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Project:

MFG Levenshulme Hot Food Takeaway

Title:

Noise Impact Assessment

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Report Title	MFG Levenshulme Hot Food Takeaway Noise Impact Assessment
Reference	EEC/EC19819-3
Version	0
Issue Date	3 February 2023
Client	MBH Design Studio Ltd
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Revision	Date	Author	Checked

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1 INTRODUCTION

1.01 Environmental Equipment Corporation Limited has been commissioned by MBH Design Studio Ltd to undertake an assessment of new noise sources proposed as part of the fit out of a new hot food takeaway offering within the Sales building of the MFG Levenshulme Service Station on Stockport Road in Greater Manchester. The proposals include the installation of new additional external condenser plant and the inlet and exhaust air apertures for kitchen and back of house ventilation in external elevations of the building.

1.02 This noise assessment has been conducted in accordance with the policies and requirements of Manchester City Council (MCC) and is based on a noise survey carried out at the site over a weekend period.

1.03 This assessment includes:

- the setting of plant noise limits in accordance with the requirements of LA and national planning policy, standards and guidance; and
- the prediction of noise impacts at the worst affected noise sensitive receptors based on the proposed items of plant and their location.

1.04 Whilst every effort has been made to ensure that this report is easy to understand, it is necessarily technical in nature. To assist the reader, an explanation of the terminology used in this report is contained in Appendix A.

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2 SITE

2.01 The MFG Levenshulme service station is located in a predominantly residential area of Greater Manchester.

2.02 The following Google Maps image has been annotated to identify the MFG Levenshulme site and the nearest noise sensitive residential properties. The measurement location used for the noise survey is also marked.



Figure 1: Site layout and nearest dwellings

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2.03 The closest and most affected noise sensitive receptors to the proposed plant items are the following:

- The two storey dwellings of 1172-1196 Stockport Road to the west.

2.04 All other noise sensitive receptors are at a greater distance from the proposed location of the plant or are protected by more screening by the intervening structures, and as such will be subject to lower levels of noise.

2.05 This application proposes the installation of two condensers along the south elevation of the sales building as well as new kitchen supply and extract ventilation, with terminals on the south elevation of the sales building. A large scale plan layout of the redeveloped site is presented in Appendix B.

3 GUIDANCE

3.01 National Planning Policy for the is presented in Appendix C of this document. However based on a review of similar planning applications in the area the following guidance would typically be applied to new installations for fixed plant:

> *"The noise assessment should be based on BS 4142: 2014 and any application for fixed plant, equipment or machinery must demonstrate that: '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 (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location'."*

BS4142:2014 'Methods for rating and assessing industrial and commercial sound'

3.02 To assess the acceptability of the resultant noise levels we have consulted the relevant standards. BS 4142:2014 'Methods for rating and assessing industrial and commercial sound'. The scope of BS4142 includes that assessment of the following sources:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which compromise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating

3.03 BS4142 gives guidance on assessing the likelihood of adverse impacts by calculating a 'rating level' of the new noise source and comparing its magnitude at noise sensitive locations to the existing or underlying background noise level. The background noise level is subtracted from the 'rating level' to assess the likelihood of complaints:

- The greater the difference the greater the likelihood of complaints.
- A difference of around +10dB or more is an indication of a significant adverse impact, depending on the context.

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- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background noise level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low sound impact, depending on the context.

3.04 This assessment is carried out over a one hour period for the daytime and a fifteen minute period for the night-time. For the purposes of the standard it states that daytime and night-time are typically 07:00 to 23:00 hours and 23:00 to 07:00 hours respectively.

3.05 The 'rating level' of the noise source is obtained taking the following factors into consideration:

- The new plant noise (the specific noise) is measured or predicted in terms of L_{Aeq}.
- An additional correction shall be included if the noise contains a distinguishable, discrete continuous note, if the noise contains distinct impulses or if the noise is irregular enough to attract attention. The value for any tonal noise can be an addition of up to 6dB and for impulsive noise of up to 9dB.

3.06 The background sound level should be established in terms of the L_{A90} noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. The standard states that *'a representative level ought to account for the range of* background *sound levels and ought not to automatically to be assumed to be either the minimum or modal value.'*

3.07 BS 4142 goes onto state that:

'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.'

3.08 BS4142 requires uncertainties in the assessment to be considered and, where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a weekday period, between 0730 hours on Friday 23rd July 2021 and concluded 0830 hours on Monday 26th July, 2021, to establish the existing noise levels at the site. The survey methodology and results are set out below.

4.02 Noise measurements have been carried out at the following position, as shown in Figure 1 and described as:

- Position 1: located at a height of approximately 1.7 metres above ground level on the east side of the site. The measurement was not located within 3.5 metres of any reflecting surfaces, other than the mounting surface.

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4.03 This position is considered to be representative of the nearest windows on the front elevations of the dwellings along Cringle Road. It is expected that the noise levels outside the properties along Stockport Road will be slightly higher due to their proximity to Stockport Road which is one of the dominant noise sources in the area. The survey results are therefore considered to provide the basis of a very much worst case assessment of noise impact, the conclusions likely overstating the impact.

5 EQUIPMENT

5.01 The equipment used for the survey was as follows:-

- 01dB Metravib Black Solo Integrating Sound Level Meter conforming to Class 1 BS EN 61672, Type 1 BS EN 60804 & BS EN 60651: 1994;
- 01dB Metravib MCE 212 Condenser Microphone, PRE 21 S Pre-amp and Connecting Leads;
- 01dB Outdoor Microphone Kit and a
- Tripod.

5.02 The equipment holds current UKAS or equivalent accreditation and serial numbers as follows:

Sound Level Meter 01dB Black Solo	Serial No.	61719
	Calibration Date	30th July 2020
	Cal Certificate No.	U35361
½" MCE 212 Condenser Mic.	Serial No.	166397
	Calibration Date	30th July 2020
	Cal Certificate No.	35360/U35361
Calibrator CAL 21	Serial No.	34634297
	Calibration Date	25th March, 2021
	Cal. Certificate No.	U37495

N.B. Copies of calibration certificates are available upon request.

5.03 The equipment was calibrated both before and after the survey with no difference noted in the levels.

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6 RESULTS

6.01 The weather during the survey was generally suitable for noise measurement for the weekend period with conditions being dry and calm throughout.

6.02 A list of the levels measured is included in Appendix D and represented graphically in Appendix E.

6.03 A summary of the time averaged ambient levels and measured background levels over the measurement periods are shown in Table 6.1. The L_{A90} levels presented are based on fifteen-minute measurements in the specified period.

Day	Period	Average $L_{Aeq,T}$ – dB	Range $L_{A90,15min}$ – dB	Representative $L_{A90,15min}$ – dB
Friday 23rd July, 2021	Day time (0700-1900 hrs)	64.8	52-63	55
	Evening (1900-2300 hrs)	64.4	52-58	54
	Night-time (2300-0700 hrs)	59.7	37-52	40
Saturday 24th July, 2021	Day time (0700-1900 hrs)	62.9	44-58	54
	Evening (1900-2300 hrs)	62.6	53-57	53
	Night-time (2300-0700 hrs)	60.3	39-53	42
Sunday 25th July, 2021	Day time (0700-1900 hrs)	63.2	43-58	52
	Evening (1900-2300 hrs)	65.4	50-57	52
	Night-time (2300-0700 hrs)	59.1	32-53	34

Table 6.1: Free-Field Measured Ambient and Measured Background Noise Levels

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7 PLANT ASSESSMENT

7.01 This application is for the installation two new external condensers and an extract and supply fans, located internally but ducted to the external elevation.

7.02 Based on the standard requirements of Manchester City Council and the lowest measured background noise level in each time period, Table 7.1 sets out the recommended noise limits that the proposed items of plant should meet.

7.03 In accordance with the requirements of MCC, the proposed noise limits are based on being 5 dB below the measured background noise level.

Period	Measured Existing $L_{A90,T}$	Proposed Noise Limit L_{Ar}
Day	52 dB	47 dB
Evening	52 dB	47 dB
Night	34 dB	29 dB

Table 7.1: Suggested Plant Noise Emission Limits Based on Lowest Measured L_{A90}, Free-field dB

7.04 Note that the limits suggested above are rating levels and as such any design should take into account the acoustic characteristics of the plant. In this instance the proposed units display none of the characteristics whereby the acoustic correction should be applied.

7.05 Assuming the proposed items meet the noise limits set out in Table 7.1 noise will be approaching the NOEL with respect to the NPPF.

7.06 The proposed units have the following stated manufacturers noise levels. Copies of the manufacturer's plant data sheets are included in Appendix F.

Plant Item	Model	Noise Data
AC Condenser	Toshiba RAV-RM1401	55 dB(A) at 1m
Kitchen Extract Fan	Systemair MUB/T 062 560EC	74 dB(A) SWL
Kitchen Supply Fan	Systemair MUB 042 500EC	86 dB(A) SWL
BoH Extract	Systemair Prio 200 EC	72 dB(A) SWL

Table 7.2: Summary details of manufacturer's published noise data for plant.

7.07 To ensure compliance with the design criteria, duct-mounted attenuators will be installed. The attenuation will need to achieve the following minimum dynamic insertion losses:

	Dynamic Insertion Loss - dB							
Plant Item	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Kitchen Extract Fan	8	15	19	24	30	33	30	26
Kitchen Supply Fan	4	6	10	16	21	23	17	11
BoH Extract	5	8	15	23	30	30	25	20

Table 7.3: Summary details of manufacturer's published noise data for plant.

7.08 The propagation of noise from the proposed new plant has been modelled using CadnaA software produce by Datakustik. Calculations are undertaken using the General Method of Calculation from ISO9613-2:1996. Within the noise model, buildings and the immediate topography have been

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accounted for along with the localised screening where applicable. A total order of reflection of three has been set and hard ground conditions adopted.

7.09 Predicted noise levels have been calculated at all the closest noise sensitive windows.

7.10 The following illustrations show a graphical representation of the resulting noise model and calculated noise levels due to the operating conditions outlined above.

7.11 The results of the noise modelling show that the nearest and most affected dwelling. The calculated noise levels are summarised below:

- 1172 Stockport Road 29 dB(A) all plant operating

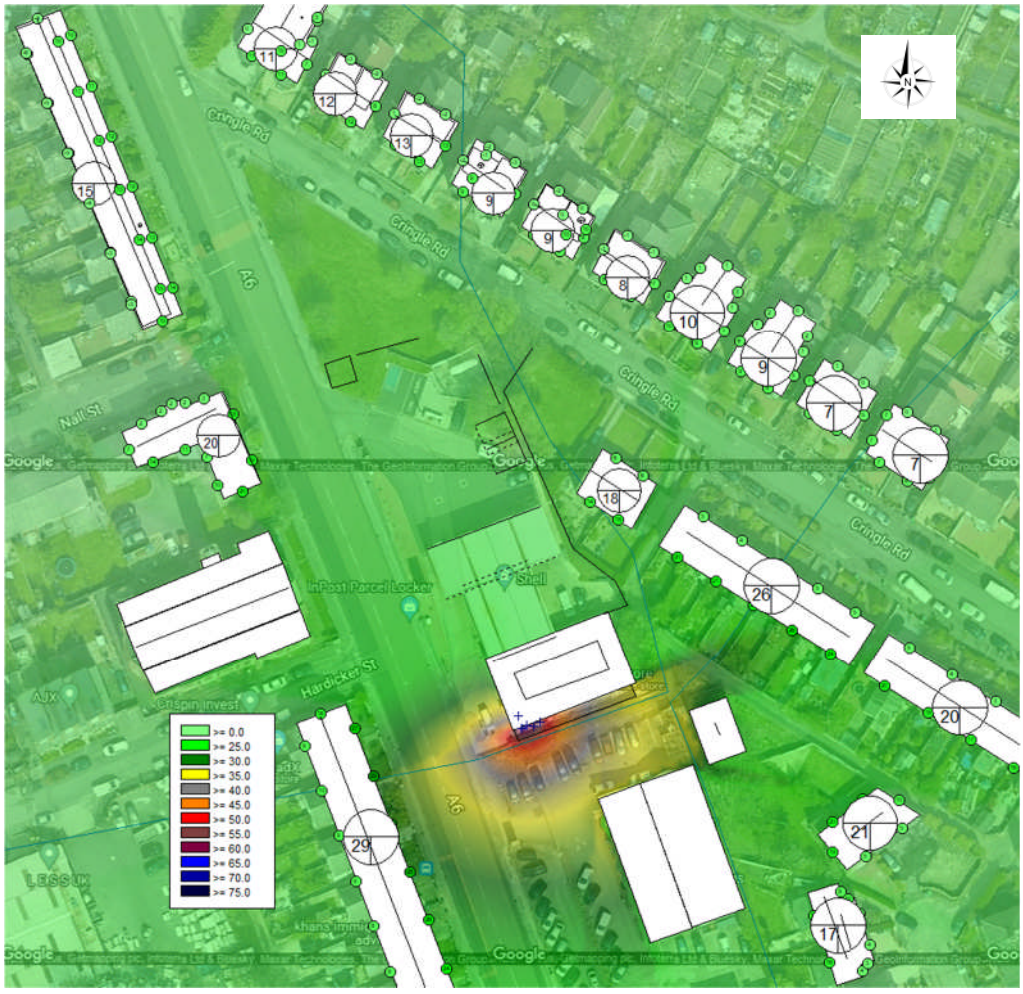


Figure 3: Specific Noise Levels – $L_{Aeq,T}$

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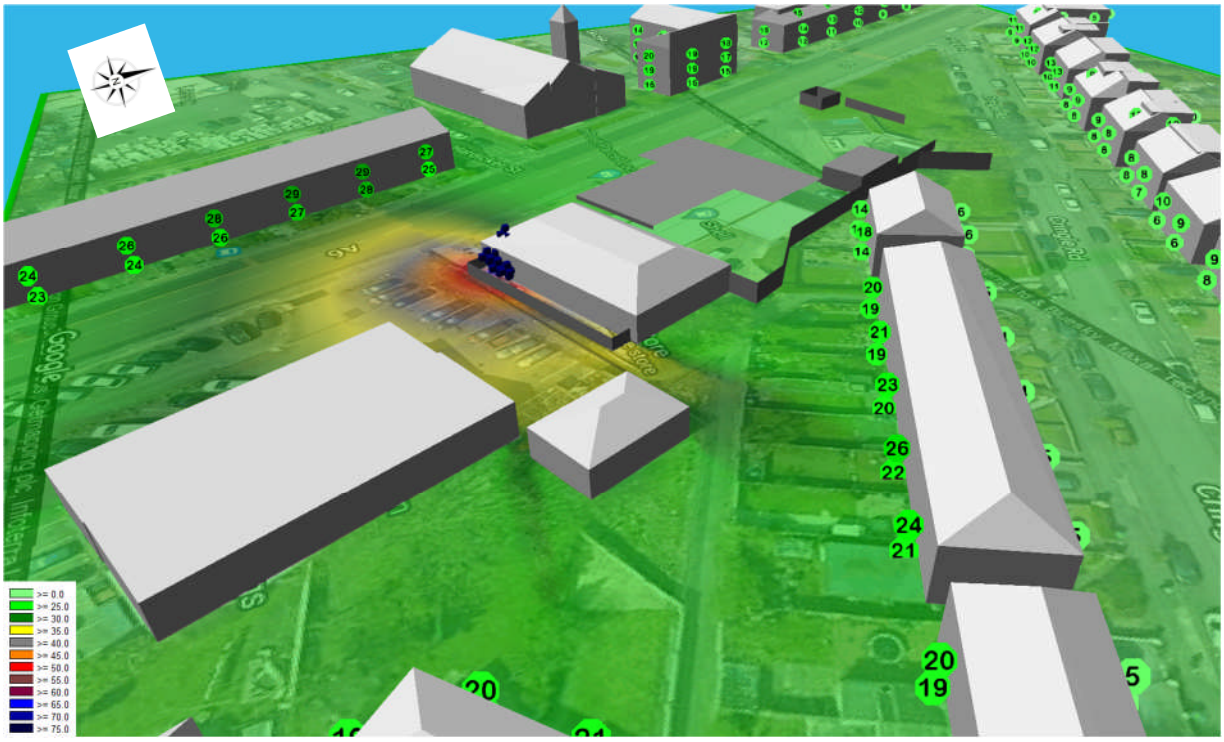


Figure 4: Isometric view of noise propagation all equipment in operation (typical worst case daytime)

7.12 It can be seen from the above figure above that the night time noise limit of 29dB(A) is not exceeded.

7.13 Assuming that the proposed plant and duct mounted attenuation is included in the installation, predicted noise levels will meet the requirements of the Local Authority during all periods of operation and at the closest noise sensitive receptors.

7.14 With respect to the NPPF, achieving the noise limits would be classified as approaching the NOEL.

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8 CONCLUSIONS

8.01 MBH Design Studio Ltd has appointed Environmental Equipment Corporation Limited to undertake a noise assessment for proposed new HVAC plant to be installed at the rear of the existing sales building of the MFG Levenshulme service station as part of the fitout for a new hot food takeaway.

8.02 The assessment has been carried out in accordance with national planning guidance and the typical requirements of Manchester City Council and is based on an environmental noise survey conducted at the site over a weekend period.

8.03 A noise assessment has been undertaken to evaluate the potential noise impact of the proposed HVAC plant at the closest existing residential receptors.

8.04 Plant noise limits have been set based on the methodology contained in BS4142, the results of a background noise survey and the requirements of MCC, to control the noise from the proposed plant.

8.05 Predictions have shown that the noise criterion is met at all assessment locations at all times, assuming, duct mounted attenuation is installed on both the supply and extract fan systems.

8.06 Assessing the site in accordance with the principles of the National Planning Policy Framework has shown that predicted noise levels would be approaching the level at which no effects are observed to occur, the NOEL.

8.07 On the basis of this assessment it is considered that noise does not pose a material constraint to the operation of the proposed HVAC plant.

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APPENDIX A

GLOSSARY OF TECHNICAL TERMS

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ACOUSTIC TERMINOLOGY

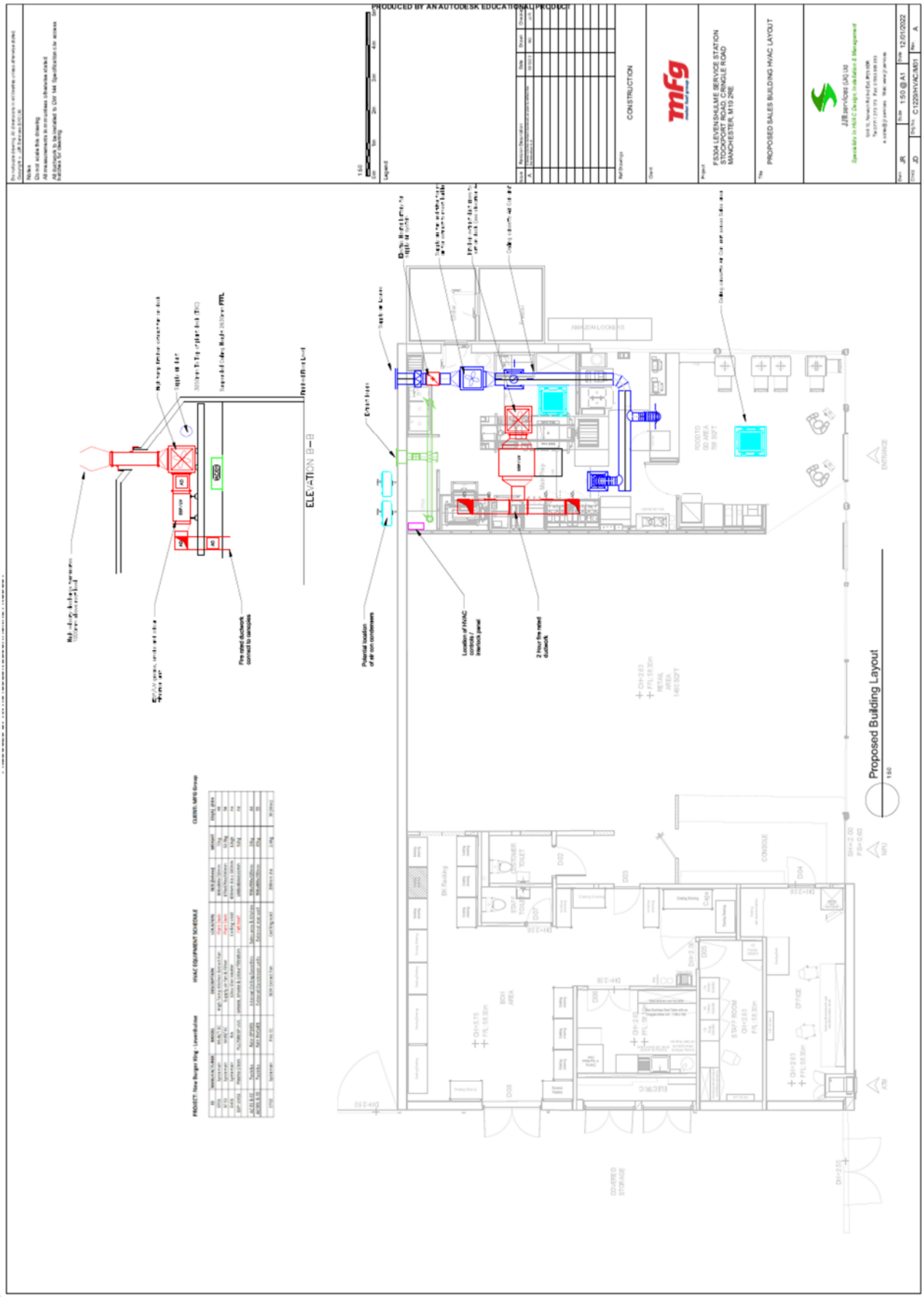
Absorption Classes	The sound absorption of a material is rated from Class A to Class E, where Class A materials provide the highest level of sound absorption.
Ambient Noise Levels	Noise levels measured in the absence of noise requiring control, frequently measured to determine the situation prior to the additional of a new noise source.
dB	Decibel. The logarithmic unit of sound level.
dBA	A-weighted decibel. The A-weighting approximates the response of the human ear.
$D_{nT,w}$	Weighted standardized level difference. A single number quantity of the sound level difference between two rooms. $D_{nT,w}$ is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling. Measured in accordance with BS EN ISO 16283-1 and weighted in accordance with BS EN ISO 717-1.
$D_{n,e,w}$	The weighted element-normalized level difference. A single number rating of the sound reduction provided by a sound passing through an individual element. $D_{n,e,w}$ is typically used to define the sound insulation provided by ventilators. Measured in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4kHz, roughly equal to the range of frequencies on a piano.
Impact Sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
$L_{Aeq,t}$	The equivalent continuous sound level measured in dBA. This is commonly referred to as the average noise level. 't' is the interval time for the measurement. Typically 't' of 16hrs and 8hrs is used for day and night time ambient noise respectively or 't' is defined by the period of interest in BS4142 assessments.
$L_{A90,t}$	The noise level exceeded for 90% of the measurement period, measured in dBA. This is commonly referred to as the background noise level.
$L'_{nT,w}$	Weighted, standardized impact sound pressure level. A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard "tapper" machine. The lower the $L'_{nT,w}$, the better the acoustic performance. Measured in accordance with BBS EN ISO 140-7 and rated in accordance with BS EN ISO 717-2.
NR	Noise Rating. A single number rating which is based on the sound level in the octave bands 31.5Hz – 8kHz inclusive, generally used to assess noise from mechanical services in buildings.
Octave Band	Frequencies are often grouped together into octaves for analysis. Octave bands are labelled by their centre frequency which are: 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz and 4kHz.
Reverberation Time (T_{mf})	Reverberation time is used for assessing the acoustic qualities of a space. It is defined as the time it takes for an impulse to decay by 60dB. T_{mf} is the arithmetic average of the reverberation time in the mid frequency bands (500Hz, 1kHz and 2kHz).
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete. Measured in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1.
Sound Absorption	When sound hits a surface, some of the sound energy is absorbed by the surface material. Sound absorption refers to the ability of a material to absorb sound, rated from 0, complete reflection, to 1, complete absorption.
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to the ability of a material to prevent the travel of sound.
Structure-borne transmission	Transmission of sound energy as vibrations via the structure of a building.

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APPENDIX B

PROPOSED PLANT LAYOUT

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APPENDIX C

PLANNING POLICY
AND GUIDANCE

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PLANNING POLICY AND GUIDANCE

National Planning Policy Framework and the Noise Policy Statement for England

The Department for Communities and Local Government published the National Planning Policy Framework (NPPF) on 27th March 2012 (as amended on 20th July 2021) and upon its publication, the majority of planning policy statements and guidance notes were withdrawn, including Planning Policy Guidance 24 Planning and Noise, which previously presented the government's overarching planning policy on noise.

Paragraph 174 in Section 15 of the NPPF (2021), entitled Conserving and enhancing the natural environment, states that:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability…"*

Paragraph 185 in Section 15 also states that:

> "*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of*

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the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…"

The Department for Environment Food and Rural Affairs published the Noise Policy Statement for England (NPSE) in March 2010. The explanatory note of NPSE defines the following terms used in the NPPF:

"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.

2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur."

The NPSE does not define any of the above effect levels numerically.

The NPSE presents the Noise Policy Aims as:

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

avoid significant adverse impacts on health and quality of life;

mitigate and minimise adverse impacts on health and quality of life; and

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

It can be seen that the first two bullet points are similar to Section 11 of the NPPF, with a third aim that seeks to improve health and quality of life. The NPSE later expands on the Noise Policy Aims, stating:

2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).

2.24 The second aim of the NPSE refers to the situation where the impact 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). This does not mean that such adverse effects cannot occur.

2.25 This aim (the third aim)*, seeks where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding*

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principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

It is clear that noise described in the NPSE as SOAEL that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, termed the LOAEL, but not so high that it leads to significant adverse effects.

British Standard 4142

To assess the acceptability of the resultant noise levels we have consulted the relevant standards. BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' has been used to assess the likelihood any adverse impacts based on the resultant noise level from the new plant item, including any corrections for the character of the noise against the existing background noise level.

BS4142 gives guidance on assessing the likelihood of adverse impacts by calculating a 'rating level' of the new noise source and comparing its magnitude at noise sensitive locations to the existing or underlying background noise level. The background noise level is subtracted from the 'rating level' to assess the likelihood of complaints:

- The greater the difference the greater the likelihood of complaints.
- A difference of around +10dB or more is an indication of a significant adverse impact, depending on the context.
- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background noise level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low sound impact, depending on the context.

This assessment is carried out over a one hour period for the daytime and a fifteen minute period for the night-time. For the purposes of the standard it states that daytime and night-time are typically 07:00 to 23:00 hours and 23:00 to 07:00 hours respectively.

The 'rating level' of the noise source is obtained taking the following factors into consideration:

- The new plant noise (the specific noise) is measured or predicted in terms of L_{Aeq}.
- An additional correction shall be included if the noise contains a distinguishable, discrete continuous note, if the noise contains distinct impulses or if the noise is irregular enough to attract attention. The value for any tonal noise can be an addition of up to 6dB and for impulsive noise of up to 9dB.

BS 4142 goes onto state that:

'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

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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.'

BS4142 has been referenced in setting noise limits for any fixed plant proposed as part of the proposed development.

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APPENDIX D

SURVEY RESULTS
(TABULAR)

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EC 18541 - MFG Levenshulme

MBH Design Studio Ltd

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:30	63.6	79.0	54.2
07:45	63.3	81.3	53.4
08:00	62.4	80.4	52.3
08:15	62.7	69.8	55.3
08:30	62.4	70.0	55.5
08:45	63.1	74.9	54.7
09:00	62.8	73.7	54.9
09:15	62.0	72.0	55.1
09:30	62.5	74.1	54.6
09:45	65.4	87.4	55.1
10:00	62.9	82.2	55.3
10:15	63.0	81.7	54.2
10:30	62.4	70.9	57.0
10:45	65.5	86.3	55.4
11:00	61.5	72.2	56.2
11:15	59.8	71.5	54.1
11:30	59.9	70.9	53.5
11:45	62.8	83.0	55.6
12:00	63.2	77.7	54.2
12:15	66.1	76.4	63.0
12:30	65.2	76.9	63.1
12:45	64.7	75.0	58.2
13:00	61.2	72.4	55.2
13:15	62.0	73.6	55.2
13:30	62.5	78.0	56.8
13:45	62.2	80.6	56.5
14:00	62.2	75.1	57.1
14:15	62.3	74.4	57.0
14:30	62.8	73.0	57.9
14:45	63.7	82.2	57.0
15:00	62.5	71.0	55.6
15:15	65.9	90.4	57.4
15:30	67.6	95.2	56.9
15:45	62.8	73.3	56.7
16:00	66.2	89.8	56.8
16:15	62.9	77.8	56.8
16:30	62.9	77.1	57.0
16:45	64.0	83.2	57.4
17:00	64.2	87.6	56.1
17:15	62.5	70.9	56.4
17:30	64.2	84.4	56.8
17:45	62.6	70.8	58.3
18:00	62.8	78.7	57.4
18:15	63.2	73.8	57.5
18:30	75.9	106.6	58.2
18:45	63.8	82.8	57.6
19:00	66.1	96.8	56.4
19:15	63.2	76.4	57.7

Time	L_{Aeq}	L_{AMax}	L_{A90}
19:30	63.3	77.1	54.9
19:45	65.8	90.3	56.4
20:00	70.4	94.0	55.3
20:15	62.4	71.3	54.8
20:30	63.3	81.6	56.2
20:45	62.1	70.3	55.5
21:00	62.9	88.4	55.8
21:15	61.9	80.6	56.6
21:30	63.1	84.4	56.4
21:45	62.2	80.5	54.9
22:00	61.6	71.1	54.4
22:15	62.5	84.7	54.2
22:30	64.9	89.9	52.4
22:45	63.7	84.7	51.5
23:00	61.2	79.9	51.5
23:15	62.0	75.7	50.9
23:30	61.1	72.5	50.3
23:45	61.0	74.9	47.3
00:00	60.9	70.3	50.7
00:15	60.3	70.5	47.4
00:30	60.7	73.2	50.3
00:45	59.4	75.2	46.9
01:00	59.4	72.0	47.9
01:15	60.2	70.9	48.3
01:30	58.9	70.9	44.1
01:45	59.7	77.7	46.5
02:00	59.1	69.5	45.2
02:15	58.6	69.4	43.5
02:30	57.7	69.1	41.9
02:45	58.9	76.8	41.2
03:00	58.1	77.1	40.7
03:15	57.7	70.9	40.8
03:30	59.0	76.4	43.0
03:45	57.8	70.8	37.1
04:00	59.2	71.7	41.7
04:15	59.4	74.8	43.0
04:30	58.4	69.4	38.4
04:45	58.7	76.5	43.4
05:00	59.7	73.7	43.4
05:15	59.0	69.2	42.3
05:30	58.2	72.0	39.4
05:45	60.6	77.4	39.0
06:00	60.2	78.0	43.3
06:15	59.8	73.2	42.4
06:30	61.1	75.3	48.5
06:45	60.6	72.9	47.9
07:00	60.3	72.4	44.1
07:15	60.8	76.5	45.9

quietly moving forward

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:30	60.2	71.4	47.0
07:45	61.1	71.9	48.6
08:00	62.0	74.0	50.3
08:15	61.4	77.4	48.7
08:30	61.8	72.2	52.1
08:45	61.8	68.7	54.0
09:00	61.1	69.7	48.7
09:15	61.7	79.2	51.2
09:30	64.4	87.5	54.3
09:45	61.9	70.8	53.2
10:00	62.6	73.5	54.6
10:15	62.2	72.3	51.5
10:30	64.6	86.5	56.5
10:45	66.1	93.0	56.7
11:00	62.3	70.0	55.6
11:15	62.1	76.8	53.7
11:30	63.0	81.1	57.2
11:45	62.6	77.4	55.9
12:00	63.2	81.8	54.8
12:15	62.2	73.8	54.2
12:30	62.5	76.4	55.9
12:45	63.7	84.6	54.5
13:00	63.1	73.8	58.3
13:15	63.5	80.0	56.9
13:30	62.8	76.1	57.0
13:45	62.5	70.6	56.4
14:00	62.6	77.5	56.4
14:15	63.7	86.1	56.7
14:30	62.0	71.1	56.6
14:45	62.8	73.8	56.9
15:00	62.6	78.2	57.1
15:15	62.2	75.2	56.7
15:30	66.4	92.6	56.0
15:45	62.6	72.6	56.4
16:00	62.8	81.6	55.6
16:15	62.6	81.6	56.7
16:30	63.4	80.7	56.8
16:45	62.8	73.1	55.8
17:00	63.4	78.6	56.4
17:15	62.8	80.7	57.0
17:30	65.5	89.0	55.7
17:45	64.2	83.4	55.7
18:00	63.1	74.1	56.2
18:15	63.3	80.1	55.2
18:30	62.8	72.6	56.3
18:45	63.2	73.6	56.7
19:00	64.6	80.6	56.1
19:15	63.5	81.9	57.3

Time	L_{Aeq}	L_{AMax}	L_{A90}
19:30	63.4	77.7	56.3
19:45	63.0	73.8	55.3
20:00	62.7	72.4	54.7
20:15	63.0	74.6	56.8
20:30	62.5	79.7	55.8
20:45	62.8	72.0	56.2
21:00	63.3	84.0	54.8
21:15	61.9	75.8	53.6
21:30	61.9	75.7	54.1
21:45	61.3	73.6	53.6
22:00	61.6	73.0	53.1
22:15	61.4	71.7	52.8
22:30	62.4	80.7	53.3
22:45	61.4	75.5	53.0
23:00	62.0	71.5	52.9
23:15	61.9	72.7	50.7
23:30	61.4	71.5	50.7
23:45	61.4	75.6	49.8
00:00	61.1	72.9	49.9
00:15	61.0	75.6	51.1
00:30	62.7	94.4	48.7
00:45	61.2	74.9	50.2
01:00	60.7	72.1	47.4
01:15	61.0	79.5	44.8
01:30	59.7	69.6	45.9
01:45	61.6	72.0	52.0
02:00	60.3	76.6	48.0
02:15	60.6	79.1	46.3
02:30	60.7	70.0	45.7
02:45	59.3	71.9	43.8
03:00	58.0	79.0	43.0
03:15	59.5	71.6	43.7
03:30	59.3	71.8	44.9
03:45	59.2	71.8	42.6
04:00	59.0	73.4	42.7
04:15	59.5	71.7	41.8
04:30	59.9	77.0	43.3
04:45	59.7	79.1	39.1
05:00	57.8	70.5	41.4
05:15	58.2	70.6	39.2
05:30	58.4	70.3	42.9
05:45	58.7	69.9	42.6
06:00	59.1	70.8	46.7
06:15	59.5	72.3	41.7
06:30	60.7	76.4	47.4
06:45	60.9	72.8	47.4
07:00	60.3	71.0	46.0
07:15	58.9	69.4	43.2

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Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:30	59.4	68.4	43.3
07:45	59.5	72.1	45.4
08:00	60.9	74.9	47.8
08:15	60.2	71.2	47.6
08:30	60.1	69.5	47.4
08:45	60.2	71.9	48.6
09:00	60.8	72.9	51.0
09:15	60.9	70.6	49.7
09:30	61.3	72.8	51.4
09:45	61.9	71.1	50.8
10:00	61.6	73.6	52.0
10:15	63.1	80.7	54.1
10:30	63.1	78.4	54.4
10:45	62.5	72.6	53.5
11:00	62.0	75.5	52.8
11:15	63.6	83.8	55.0
11:30	62.8	81.3	53.4
11:45	63.9	82.7	55.1
12:00	62.5	73.3	56.4
12:15	62.5	69.2	55.9
12:30	62.9	76.1	56.3
12:45	63.2	74.4	56.9
13:00	62.5	72.0	53.6
13:15	62.9	79.9	53.2
13:30	62.4	71.6	55.0
13:45	63.5	82.1	56.8
14:00	65.9	96.2	55.3
14:15	66.8	91.1	55.8
14:30	66.0	90.5	58.3
14:45	67.5	87.4	55.8
15:00	62.3	81.6	53.0
15:15	62.9	71.6	56.1
15:30	62.0	76.5	52.2
15:45	62.2	76.7	55.2
16:00	63.6	86.4	53.8
16:15	62.7	77.2	53.2
16:30	62.8	72.7	55.2
16:45	69.6	93.7	54.5
17:00	62.5	73.6	55.3
17:15	62.7	76.7	55.7
17:30	62.6	74.6	55.0
17:45	63.2	77.2	55.3
18:00	62.8	74.2	56.2
18:15	63.9	78.6	56.2
18:30	63.3	84.2	54.3
18:45	62.2	77.7	55.9
19:00	62.4	76.9	54.6
19:15	63.3	78.4	54.4

Time	L_{Aeq}	L_{AMax}	L_{A90}
19:30	73.0	98.1	56.8
19:45	64.6	84.8	55.8
20:00	65.0	90.4	56.1
20:15	70.0	95.1	54.5
20:30	61.8	76.4	52.0
20:45	61.6	75.4	53.6
21:00	61.6	79.6	54.2
21:15	61.2	72.2	53.5
21:30	62.2	74.9	52.7
21:45	61.8	81.3	53.2
22:00	62.7	88.9	51.1
22:15	61.2	72.6	50.1
22:30	61.3	70.8	51.5
22:45	62.6	86.2	51.9
23:00	63.2	78.4	53.1
23:15	61.2	79.0	49.9
23:30	61.4	80.0	51.1
23:45	61.8	84.0	50.0
00:00	59.5	72.7	46.5
00:15	58.7	70.8	46.8
00:30	58.5	69.3	46.0
00:45	57.5	73.1	41.2
01:00	57.2	69.8	40.0
01:15	57.5	78.2	42.3
01:30	56.9	69.0	39.0
01:45	55.8	77.3	36.7
02:00	55.9	69.2	39.2
02:15	54.4	71.9	36.1
02:30	53.2	68.0	35.9
02:45	56.6	78.4	36.2
03:00	55.1	71.0	32.8
03:15	55.5	67.8	34.6
03:30	53.0	75.9	31.6
03:45	53.7	68.0	33.9
04:00	54.0	69.0	33.2
04:15	56.0	70.1	33.9
04:30	55.1	69.5	34.5
04:45	55.8	69.3	36.6
05:00	57.0	73.8	36.5
05:15	56.7	71.6	38.2
05:30	59.5	75.8	40.4
05:45	61.3	86.7	46.2
06:00	60.8	73.8	44.9
06:15	61.3	72.3	47.0
06:30	62.8	73.2	50.6
06:45	65.0	90.6	49.5
07:00	63.6	91.2	53.6
07:15	62.2	78.1	53.5

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MBH Design Studio Ltd

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
07:30	*61.9*	*76.0*	*55.2*
07:45	*64.4*	*79.9*	*55.3*
08:00	*62.9*	*75.5*	*55.4*
08:15	*63.4*	*74.3*	*56.8*

Time	L_{Aeq}	L_{AMax}	L_{A90}

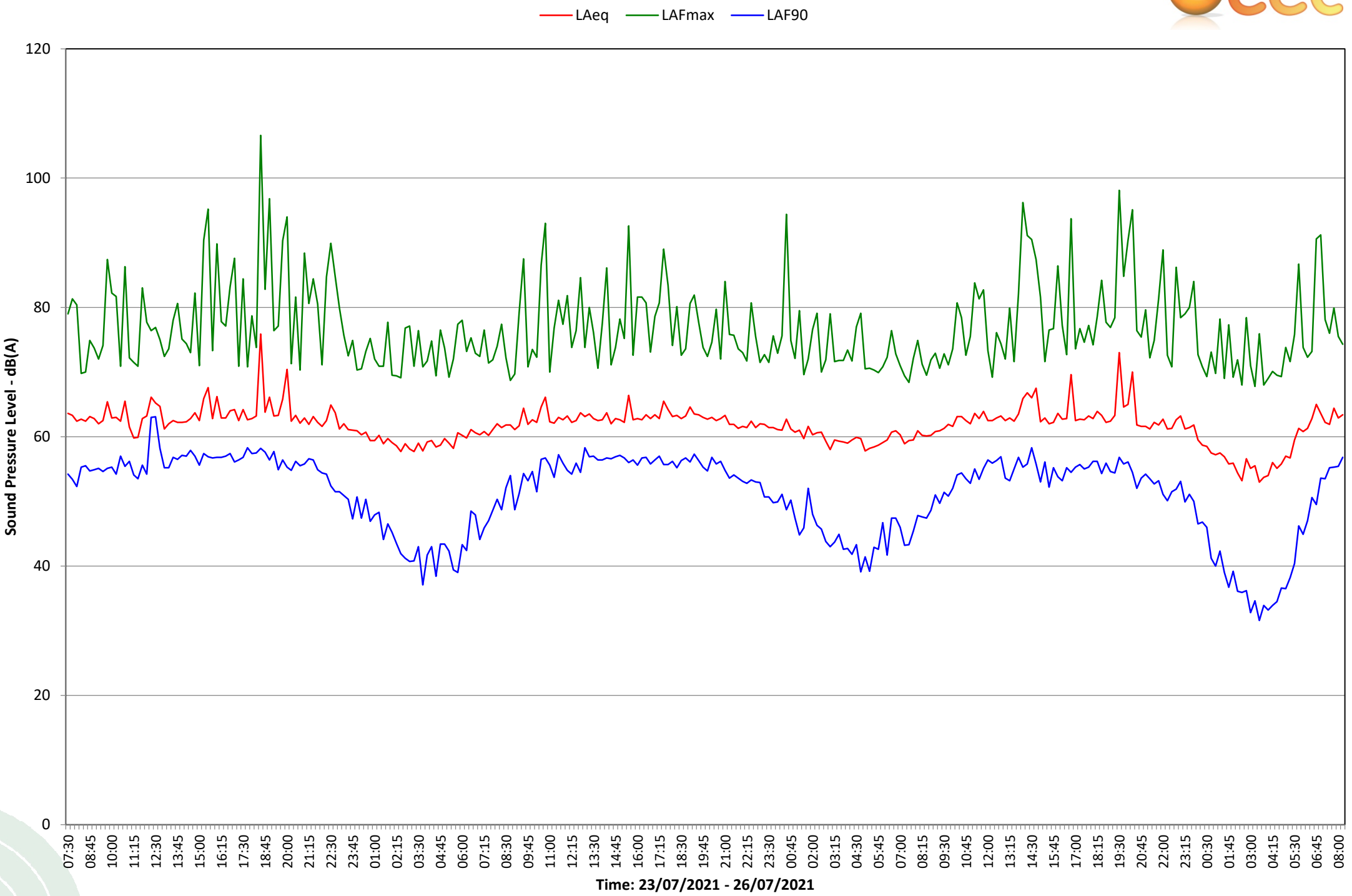
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APPENDIX E

SURVEY RESULTS
(GRAPHICAL)

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Noise Level Time History at MFG Levenshulme



APPENDIX F

PUBLISHED PLANT NOISE DATA

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CODE			100	100	125	125
Outdoor Unit		RAV-	SM1104ATP-E	SM1104AT8P-E	SM1404ATP-E	SM1404AT8P-E
Cooling Range (Min. - Max.)		kW	3.0 - 11.2	3.0 - 11.2	3.0 - 13.2	3.0 - 13.2
Heating Range (Min. - Max.)		kW	3.0 - 13.0	3.0 - 13.0	3.0 - 16.0	3.0 - 16.0
Ambient Operating Range Cooling/Heating		°C	46 to -15/15 to -15	46 to -15/15 to -15	46 to -15/15 to -15	46 to -15/15 to -15
Fan(s)	Motor Power	W	100	100	100	100
	Standard Air Flow	l/s	1133	1133	1167	1167
	Standard Air Flow	m³/min	68	68	70	70
	Standard Air Flow	m³/h	4080	4080	4200	4200
Sound	Pressure Level C/H	dB(A)	53/54	53/54	54/55	54/55
	Power Level C/H	dB(A)	70/71	70/71	70/71	70/71
Unit	Appearance		Silky Shade (Muncel 1Y 8.5/0.5)	Silky Shade (Muncel 1Y 8.5/0.5)	Silky Shade (Muncel 1Y 8.5/0.5)	Silky Shade (Muncel 1Y 8.5/0.5)
	Heat Exchanger		Finned tube	Finned tube	Finned tube	Finned tube
	Compressor Type		Hermetic Twin Rotary	Hermetic Twin Rotary	Hermetic Twin Rotary	Hermetic Twin Rotary
	Compressor Power	kW	2.5	3.0	3.0	3.0
	Height x Width x Depth	mm	890 x 900 x 320	890 x 900 x 320	890 x 900 x 320	890 x 900 x 320
	Total Weight	kg	68	68	68	68
Refrigerant	Control		Pulse motor valve	Pulse motor valve	Pulse motor valve	Pulse motor valve
	Gas Type		R410A	R410A	R410A	R410A
	Base Charge/Chargeless To	kg/m	2.8/30	3.1/30	2.8/30	3.1/30
	Additional Charge Main Liquid Side	g/m	40	40	40	40
	Replacement Technology	Yes	R22, R407C, R417A, R134a, R12	R22, R407C, R417A, R134a, R12	R22, R407C, R417A, R134a, R12	R22, R407C, R417A, R134a, R12
Pipe Connections	Min.-Max. Length	m	5-50	5-50	5-50	5-50
	Height Difference Outdoor To AHU	m	±30	±30	±30	±30
	Gas Side	inch	5/8	5/8	5/8	5/8
	Liquid Side	inch	3/8	3/8	3/8	3/8
	Drain Port Connector Hose Inner Diameter	mm	16	16	16	16
Electrical	Power Supply	V/ph/Hz	220-240/1/50	380-415/3/50	220-240/1/50	380-415/3/50
	Maximum Run Current	A	15.18	3.67	21.37	3.67
	Suggested Fused Supply	A	20	10	32	10

systemair

MUB 042 500EC Multibox

Sound power level		63	125	250	500	1k	2k	4k	8k	Total
Inlet	dB(A)	46	65	62	68	68	65	62	54	74
Outlet	dB(A)	47	67	64	70	70	67	63	55	75
Surrounding	dB(A)	25	47	38	38	39	39	30	19	49
Sound pressure level at 3m (20m² Sabine)	dB(A)	-	-	-	-	-	-	-	-	42
Sound pressure level at 3m free field	dB(A)	-	-	-	-	-	-	-	-	28

systemair

MUB/T 062 560EC

Sound power level		63	125	250	500	1k	2k	4k	8k	Total
Inlet	dB(A)	47	64	79	80	80	78	74	69	86
Outlet	dB(A)	48	65	80	81	82	79	76	70	87
Surrounding	dB(A)	27	47	51	48	50	49	42	33	57
Sound pressure level at 3m (20m² Sabine)	dB(A)	-	-	-	-	-	-	-	-	50
Sound pressure level at 3m free field	dB(A)	-	-	-	-	-	-	-	-	36

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systemair

prio 200EC circ. duct fan

Sound power level		63	125	250	500	1k	2k	4k	8k	Total
Inlet	dB(A)	46	54	70	71	73	69	64	56	77
Outlet	dB(A)	44	54	58	67	68	65	61	56	72
Surrounding	dB(A)	13	27	39	52	56	53	45	32	59
Sound pressure level at 3m (20m² Sabine)	dB(A)	-	-	-	-	-	-	-	-	52
Sound pressure level at 3m free field	dB(A)	-	-	-	-	-	-	-	-	38

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