreading, the effect of any intervening buildings, walls or ground features, as well as reflections from the hard surfaces that are part of the Proposed Development.

For the purposes of this assessment, the following assumptions were made in the noise model:

- Ground absorption is '0' by default to reflect the primarily hard surfaces.
- All buildings are fully reflective, with second order reflections calculated.
- All noise sources have been modelled as point-sources or conformal area-sources between 0.5 – 2.0m above the mounting surface (as appropriate), reflective of the actual in-situ dimensions of each unit.
- Directionality of louvre/grille sources was accounted for within the model based on actual louvre/grille dimensions.
- The noise model has been calibrated to accurately reflect the measured in-situ noise emissions.
- All noise sources are operating simultaneously and at maximum design duty, based on indications of the site engineers.
- Site topography and elevations have been taken from available open-source mapping data and site observations during the attended periods.

5.3 Plant Installations

The mechanical services plant installed at this site, and to which this assessment pertains, is as follows:

Level 09:

- 1 No. kitchen extract AHU, comprising outlet and casing radiated noise.
- 1 No. kitchen supply AHU, comprising inlet and casing radiated noise.
- 3 No. DX condenser units (providing temperature control for the kitchen supply AHU), comprising casing radiated noise.
- 1 No. kitchen dishwasher extract fan, comprising outlet and casing radiated noise.

Level 08:

- 2 No. bedroom supply AHUs, comprising inlet, outlet and casing radiated noise.
- 33 No. VRF condenser units, comprising casing radiated noise.
- 4 No. water heaters with associated pressurisation tanks and pumps located within the plantroom to the east of the roof.

[4] International Standard 9613-2:1996, *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*, 1996, International Organization for Standardization

- The parapet wall at Level 08 contains 11 No. openings housing acoustic louvres. The laboratory measured Sound Reduction Index (SRI) of these acoustic louvre products has been confirmed as below.

Table 2: SRI of Level 08 Acoustic Louvres								
Location	Minimum Dynamic Insertion Loss, dB							
	63	125	250	500	1k	2k	4k	8k
Level 08 Parapet Wall – Louvred Openings	5	4	6	10	16	16	13	12

Level 00:

- Water tanks and associated pumps located within a plantroom on the north-western corner of the development.

Following initial site investigations, the following test schedule was produced and undertaken to accurately quantify the cumulative noise emissions from the site:

Test Schedule:

1. 1m from kitchen extract AHU duct termination (on axis).
2. 1m from kitchen extract AHU casing.
3. 1m from kitchen supply AHU duct termination (on axis).
4. 1m from kitchen supply AHU casing.
5. 1m from kitchen supply Ahu DX condenser units.
6. 1m from dishwasher extract duct termination (on axis).
7. 1m from dishwasher extract casing.
8. 1m from AHU 08-02 (bedroom) inlet and outlet duct terminations[5].
9. 1m from AHU 08-02 (bedroom) casing.
10. 1m from AHU 08-01 (bedroom) inlet and outlet duct terminations[5].
11. 1m from AHU 08-01 (bedroom) casing.
12. Immediately to the rear of each louvered opening in the Level 08 parapet wall (8 No. measurements)
13. 3m above roof level in the centre of the Level 08 plant area above the condenser compound.
14. 3m above roof level eastern extent of the Level 08 condenser compound.
15. 3m above roof level in the western extent of the Level 08 condenser compound.
16. Immediately behind the louvred opening in the water heater plantroom.
17. Spatial average Sound Pressure Level within the ground floor water tank room.

5.4 Results of In-Situ Plant Noise Measurements

The raw results from the in-situ noise measurements are presented in Table B3 in Appendix B. It was confirmed during Sweco's attendance that all plant was operating correctly and at the target design duty.

[5] These AHUs were configured with inlet and outlet duct terminations staked vertically. As such, it was not possible to measure independent noise emissions from each element.

5.5 Assessment of Noise Impact

5.5.1 Calculation of Specific Noise Levels

Propagation of noise emissions to the surrounding noise sensitive premises, including the adjacent future development plots, were carried out based on the results of the in-situ testing.

Figure 3 presents a summary illustration of the 3D noise model of the site, demonstrating the specific noise levels predicted at the neighbouring noise sensitive premises. Tabular results are presented in Table 3.

The predicted specific sound levels are presented in Figure 3 and Table 3, and are expressed in terms of the equivalent continuous sound pressure level ($L_{Aeq,T}$) of the cumulative plant noise emissions.

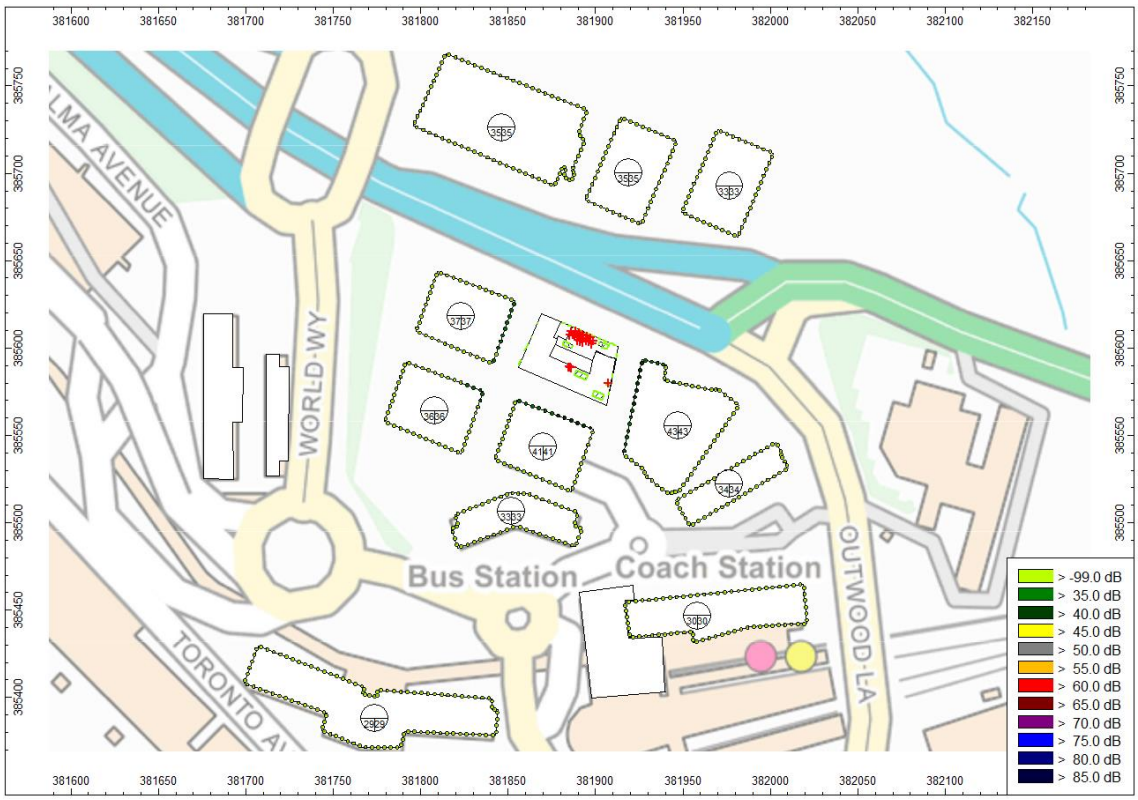

Figure 3: Aerial view of the 3D noise model and installed plant equipment.

Table 3: Worst-Case Specific Noise Levels at the Nearest Receptors		
Receptor	Time of the day	Predicted Specific noise level at worst-affected position on receptor, dB $L_{Aeq,T}$
NSR1 – Raddison Blu Hotel	Day (07:00 – 23:00)	29
	Night (23:00 – 07:00)	29
NSR2 – Plot H2 (west)	Day (07:00 – 23:00)	37
	Night (23:00 – 07:00)	37
NSR3 – Plot H5 (south-west)	Day (07:00 – 23:00)	36
	Night (23:00 – 07:00)	36
NSR4 – Plot H6 (south)	Day (07:00 – 23:00)	41
	Night (23:00 – 07:00)	41
NSR5 – Plot G2 (East)	Day (07:00 – 23:00)	43
	Night (23:00 – 07:00)	43
NSR6 – Plot E1 (North)	Day (07:00 – 23:00)	35
	Night (23:00 – 07:00)	35

5.5.2 BS 4142 Assessment

In accordance with BS 4142 assessment procedures, the calculated specific noise levels are subject to corrections based on the character of the acoustic emissions.

Following site observations, review of the in-situ measurement data, and when considering the site context (largely commercial surroundings in close proximity to motorway and airport with high day and night-time residual ($L_{Aeq,t}$) noise levels), it is considered that the plant installations assessed herein will not result in any audible or new acoustic characteristics at the adjacent NSRs. As such, no character corrections have been applied.

Table 4 presents a summary assessment of the predicted worst-case Rating levels for the installation and the predicted noise impact.

Table 4: BS 4142 Assessment of Noise Impact for Condition 3 Compliance						
Receiver Location	Period	Predicted specific sound level, dB L_{As}	Character Correction, dB	Predicted rating level, dB $L_{Ar,Tr}$	Rating level limit, dB $L_{Ar,Tr}$ (5 dB below $L_{A90,T}$)	Difference and compliance result, dB
NSR1 – Raddison Blu Hotel	Daytime	29	0	29	53	-24, Compliant
	Night	29	0	29	48	-19, Compliant
NSR2 – Plot H2 (west)	Daytime	37	0	37	53	-16, Compliant
	Night	37	0	37	48	-11, Compliant
NSR3 – Plot H5 (south-west)	Daytime	36	0	36	53	-17, Compliant
	Night	36	0	36	48	-12, Compliant
NSR4 – Plot H6 (south)	Daytime	41	0	41	53	-12, Compliant
	Night	41	0	41	48	-7, Compliant
NSR5 – Plot G2 (East)	Daytime	43	0	43	53	-10, Compliant
	Night	43	0	43	48	-5, Compliant
NSR6 – Plot E1 (North)	Daytime	35	0	35	53	-18, Compliant
	Night	35	0	35	48	-13, Compliant

Table 4 demonstrates that the plant installation at the assessment site complies with the requirements of Condition 9 at all receiver locations.

As such, it is considered that Condition 9 may be discharged and that the credit available under BREEAM UK NC 2018 Pol 05 may be awarded.

5.6 Uncertainty

The acoustic assessment has been undertaken in accordance with industry best practice and utilises environmental and plant noise data captured by Sweco UK Ltd using calibrated Class 1 monitoring equipment. Propagation of noise emissions has been modelled in accordance with ISO 9613 using industry standard procedures, open-source mapping/topographical data, site observations, and measured plant noise emissions. The noise model was calibrated at the measurement positions to within 1 dB of the measured noise level. Uncertainty in the assessment is therefore considered to be low.

6 Conclusion

Sweco UK Limited has been commissioned by MY Construction Ltd to undertake post-installation noise measurements and plant noise assessment to support the discharge of Condition 9 of the planning permissions for this development, and to demonstrate compliance with BREEAM UK NC Pol 05.

The building services noise limits set out during the planning stage, to which Condition 9 pertains, have been presented. These limits were set such that plant noise emissions did not exceed a rating level greater than 5 dB below the pre-existing typical background sound level, when assessed according to BS 4142.

An updated plant noise impact assessment has then been carried out for the installed equipment based on measurements of in-situ noise emissions from the plant.

The assessment presented in this report demonstrates that the installed equipment will achieve the planning noise limits at all receiver locations and as such is considered compliant with Condition 9 of the permissions.

Therefore, it is considered that Condition 9 may be discharged.

Given that the requirements of Condition 9 align wholly with the requirements of BREEAM UK NC Pol 05, the single credit available may also be awarded.

Appendix A - Glossary of Acoustic Terminology

Sound is the vibration of particles in a medium, such as air, which may be detected by the human ear. This sound is defined as noise when it is audible and unwanted or undesirable to a listener.

The vibration, or oscillation, of particles about an equilibrium position results in local pressure fluctuations from the normal pressure. These local pressure fluctuations are described as sound pressure, and the number of oscillations per second is described as the frequency.

The human ear responds to an incredibly large range of sound pressure, from 0.00002 Pa to 200 Pa, and the perceived loudness is proportional to the logarithm of the sound pressure squared. For this reason, sound is measured in terms of a logarithmic parameter, the sound pressure level, to approximate the response of the ear. Sound pressure levels are quantified in decibels (dB) relative to the threshold of hearing.

The human ear responds to a wide range of sound frequencies, from the lowest perceptible bass note, around 20 Hz, to the highest perceptible treble note, around 20,000 Hz. The ear does not respond equally to each frequency and is most sensitive to sound within the mid-frequency range of around 600 to 8000 Hz.

The response of the ear to each frequency also varies with the sound pressure level. For very loud sounds the difference in perceived loudness between each frequency is less pronounced than for low level sound.

Acousticians measure sound pressure levels using sound level meters, which incorporate a microphone.

A sound level meter approximates the response of the human ear to sound by using frequency filters. For typical environment sounds, the A-weighting filter is used to approximate the response of the ear at typical sound pressure levels. The sound pressure level, adjusted to approximate the response of the ear, is quantified in A-weighted decibels, dB(A) or dB L_{pA}.

In a typical environment, the A-weighted sound pressure level will vary with time. For this reason, acousticians use statistical measurement parameters to describe the sound environment. The most common measurement parameters are as follows:

- dB $L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure level. This is the energy-average sound pressure level during a measurement period, T.
- dB $L_{AFmax,T}$: Maximum A-weighted sound pressure level. This is the maximum sound pressure level during a measurement period, T, and measured in a way that approximates the time-response of the ear.
- dB $L_{A90,T}$: 90th percentile A-weighted sound pressure level. This is the sound pressure level exceeded for 90% of the measurement period, T, commonly referred to as the background sound level.

Sound pressure levels in typical environments are presented in Table A1. Further definitions of acoustic parameters are presented in Table A2.

Table A1: Sound pressure levels within typical environments	
Sound Pressure Level, dB	Typical Environment or Description
0	Threshold of hearing
15 to 25	A recording studio
25 to 35	A hotel bedroom at night
35 to 45	An unoccupied office
45 to 55	Quiet residential street
55 to 65	Normal conversation, 1 m away TV programme, listener position
65 to 75	Raised voices, 1 m away Urban high street traffic
75 to 85	Busy motorway traffic, on hard shoulder Typical small plant room
85 to 95	High-speed hand-dryer, operator position Inside London underground (average)
95 to 105	Pneumatic hammer, operator position Concert orchestra
105 to 115	Typical nightclub Untreated generator plantroom
115 to 140	Aircraft take-off, close proximity Threshold of pain

Table A2: Definitions of Acoustic Terminology and Parameters	
Wording	Description
Ambient sound level	The total sound pressure level in a given position from all surrounding sources of noise, both near and far. Normally expressed as an equivalent continuous A-weighted sound pressure level, dB $L_{Aeq,T}$.
A-weighting	The process of weighting the observed sound pressure level at each frequency band, to approximate the sensitivity of the human ear to sounds of different frequencies. A-weighted sound pressure levels are expressed as dB(A) or dB L_{Ap}.
Decibel	A logarithmic value quantifying the sound pressure at a specified position or sound power. relative to a reference sound pressure or sound power (20 µPa for sound pressure, 10-12 W for sound power).
Façade	A sound monitoring position is a “façade” position when it includes a strong reflection from an adjacent building or structure. This corresponds with a position that is between 1 and 2 metres away from a reflecting building or structure.
Free-field	A sound monitoring position is a “free-field” position when it is not affected by sound reflections from surrounding buildings and structures. This corresponds with a position at least 3.5 metres away from reflecting buildings or structures.
Frequency	The number of oscillations per second of a vibrating particle in a medium, measured in Hertz (Hz) or cycles per second.
$L_{A90,T}$	The A-weighted sound pressure level exceeded during 90% of the time interval, T. Typically used to quantify the background sound level at a specified position.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level over a time interval, T. This is an energy-average sound pressure level over the specified time period.
$L_{AFmax,T}$	The maximum A-weight sound pressure level during a specified time interval, T. Measured with “fast” time-weighting (which approximates the time-response of the human ear).
Noise	Unwanted or undesirable sounds observed by a listener.
Octave band	A frequency band used in acoustical measurements. An octave is a frequency interval between two sounds where the frequency of the lower sound is half the frequency of the upper sound. The human hearing range is divided into ten logarithmically equal frequency divisions called octave bands, with centre-band frequencies as follows: (16 Hz, 32 Hz,) 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 16000 Hz.
Rating level, $L_{Ar,Tr}$	The specific sound level plus a correction accounting for acoustic features such as impulses, tones, intermittent features, or any other characteristics that draw more attention to the sound source.

Table A2: Definitions of Acoustic Terminology and Parameters	
Wording	Description
Residual sound level	The equivalent continuous A-weighted sound pressure level of the ambient sound remaining at a specified position when the specific sound source (the sound source being assessed) does not contribute to the ambient sound.
Sound	The vibration, or oscillation, of particles in a medium, such as air, which may be detected by the human ear.
Sound absorption	The reduction of sound energy by transmission through an absorbing medium such an “acoustically soft” material or surface which results in a reduced reflection of incident sound.
Sound power level	A logarithmic measurement that quantifies the total sound power of a source emitted in all directions relative to a reference sound power (Wref = 1 pW or 10-12 W). Equal to 10 log10 (W / Wref) and expressed in decibels.
Sound pressure level (SPL)	A logarithmic measurement that quantifies the sound pressure at a specified position relative to a reference sound pressure (pref = 20 µPa). Equal to 20 log10 (p / pref) and expressed in decibels.
Specific sound level	The equivalent continuous A-weighted sound pressure level at a specified position due to the specific sound source (the sound source being assessed).
Third-octave band	A higher-resolution frequency band used in acoustical measurements. A third-octave band is equal to one of three logarithmically equal parts of the corresponding octave frequency band. The upper band edge frequency is equal to the lower band-edge frequency multiplied by 21/3.

Appendix B – Post-Installation Noise Survey

Noise Survey Overview

A series of short-term attended noise measurements were undertaken by Sweco UK to determine the in-situ noise emissions from each plant item installed at the assessment site.

Measurements were undertaken between 17:00 and 19:00 on Thursday 12th September 2024 by Adam Ford MSc MIOA MAES, Senior Acoustic Consultant at Sweco UK.

Survey Methodology

The plant noise measurements were undertaken using suitable measurement instrumentation configured to log sound pressure levels in each 1/3 octave frequency band every 125 ms. The noise data was then analysed to determine the following parameters for each measurement period (typically 30 second to 1-minute duration) (T):

- dB $L_{Aeq,T}$: The A-weighted equivalent continuous sound pressure level over the measurement period, T.

Noise measurements were taken at the positions described in the below test schedule.

1. 1m from kitchen extract AHU duct termination (on axis).
2. 1m from kitchen extract AHU casing.
3. 1m from kitchen supply AHU duct termination (on axis).
4. 1m from kitchen supply AHU casing.
5. 1m from kitchen supply Ahu DX condenser units.
6. 1m from dishwasher extract duct termination (on axis).
7. 1m from dishwasher extract casing.
8. 1m from AHU 08-02 (bedroom) inlet and outlet duct terminations.
9. 1m from AHU 08-02 (bedroom) casing.
10. 1m from AHU 08-01 (bedroom) inlet and outlet duct terminations.
11. 1m from AHU 08-01 (bedroom) casing.
12. Immediately to the rear of each louvered opening in the Level 08 parapet wall (8 No. measurements starting on the eastern façade moving counter-clockwise – references as measurements ‘12a’ though ‘12h’)
13. 3m above roof level in the centre of the Level 08 plant area above the condenser compound.
14. 3m above roof level eastern extent of the Level 08 condenser compound.
15. 3m above roof level in the western extent of the Level 08 condenser compound.
16. Immediately behind the louvred opening in the water heater plantroom.
17. Spatial average Sound Pressure Level within the ground floor water tank room.

Equipment

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[6]. Details of the noise measurement instrumentation used are shown in Table B1.

Each meter had been calibrated by a UKAS accredited laboratory within the previous 24 months. The calibration level was also checked at the start and end of the survey using field calibrators (which had been suitably calibrated by an accredited laboratory).

The microphones were fitted with protective windshields for the measurements.

Table B1: Inventory of Acoustic Measurement Equipment

Item	Manufacturer/Model Type	Serial Number
Sound Level Meter	01dB Fusion	12825
Preamplifier	01dB PRE-22N°	2004246
Microphone	GRAS 40CD	292431
Sound Level Meter	01dB Fusion	12825

Observations

Environmental noise levels in the area were controlled by traffic noise from the M56 to the north, and regular aircraft flyovers. In proximity to the plant however, the acoustic environment was controlled by the mechanical equipment assessed herein.

The plant was observed to be operating at a steady state, with no noticeable variation in fan speed or noise emissions.

During the testing period, no contributions were noted from the ongoing site activities.

Weather Conditions

The weather conditions during the survey were observed and noted as being suitable for environmental noise measurement.

Measurement Results

Table B2 presents the 1/3 octave $L_{Aeq,T}$ measurements results which have been used in this assessment.

[6] British Standard (BS) 61672:2003: *Electroacoustics. Sound level meters. Part 1 Specifications, 2003,* British Standards Institution (BSI).

Table B2: Raw Measured 1/3 Octave $L_{Aeq,T}$ Spectrum at Each Attended Monitoring Position																								
Measurement / Test Number	**1/3 Octave Centre Band Frequency, Hz**																							**dBA**
	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	
1	70.4	67.1	64.5	61.6	59.6	57.2	59.7	66.8	59.1	53.3	55.6	53.3	53.9	53	51.5	50.8	51.3	52.9	54.9	55.2	52.4	49.3	46.3	45.7	65.7
2	60.1	59.3	59	58.7	59	58.8	62.4	71.5	60.9	56.1	57.3	54	54.5	53.7	52.2	52.7	52.5	55.5	56.6	57.7	56.6	52.6	47.9	44.4	68.3
3	65	61.5	60	56.2	60.9	53.1	51.5	52.7	66.6	49	47.7	47.7	47.7	45.8	43.8	42.4	41.6	39	37.5	37.3	31.9	28.4	28	22.6	61.2
4	61.9	58.7	59.1	60.4	55.1	60.7	60.9	63	68.4	55.3	53	55.9	52.2	52.2	49.2	47.2	44.2	39.5	38.3	42.6	40	30.9	24.4	22.6	64.5
5	67.6	64	62.8	61.3	58.1	56.9	56.6	55.2	56.1	55.6	55.5	55.8	55.1	53.6	51.5	50	49	46.6	45.4	47.3	39.7	36.7	35.5	32	62.8
6	64.3	64.4	62.6	59.7	58	57	61.5	60.2	60.8	57.4	58.2	64.1	63.6	64	64.4	62	59.9	57.9	56.2	55	52.3	47.2	42.4	39.1	72
7	63.9	61.1	62	59.5	58.6	60.3	67.6	60.3	56.7	54.5	55.9	61.3	59	58.1	56.8	55.3	53.2	50.9	50	49.3	45.7	40.5	35.3	31.8	67
8	56.1	55.3	58.1	60.6	58.8	76	63.2	55.2	55.9	53.3	50.8	51.5	49.9	48.2	47.2	48.9	48.3	47.2	46.9	47.2	44.2	38.4	32.9	31.4	65
9	63	64.3	65.6	65.3	66.3	67.6	57.1	57.8	57	55	54.8	58.1	56.8	56.1	53.3	52.4	52.6	50.9	51.3	51	49.6	47.1	42.9	41.8	65.5
10	62.6	61.8	61.4	62	66.6	72.1	64.4	60	58.2	50.9	51.9	50.6	48.4	47.9	46.2	46.5	46.1	45.9	46.5	45.7	42.8	37.7	33.7	33.2	62.7
11	64.1	56.6	56.4	61.1	57.6	59.4	52.3	48.7	49.7	47.5	49.1	48.7	47.9	46.5	45.6	43.9	42.2	39.6	38.9	37.2	33.5	30.9	27.9	23.8	56.6
12a	65.7	57.6	60	63.5	60.9	75	61.7	54.4	55.6	54.1	54.3	55.9	53.1	52.3	50.5	49.5	48.2	46.9	45.5	47.3	43	39.3	34.6	33.6	65.1
12b	65	59.5	64.1	64.4	63.8	70.6	61	52.2	54.5	51.4	50.7	51.1	50.8	52	48.5	47.3	47	44.5	43.5	43.1	39.9	36.7	39.6	39.5	62.2
12c	69.5	61.7	64.6	65.7	60.9	65.1	58.1	55.7	53.1	52	51.2	52.1	52.5	51.9	49.7	48.3	48.7	46.6	46.6	49.2	46.3	40.8	36.1	33.9	61.8
12d	72.1	66.4	65	61.9	62.1	64.5	61	58.1	59.8	54.4	51.3	53.1	52.6	52.6	49.2	47.8	46.3	45.2	45.2	46.1	41.9	37.9	35.1	32.9	62.2
12e	62.4	63.7	64.4	60.4	58.3	63.9	60.9	54.6	54.2	50.3	48.8	51	51	52.1	48.4	47.1	45.3	44.7	44.2	47.5	42	38.2	36.1	34.7	60.6
12f	66.8	61.9	70	64	63.9	62.7	62.9	59.4	58.5	58.5	57.9	57.7	57.3	58.8	57.2	54.3	53.9	54.9	56.7	54.6	57.3	53.4	51.6	48.4	68.1
12g	64.7	63.8	62.2	62.9	62.7	62.4	59.6	60.3	54	53.7	55	54.4	54	53.8	53	52.2	46.7	44.6	43.2	45.4	38.1	34.2	31.8	31	62.9
12h	75.2	60.8	59.6	63	61.9	65.4	61.5	65.9	59.4	55.5	55.9	54.8	53.5	52.4	49.9	50.1	49	46.9	45.4	44.8	41.2	37.9	35	33.3	63.8
13	72.1	61.2	68.3	62.9	63	66.3	64.2	63.4	64.7	57.3	57	56.7	55	54.3	51.2	50.3	50	49.1	46.1	47.9	44	41.5	39	38.6	65.3
14	68.5	61	61	58.1	60.2	63	59.5	55.9	55.1	51.8	52.2	52.7	51.6	52.4	53.2	50.8	52.1	51	50.1	48.3	44.7	41.9	38.8	35.4	62.9
15	75.3	59.6	59.1	64.4	64.2	69.4	61.7	58.5	58.5	56.1	56.2	54.9	53.8	52.6	50.4	49.5	48.7	46.6	45.9	44.5	41.7	37.7	34	32.4	63.6

16	56.4	56	54.9	53.6	53.6	55.9	55.6	50.2	52.7	48.1	47.1	48.1	48.7	49.7	47.9	44.8	41.9	40.9	38.9	35	35.5	30.6	18.5	18	57.2
17	57.1	60.5	61.7	55.5	58.6	58.3	59	60.8	56.5	44.9	47.7	49.1	42.7	43.7	43.2	43.1	43.4	41.9	41.7	39.4	36.3	32.7	28.3	26.4	58.3
18	70.4	67.1	64.5	61.6	59.6	57.2	59.7	66.8	59.1	53.3	55.6	53.3	53.9	53	51.5	50.8	51.3	52.9	54.9	55.2	52.4	49.3	46.3	45.7	65.7
19	60.1	59.3	59	58.7	59	58.8	62.4	71.5	60.9	56.1	57.3	54	54.5	53.7	52.2	52.7	52.5	55.5	56.6	57.7	56.6	52.6	47.9	44.4	68.3
20	65	61.5	60	56.2	60.9	53.1	51.5	52.7	66.6	49	47.7	47.7	47.7	45.8	43.8	42.4	41.6	39	37.5	37.3	31.9	28.4	28	22.6	61.2
21	61.9	58.7	59.1	60.4	55.1	60.7	60.9	63	68.4	55.3	53	55.9	52.2	52.2	49.2	47.2	44.2	39.5	38.3	42.6	40	30.9	24.4	22.6	64.5
22	67.6	64	62.8	61.3	58.1	56.9	56.6	55.2	56.1	55.6	55.5	55.8	55.1	53.6	51.5	50	49	46.6	45.4	47.3	39.7	36.7	35.5	32	62.8
23	64.3	64.4	62.6	59.7	58	57	61.5	60.2	60.8	57.4	58.2	64.1	63.6	64	64.4	62	59.9	57.9	56.2	55	52.3	47.2	42.4	39.1	72
24	63.9	61.1	62	59.5	58.6	60.3	67.6	60.3	56.7	54.5	55.9	61.3	59	58.1	56.8	55.3	53.2	50.9	50	49.3	45.7	40.5	35.3	31.8	67
25	56.1	55.3	58.1	60.6	58.8	76	63.2	55.2	55.9	53.3	50.8	51.5	49.9	48.2	47.2	48.9	48.3	47.2	46.9	47.2	44.2	38.4	32.9	31.4	65
26	63	64.3	65.6	65.3	66.3	67.6	57.1	57.8	57	55	54.8	58.1	56.8	56.1	53.3	52.4	52.6	50.9	51.3	51	49.6	47.1	42.9	41.8	65.5