

Retail Convenience Store
Chorlton Street
Manchester

**Plant Noise
Impact Assessment Report**

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1	11 th March 2025	Minor amendment to plant noise design criteria, text and drawings	AQ	NAC

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1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned to provide an impact assessment for new plant serving the proposed convenience store, to be located along Chorlton Street, Manchester.
- 1.2. An environmental sound survey has been undertaken to establish the prevailing background sound pressure levels at a location representative of the sound levels outside the nearest noise sensitive receptors to the site.
- 1.3. Noise levels at the nearest noise sensitive receptors have been predicted and assessed against the local authority's usual requirements and recognised Standards and guidance.
- 1.4. To assist with the understanding of this report a glossary of acoustic terms can be found in [Appendix A](#). An in-depth glossary of acoustic terms can be viewed online at www.acoustic-glossary.co.uk.

2.0 Details of development proposals

- 2.1. The proposed convenience store will occupy part of a new mixed commercial and residential premises.
- 2.2. The new air conditioning (AC) and refrigeration plant is proposed to be located on a mezzanine level within the stores back of house area. The proposed plant room will intake and discharge through an attenuated aperture along the north western façade.
- 2.3. The proposed refrigeration plant will potentially operate 24 hours a day, although it should be noted that these units operate as required to meet demand and that store demands for cooling are generally reduced at night. The AC units and ventilation systems will operate only during store opening hours.
- 2.4. To control structure borne noise and vibration, all plant and associated pipework/ductwork will be fitted with suitable anti-vibration mounts/hangers.

3.0 Nearest noise sensitive receptors

- 3.1. The area surrounding the site is mixed residential and commercial.
- 3.2. The nearest noise sensitive property to the proposed plant room louvres is a flat within the same building (Receptor R1) located approximately 6m from the proposed louvres at its nearest position. Furthermore, there is a second dwelling (Receptor R2) which is located approximately 12m from the plant room louvres at its nearest position.

- 3.3. **Appendix B** contains an aerial photograph showing the site, surrounding area and key areas of interest.

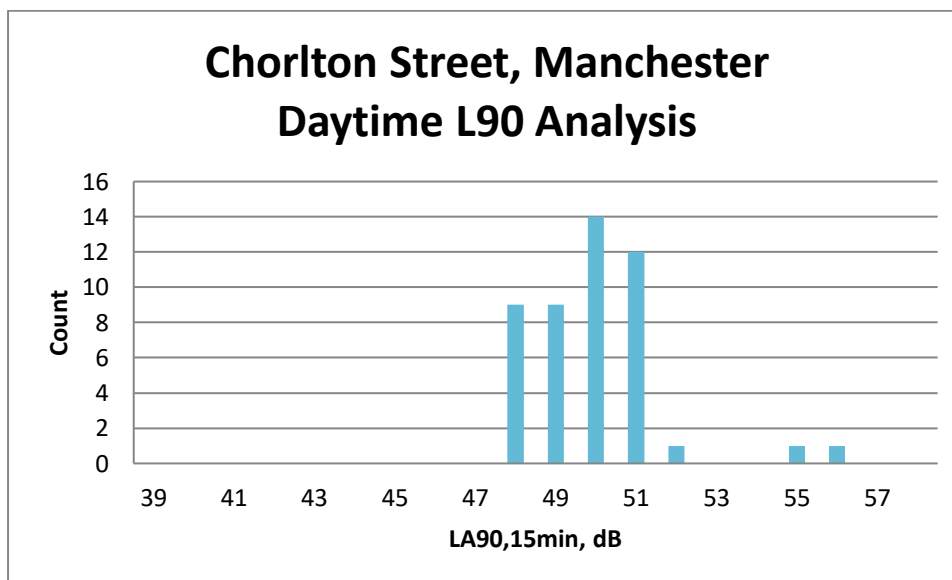
4.0 Existing noise climate

- 4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptor to the plant area during the quietest times at which the plant will operate.
- 4.2. The results of the environmental sound survey are summarised in Table 1 below. The full set of measurement results and details of the survey methodology are presented in **Appendix C**.

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	L _{Aeq} (15mins)	L _{Amax} (15mins)	L _{A10} (15mins)	L _{A90} (15mins)
Daytime (07.00 – 23.00 hours)	51-64	62-97	53-62	48-56
Night-time (23.00 – 07.00 hours)	45-54	58-73	47-56	41-50

Figure 1 Histogram of daytime L_{A90} background sound pressure levels



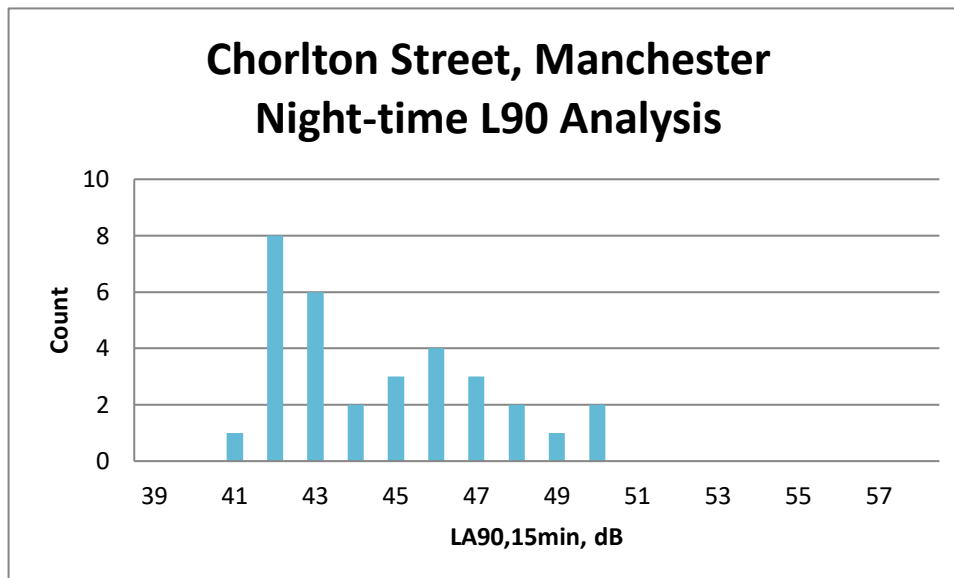
- 4.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

Table 2 Statistical analysis of $L_{A90,15min}$ levels during the daytime period

dB, L_{A90} daytime period	
Mean	50
Mode	50
Median	50

- 4.4. 49dB L_{A90} is considered as representative of the typical background sound level during the daytime period.

Figure 2 Histogram of night-time L_{A90} background sound pressure levels



- 4.5. Additional statistical analysis has been undertaken. As shown in Table 3, the mean, median, and modal values have been calculated:

Table 3 Statistical analysis of $L_{A90,15min}$ levels during the night-time period

dB, L_{A90} daytime period	
Mean	45
Mode	42
Median	44

- 4.6. 42dB L_{A90} is considered as representative of the typical background sound level during the night-time period.
- 4.7. Therefore, the following values are considered as representative of the existing background sound pressure levels at nearby noise sensitive premises:

- 49dB L₉₀ during the daytime period; and
- 42dB L₉₀ during the night-time period.

5.0 Plant noise design criteria

Sandy Brown - Operational noise limits

- 5.1. Acoustic consultants, Sandy Brown, have prepared a memo in April 2020 setting out operational noise limits for the Block E and F commercial units.¹ It is understood that the criteria contained within this report were agreed as part of the original planning approval for the retail premises. It should be noted that this memo was prepared prior to the current proposals and as such not all the criteria noted within the memo are relevant.
- 5.2. The acoustic criteria set out in this memo refers to entertainment noise, and as such, is not relevant to the current proposals. NSL have outlined Manchester City Councils guidance with regards to noise and vibration from fixed plant/equipment in paragraph 5.5 of this report.
- 5.3. With regards to floor and facade sound insulation, the memo states;

Floor sound insulation

The floor construction between the commercial units and Level 2 apartments has been specified to achieve a minimum sound insulation performance of $D_{nT,w}+C_{tr}$ 55 dB. This will be updated with the measured floor sound insulation once airborne sound insulation tests have been completed.

Facade sound insulation

The commercial unit facade sound insulation has been specified to achieve a minimum sound insulation performance of R_w+C_{tr} 30 dB

- 5.4. The Sandy Brown Memo further goes on to provide Operational noise limits. The Memo states;

Operational noise limits

Guidance on maximum internal operational noise limits, from amplified sound within the ground floor commercial/amenity spaces are provided in Table 1 based on the controlling noise transfer to the apartments above as well as noise egress to the nearby sensitive premises/apartments within the scheme. These are based on the specified floor and façade

¹ Memo: M194-A, Jessica Wright, 8th April 2020

sound insulation as set out above. The operational noise limits will be updated once airborne floor sound insulation tests have been completed.

Maximum internal sound pressure levels (L_{Fmax}) shall be limited to values 5 dB above those set out below.

Table 1 Operational noise limit in Block E and F commercial units

	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Operational noise limit in commercial units, L _{eq} (dB)	73	71	83	86	89	90	90

These limits rely on the following tenant works:

- Louvres shown through the retail facades at high level for future ductwork connections are to blanked/internally lined to maintain performance of the glazed facade.*
- External doors are to be lobbied.*

Setting operational noise limits

The exact amplified noise limits shall be determined following pre-completion sound insulation and that electronic limiters are used for each commercial unit. These limits would minimise disturbance to the residents of the apartments above the commercial units. Final sound levels should be set during commissioning of electronic sound limiters in the commercial units to ensure the MCC criteria are met.

Manchester City Council

- 5.5. The Planning and Noise Technical Guidance document for Manchester City Council² provides the following guidance with regards to noise and vibration from fixed plant/equipment.

The noise assessment should be based on BS 4142, 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 (LAeq) below the typical background (LA90) level at the nearest noise sensitive location’.

² Planning and Noise, Technical Guidance, Manchester City Council, October 2022

- 5.6. It has been assumed that this criterion would be applicable to noise from plant room louvres also.

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

- 5.7. BS 4142:2014 +A1:2019 is intended to be used to assess the likely effects of sound on people residing in nearby dwellings. The scope of BS 4142:2014³ includes *"sound from fixed plant installations which comprise mechanical and electrical plant and equipment"*.
- 5.8. The procedure contained in BS 4142:2014 is to quantify the *"specific sound level"*, which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15 minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.
- 5.9. The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.
- 5.10. The penalty for tonal elements is between 0dB and 6dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."*
- 5.11. The penalty for impulsive elements is between 0dB and 9dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."*
- 5.12. The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:
- *Typically, the greater this difference, the greater the magnitude of the 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;*
 - *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.*

³ For brevity, references to BS 4142 and BS 4142:2014 should be read as BS 4142:2014 + A1:2019

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.

- 5.13. The standard does state that *"adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."*
- 5.14. The standard goes on to note that: *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*
- 5.15. In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:
- "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."*
- 5.16. BS 4142:2014 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.

National Planning Policy Framework

- 5.17. A new edition of the NPPF was published in December 2024 and came into effect immediately. The original National Planning Policy Framework (NPPF⁴) was published in March 2012, with subsequent revisions made periodically - this document replaced the existing Planning Policy Guidance Note 24 (PPG 24) "Planning and Noise." The December 2024 revised edition contains no new directions or guidance with respect to noise. The paragraph references quoted below relate to the December 2024 edition.
- 5.18. Paragraph 187 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"preventing new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, water or noise pollution or land instability."*
- 5.19. The NPPF goes on to state in Paragraph 198:
- "planning policies and decisions should ..."*

⁴ National Planning Policy Framework, DCLG, March 2012

- 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 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 ...*

- 5.20. The NPPF document does not refer to any other documents or British Standards regarding noise other than the Noise Policy Statement for England (NPSE⁵).
- 5.21. Paragraph 2 of the NPPF states that *"planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."*
- 5.22. Paragraph 12 of the NPPF states that *"The presumption in favour of sustainable development does not change the statutory status of the development plan as the starting point for decision making. Where a planning application conflicts with an up-to-date development plan (including any neighbourhood plans that form part of the development plan), permission should not usually be granted. Local planning authorities may take decisions that depart from an up-to-date development plan, but only if material considerations in a particular case indicate that the plan should not be followed"*.
- 5.23. Paragraph 124 states that *"Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land"*.

Proposed criteria

- 5.24. To comply with Manchester City Council's stipulated requirements, it is recommended that the noise emissions should be controlled such that, at the façade of the nearest noise sensitive property the rating level should be no higher the 5dB below the prevailing background sound level.
- 5.25. The following cumulative plant noise limits are therefore proposed:

⁵ Noise Policy Statement for England, DEFRA, March 2010

Table 4 Proposed plant noise emissions level limits at noise sensitive residential receptors

Period	Cumulative plant rating level, dB(A)
Daytime (07.00 – 23.00 hours)	44
Night-time (23.00 – 07.00 hours)	37

- 5.26. The above limits have not been approved by the local authority at this stage.
- 5.27. With regards to the criteria outlined by Sandy Brown, NSL have not been approached to undertake works in relation to the sound insulation performance of the retail unit and as such are unable to comment on these areas. It should be noted however, that no wall or ceiling within the proposed store's demise will directly adjoin to any residential dwelling.

6.0 Plant Noise Assessment

- 6.1. The cumulative plant noise level at the most affected noise sensitive receptor has been predicted based on manufacturer's noise data for the proposed equipment.
- 6.2. Noise levels at the receptor have been predicted taking into account aperture size, directivity of sound propagation, screening, and distance attenuation. Predictions are inclusive of atmospheric-side attenuation fitted to the plant room as detailed in Table 5.

Table 5 Proposed atmospheric side attenuators to plant room

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Plantroom Intake	10	20	32	44	45	45	45	41
Condenser Discharge	10	20	32	44	45	45	45	41
VRV Discharge	9	17	30	43	45	45	45	40
Emergency CO2 Discharge	9	17	30	43	45	45	45	40

- 6.3. It should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems. However, a penalty of 3dB as described in BS 4142:2014 has been applied for the possible presence of "...characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment...".

- 6.4. Table 6 summarises the results of the assessment at the most affected properties. All other nearby receptors benefit from increased distance/screening to the plant such that resulting noise levels will be lower than at the receptors considered. The full set of calculations can be found in **Appendix F**.

Table 6 Assessment of predicted noise levels

Receptor	Period*	Plant sound pressure level at receptor, dB LAeq	Proposed criterion, dB LAeq	Excess, dBA
R1	Daytime (07.00 – 23.00 hours)	42	44	-2
	Night-time (23.00 - 07.00 hours)	37	37	0
R2	Daytime (07.00 - 23.00 hours)	37	44	-7
	Night-time (23.00 - 07.00 hours)	34	37	-3

- 6.5. The assessment shows that noise from the proposed plant will be at or below the recommended criteria, when attenuated as described, at the most affected noise sensitive receptors and should therefore be acceptable to the local authority.

Context and uncertainties

- 6.6. As BS 4142:2014 advises, the impact must be considered within the context of the site and the surrounding acoustic environment. The following must, therefore, also be taken into consideration when determining the potential impact that may be experienced:
- The assessment is undertaken at the nearest residential windows. The impact on all other nearby residential windows will be lower due to screening and distance attenuation.
 - The assessment has been made with all plant operating at maximum capacity, as this is not always the case, the assessment is an absolute worst case scenario.
- 6.7. Where possible, uncertainty in the above assessments has been minimised by taking the following steps:
- The meter and calibrator used have a traceable laboratory calibration and the meter was field calibrated before and after the measurements.
 - Uncertainty in the calculated impacts has been reduced by the use of a well-established calculation method.

- Calculations are based on a minimum distance of 5.7m between the plant and the nearest residential receptor.
- Care was taken to ensure that the measurement position was representative of the noise climate outside the nearby residential dwellings and not in a position where higher noise levels were present.

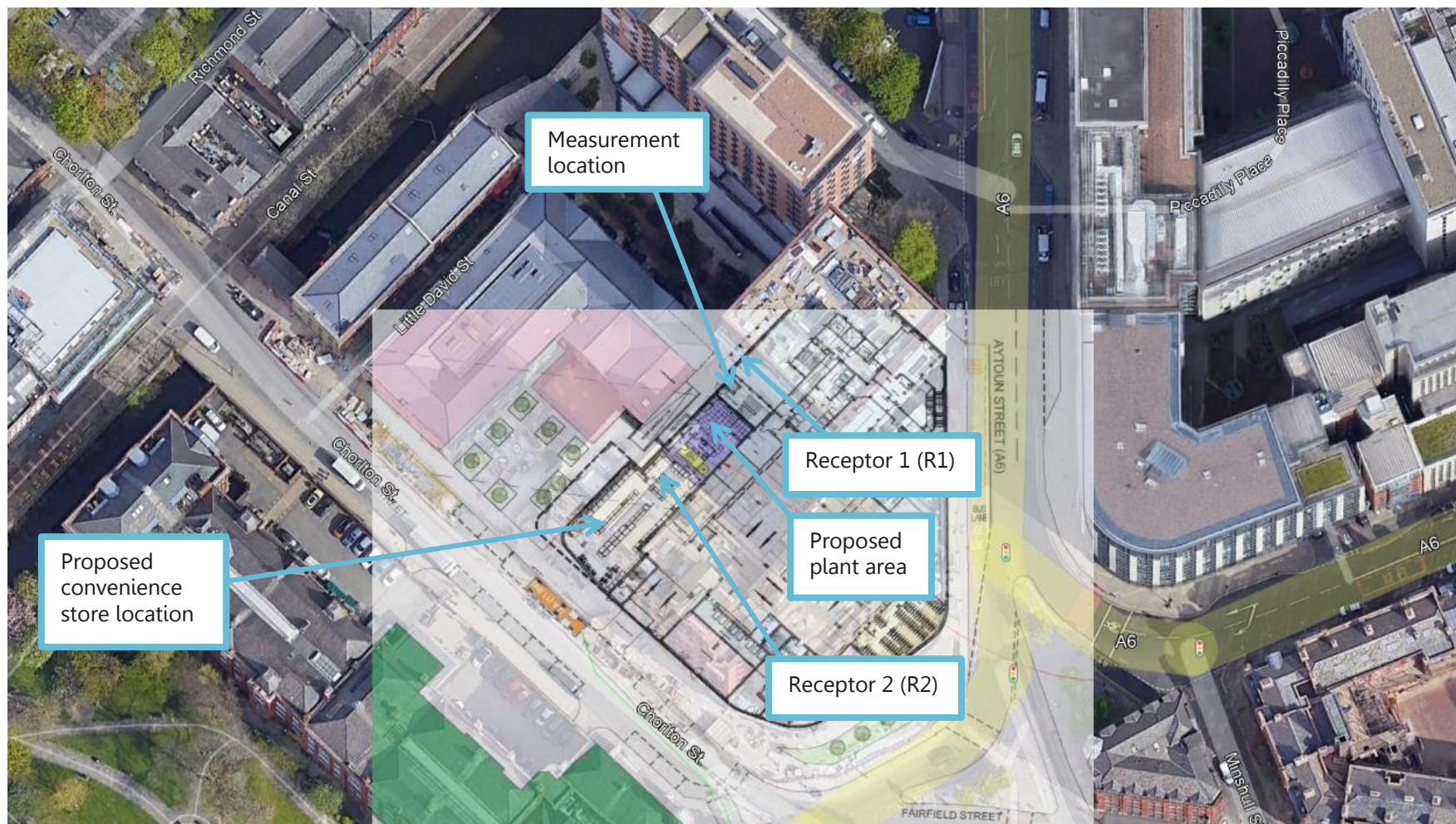
7.0 Summary

- 7.1. Noise Solutions Ltd (NSL) has been commissioned to provide an impact assessment for new plant serving the proposed convenience store, to be located along Chorlton Street, Manchester.
- 7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at a location representative of the noise climate outside the nearest noise sensitive receptors to the site.
- 7.3. The cumulative plant noise emission levels for the proposed plant have been predicted at the most affected noise sensitive receptor locations and demonstrated to be in compliance with the typical requirements of Manchester City Council. Therefore, noise from the plantroom proposals should not be a reason for refusal of planning permission.
- 7.4. Predicted plant noise levels are inclusive of the following mitigation measures;
 - Specified atmospheric-side attenuators to the proposed plantroom intake, gas cooler discharge, VRV discharge and emergency CO2 vent.
 - All plant and associated pipework/ductwork should be fitted with suitable anti-vibration mounts/hangers.

Appendix A Acoustic terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A-weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example.

Appendix B Image of site showing areas of interest



Photograph 1 Courtesy of Google Earth 2023

Appendix C Environmental sound survey

Details of environmental sound survey

- C.1 Measurements of the existing background sound levels were undertaken between 14.45 hours on Wednesday 22 March and 10.30 hours on Thursday 23 March 2023.
- C.2 The sound level meter was programmed to record the A-weighted L_{eq} , L_{90} , L_{10} and L_{max} noise indices for consecutive fifteen-minute sample periods for the duration of the survey.

Measurement position

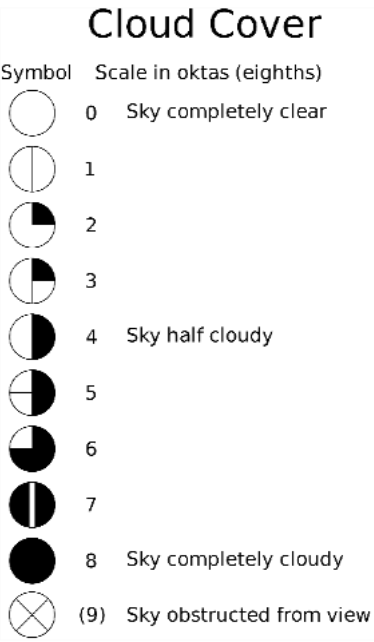
- C.3 The representative measurement position was located above the proposed plantroom, on the roof top communal garden approximately 5m from R1 (location indicated on the site plan in [Appendix B](#)). In accordance with BS 7445-2:21991 '*Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use*', the measurements were undertaken under free-field conditions.

Equipment

- C.4 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change in the calibration level was noted.

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Rion NL-52 / 00654035	30/08/2022	TCRT22/1544
Condenser microphone	Rion UC-59 / 14826		
Preamplifier	Rion NH-25 / 87474		
Calibrator	Rion NC-74 / 34235932	04/10/2022	1503480-1

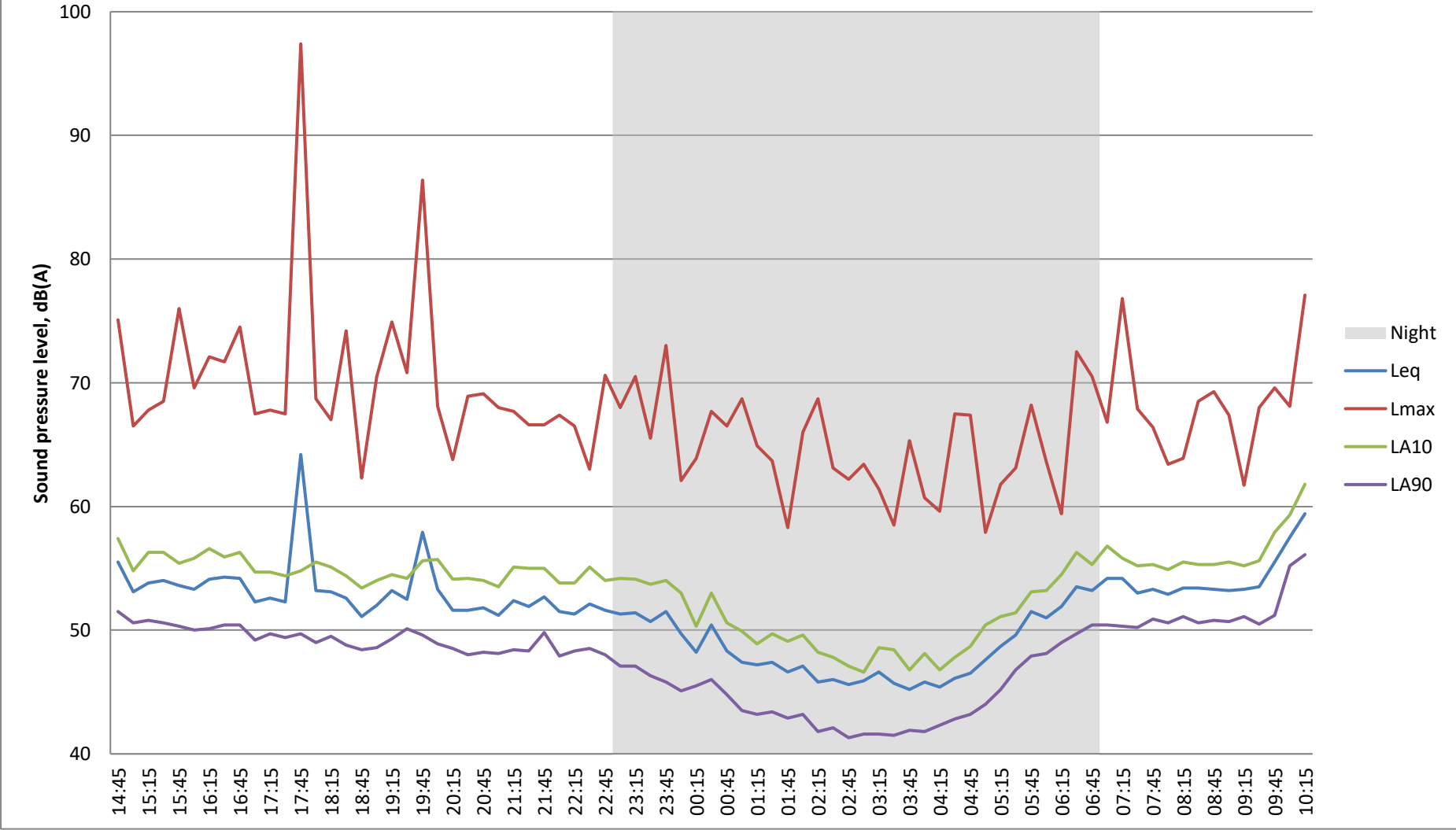
- C.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were generally appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	Time/Date	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	14.45 22/3/23 - 10.30 23/3/23	Temperature (°C)	8	10
Cloud Cover  Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view		Precipitation:	Rain	Rain
		Cloud cover (oktas – see guide)	6	7
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Wet	Wet
		Wind Speed (m/s)	<1	<1
		Wind Direction	From North	From North West
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

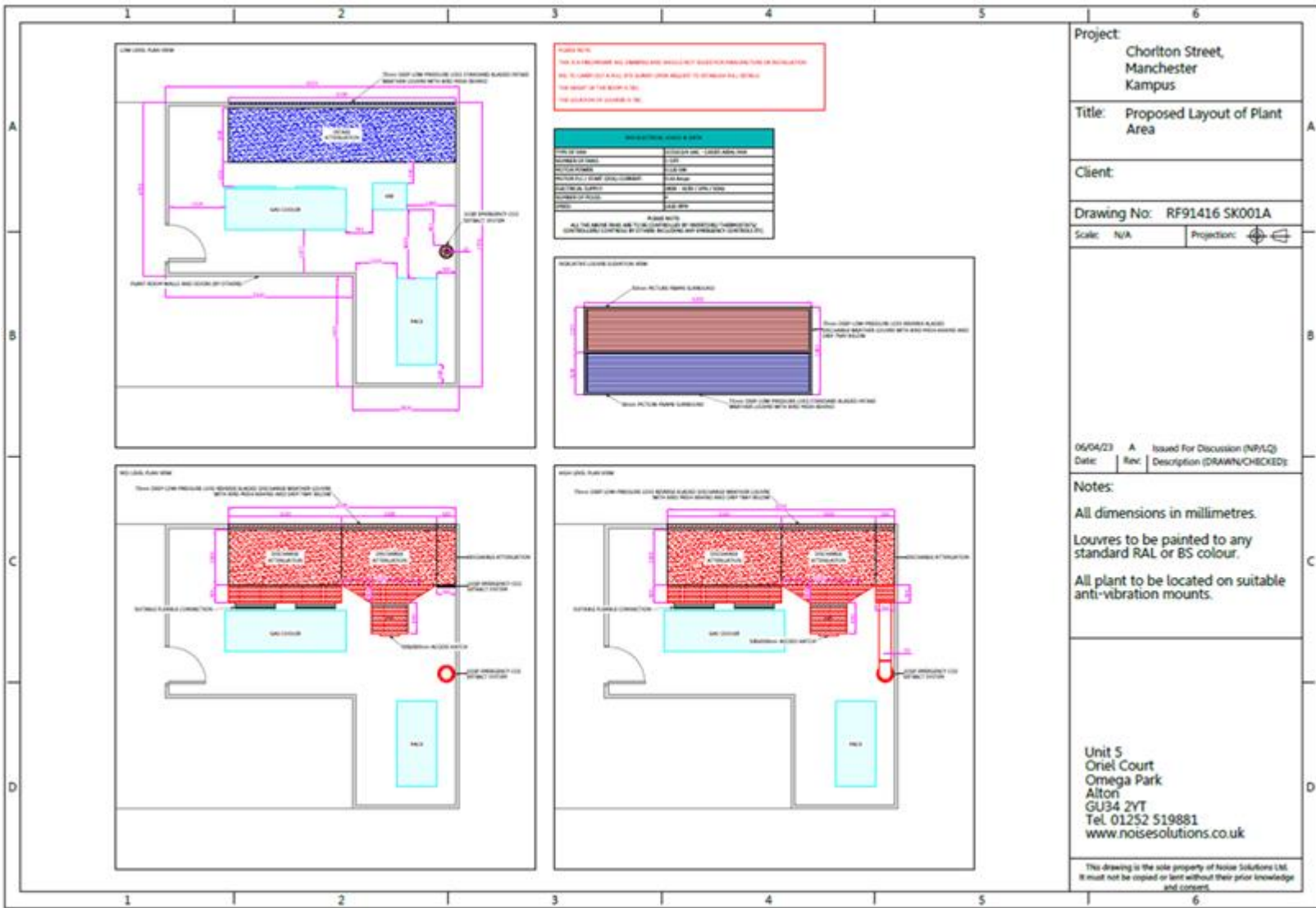
Results

- C.7 The results of the survey are considered to be representative of the background sound pressure levels at the façades of the most affected noise sensitive receptors to the plant area during the quietest times at which the plant will operate. The noise climate at the measurement position was dominated by road traffic. Furthermore, to a lesser degree, aircraft and pedestrians could also be heard. The results of the survey are presented in a time history graph overleaf.

Chorlton Street, Manchester
Wednesday 22 - Thursday 23 Mar 2023



Appendix D Plant Layout



Appendix E Plant noise data

Plant	Unit/Model	No. of units	Description	Sound power/pressure level (dB) at octave band centre frequencies (Hz)								dBA
				63	125	250	500	1000	2000	4000	8000	
Gas Cooler	Kelvion/ GE-MB102GX-HH	1	Intake sound power level*	82**	82	78	72	72	70	66	66**	78
			Discharge sound power level*	88**	88	84	78	78	76	72	72**	84
ACU	Mitsubishi/ PURY-M300YNW-A1(-BS)	1	Intake sound power level	88	83	82	79	74	70	65	61	80
			Discharge sound power level	94	89	88	85	80	76	71	67	86
Pack	SCM	1	Sound Power Level	82	76	78	73	70	67	63	55	76

*Sound power level given of a single fan. Unit houses two fans.

** Level assumed due to insufficient data

Appendix F Plant noise calculations

Summary

Receptor	Period	Intake louvre rating level, dBA	Condenser discharge louvre plantroom rating level, dBA	VRV discharge louvre rating level, dBA	CO2 discharge louvre rating level, dBA	Total
R1	Day (07.00 – 23.00)	36	35	39	16	42
	Night (23.00 – 07.00)	33	35	-	13	37
R2	Day (07.00 – 23.00)	30	33	32	8	37
	Night (23.00 – 07.00)	28	33	-	5	34

Plantroom Daytime

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	86	83	79	74	72	68	64	62	78
All plant running										
Opening area (m2)	7.13	9	9	9	9	9	9	9	9	
SRI of opening	I.L	-10	-20	-32	-44	-45	-45	-45	-41	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	78	66	49	33	29	25	21	24	54
R1										
Directivity correction	(6200,25deg x 1150,80deg)	2	2	2	-1	-5	-5	-5	-5	
Distance correction (m)	5.7	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	60	47	31	12	4	0	-4	-1	36
R2										
Directivity correction	(6200,20deg x 1150,60deg)	2	3	2	2	1	1	1	1	
Distance correction (m)	11.5	-29	-29	-29	-29	-29	-29	-29	-29	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	54	42	25	9	4	0	-4	-1	30

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Condenser Discharge										
Sound power	Lw	91	91	87	81	81	79	75	75	87
End reflection	3.8285	-1	0	0	0	0	0	0	0	
SRI of opening	I.L	-10	-20	-32	-44	-45	-45	-45	-41	
Lw of opening		80	71	55	37	36	34	30	34	58
R1										
Directivity correction	(3100,25deg x 1235,80deg)	1	1	2	-1	-5	-5	-5	-5	
Distance correction (m)	8.4	-26	-26	-26	-26	-26	-26	-26	-26	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	58	49	33	13	8	6	2	6	35
R2										
Directivity correction	(3100,20deg x 1235,60deg)	2	2	2	2	1	1	1	1	
Distance correction (m)	11.5	-29	-29	-29	-29	-29	-29	-29	-29	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	55	47	31	13	11	9	5	9	33
VRV Unit Discharge										
Sound power	Lw	94	89	88	85	80	76	71	67	86
End reflection	3.211	-3	-1	0	0	0	0	0	0	
SRI of opening	I.L	-9	-17	-30	-43	-45	-45	-45	-40	
Lw of opening		82	71	58	42	35	31	26	27	59
R1										
Directivity correction	(2600,45deg x 1235,80deg)	0	0	0	-3	-7	-7	-7	-7	
Distance correction (m)	5.7	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	62	51	37	19	8	4	-1	0	39
R2										
Directivity correction	(2600,20deg x 1235,60deg)	2	2	2	2	1	1	1	1	
Distance correction (m)	14.5	-31	-31	-31	-31	-31	-31	-31	-31	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	55	45	31	15	7	3	-1	0	32

SUMMARY

Receptor R1

Intake
Condenser Discharge
VRV Discharge
Cumulative

63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
60	47	31	12	4	0	-4	-1	36
58	49	33	13	8	6	2	6	35
62	51	37	19	8	4	-1	0	39
65	54	39	20	12	8	4	7	42

Receptor R2

Intake
Condenser Discharge
VRV Discharge
Cumulative

54	42	25	9	4	0	-4	-1	30
55	47	31	13	11	9	5	9	33
55	45	31	15	7	3	-1	0	32
60	50	35	18	13	10	6	10	37

Plantroom Night-time

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	83	81	76	71	70	67	63	62	75
All plant running										
Opening area (m2)	7.1	9	9	9	9	9	9	9	9	
SRI of opening	I.L	-10	-20	-32	-44	-45	-45	-45	-41	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	75	64	47	29	27	24	20	23	52
R1										
Directivity correction	(6200,25deg x 1150,80deg)	2	2	2	-1	-5	-5	-5	-5	
Distance correction (m)	5.7	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	56	45	28	8	2	-1	-5	-2	33
R2										
Directivity correction	(6200,20deg x 1150,60deg)	2	3	2	2	1	1	1	1	
Distance correction (m)	11.5	-29	-29	-29	-29	-29	-29	-29	-29	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	51	40	23	5	2	-1	-5	-2	28

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Discharge										
Condenser Discharge										
Sound power	Lw	91	91	87	81	81	79	75	75	87
End reflection	3.8	-1	0	0	0	0	0	0	0	
SRI of opening	1.L	-10	-20	-32	-44	-45	-45	-45	-41	
Lw of opening		80	71	55	37	36	34	30	34	58
R1										
Directivity correction	(3100,25deg x 1235,80deg)	1	1	2	-1	-5	-5	-5	-5	
Distance correction (m)	8.4	-26	-26	-26	-26	-26	-26	-26	-26	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	58	49	33	13	8	6	2	6	35
R2										
Directivity correction	(3100,20deg x 1235,60deg)	2	2	2	2	1	1	1	1	
Distance correction (m)	11.5	-29	-29	-29	-29	-29	-29	-29	-29	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	55	47	31	13	11	9	5	9	33

SUMMARY

Receptor R1

Intake

Condenser Discharge

Cumulative

	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Intake	56	45	28	8	2	-1	-5	-2	33
Condenser Discharge	58	49	33	13	8	6	2	6	35
Cumulative	60	50	34	14	9	6	2	6	37

Receptor R2

Intake

Condenser Discharge

Cumulative

	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Intake	51	40	23	5	2	-1	-5	-2	28
Condenser Discharge	55	47	31	13	11	9	5	9	33
Cumulative	57	48	31	13	11	9	5	9	34

CO2 Extract

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
CO2 Extract	NB fan only runs under emergency conditions and is excluded from below									
DAY										
Reverberant level in plant room	Rev Lp	86	83	79	74	72	68	64	62	78
All plant running										
Opening area (m2)	0.08	-11	-11	-11	-11	-11	-11	-11	-11	
SRI of opening	I.L	-9	-17	-30	-43	-45	-45	-45	-40	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	60	49	32	15	10	6	2	5	37
R1										
Directivity correction	(500,45deg x 1235,80deg)	-1	-1	-1	-3	-7	-7	-7	-7	
Distance correction (m)	5.7	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	39	29	11	-8	-17	-21	-25	-21	16
R2										
Directivity correction	(500,20deg x 1235,60deg)	1	1	1	1	1	1	1	1	
Distance correction (m)	17.3	-33	-33	-33	-33	-33	-33	-33	-33	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	31	21	3	-14	-20	-23	-27	-23	8

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
CO2 Extract	NB fan only runs under emergency conditions and is excluded from below									
NIGHT										
Reverberant level in plant room	Rev Lp	83	81	76	71	70	67	63	62	75
All plant running										
Opening area (m2)	0.08	-11	-11	-11	-11	-11	-11	-11	-11	
SRI of opening	1.L	-9	-17	-30	-43	-45	-45	-45	-40	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	57	47	29	11	8	5	1	5	34
R1										
Directivity correction	(500,45deg x 1235,80deg)	-1	-1	-1	-3	-7	-7	-7	-7	
Distance correction (m)	5.7	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	36	27	9	-12	-19	-22	-26	-22	13
R2										
Directivity correction	(500,20deg x 1235,60deg)	1	1	1	1	1	1	1	1	
Distance correction (m)	17.3	-33	-33	-33	-33	-33	-33	-33	-33	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R2	Lp @ R2	27	19	1	-18	-21	-24	-28	-24	5