NSL Noise Solutions Ltd

Jollibee

82-84 Market Street
Manchester
M4 1PD

Plant Noise Impact Assessment

On behalf of

BEE WORLD UK LIMITED

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1.0 Introduction

1.1. Noise Solutions Ltd (NSL) has been commissioned by Bee World UK Limited to undertake a noise impact assessment for new plant serving the proposed Jollibee restaurant at 82-84 Market 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. Cumulative plant noise emission levels for the proposed plant have been predicted at the most potentially affected noise sensitive receptor and assessed following Manchester City Council's usual requirements.

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 Jollibee restaurant will occupy the commercial retail space at 82-84 Market Street, Manchester.

2.2. Plant is to be located on the roof of the building. External plant will comprise a supply fan intake (SF1), kitchen extract fan discharge (EF1), general extract fan and fan discharge (EF2), three air conditioning units (ACU-1/2/3) and two catering condensers (CC-1/2).

2.3. All plant will operate when the restaurant is trading. Proposed operating hours are 08.00 hours to midnight, daily. Only the catering condensers will operate outside of the opening hours.

2.4. Mitigation is to be installed in the form of atmospheric side attenuators fitted to SF1 and EF1, and acoustic lagging fitted to exposed ductwork

2.5. **Appendix B** contains a table with the manufacturer's published sound pressure levels for the proposed plant.

3.0 Nearest noise sensitive receptors

3.1. The area surrounding the site is predominantly commercial in use and many of the neighbouring properties have significant numbers of plant items serving them.

3.2. The nearest residential properties are understood to be the flats currently under development at 86-88 Market Street (Receptor R1), approximately 2.2m from the closest item of plant.

3.3. An aerial view showing the site and surrounding area, the nearest noise sensitive properties and noise monitoring location used in this assessment is presented in **Appendix C**.

4.0 Existing noise climate

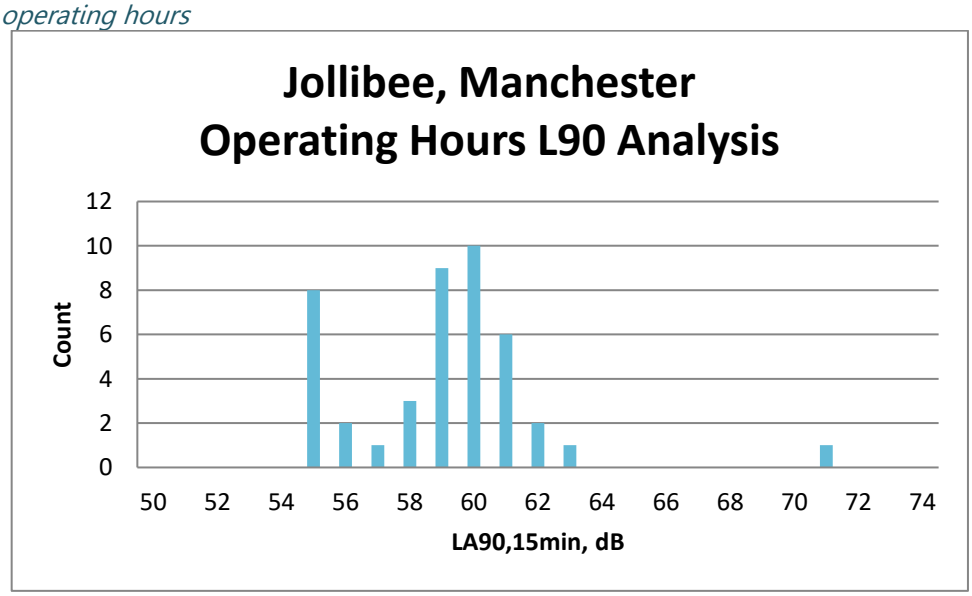
4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.

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 D**.

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	$L_{Aeq(15mins)}$	$L_{Amax(15mins)}$	$L_{A10(15mins)}$	$L_{A90(15mins)}$
Restaurant operating hours (08.00 hours – midnight)	62-78	76-94	64-81	55-71
Restaurant non-operating hours (midnight to 08.00 hours)	64-80	78-94	68-84	51-72

Figure 1 Histogram of L_{A90} background sound pressure levels during proposed restaurant operating hours



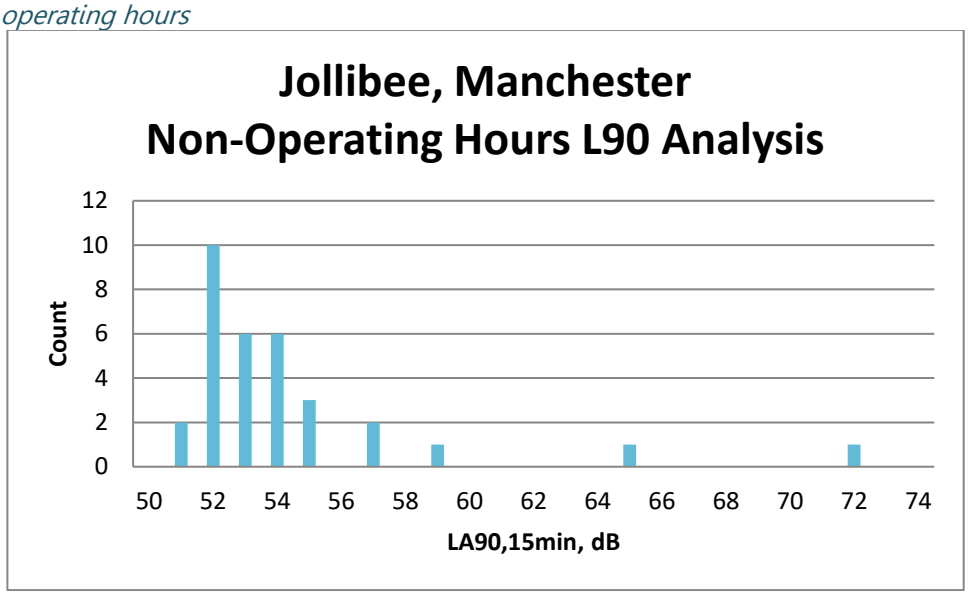
4.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

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

dB, L_{A90} 08.00 hours - midnight	
Mean	59
Modal	60
Median	59

4.4. From review of the histogram in Figure 1 it is considered that 55dB(A) is a robust representation of the background sound level outside the nearest premises, during restaurant operating hours.

Figure 2 Histogram of LA90 background sound pressure levels during proposed restaurant non-operating hours



4.5. Further statistical analysis has been carried out on the data and the mean and median values are shown in Table 3 below.

Table 3 Statistical analysis of $L_{A90,15min}$ levels during the restaurant non-operational period

dB, L_{A90} midnight -8.00 period	
Mean	54
Modal	52
Median	53

4.6. From the histogram analysis, 51dB(A) has been chosen as a robust representation of the background sound level outside the nearest premises, during restaurant operating hours.

4.7. Therefore, the following values are considered representative of the existing background sound pressure levels at nearby noise sensitive premises:

- 55dB L_{A90} during the daytime period; and

- 51dB L_{A90} during the night-time period.

5.0 Plant noise design criteria

Manchester City Council

5.1. On recently approved planning applications by Manchester City Council the guidance on noise criteria has been:

> *"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."*

5.2. It can be assumed that a similar condition may be applied for this planning application.

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

5.3. BS 4142:2014 is intended to be used to assess the likely effects of sound on people residing in nearby dwellings. The scope of BS 4142:2014 includes "sound from fixed plant installations which comprise mechanical and electrical plant and equipment".

5.4. 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.

5.5. 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.

5.6. 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."

5.7. 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."

5.8. 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. 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.*

5.9. 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."

5.10. 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."

5.11. 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."

5.12. 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.

Summary of criteria

5.13. In accordance with Manchester City Council's usual requirements, it is proposed that the noise level of the new plant is at least 5dBA below the pre-existing representative background sound level. The proposed plant noise limits are shown in Table 4.

Table 4 Proposed plant noise emissions level limits at nearest receptor

Period	Cumulative plant noise level, dB(A)
All plant operating (08.00 hrs to midnight)	50
All other times (midnight to 08.00 hours)	46

6.0 Plant noise impact assessment

6.1. The cumulative plant noise levels at the nearest noise sensitive receptors have been predicted. The assessment has considered attenuation, directivity, any screening between source and receivers and distance attenuation. The predictions during the proposed operating period (08.00 hours to midnight) have been based on the proposed plant all operating at full capacity. Predictions outside of opening hours are based on only the catering condensers operating.

6.2. Predictions are inclusive of acoustic lagging fitted to exposed ductwork and the following atmospheric-side attenuators fitted to the fans:

Table 5 Proposed atmospheric side attenuators to ventilation systems

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
EF1 Kitchen Extract	12	27	44	40	40	36	31	27
SF1 Supply Fan	4	6	11	21	28	25	21	16

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 plant items are inverter driven, which means the fans gently ramp to cope with system demands. As a result, the plant items are not considered to operate intermittently. Although 1/3 octave band data is not available from the unit manufacturers to assess tonality, experience of comparable plant operating at other similar sites indicates that no tonal components are present.

6.4. In view of the above, and since the noise-environment of the area is dominated by noise from existing similar plant serving other premises, it is considered inappropriate to apply a BS 4142:2014 feature correction to derive the rating level.

6.5. Table 6 summarises the results of the assessment at the most affected properties. Screening is afforded to R1 by the parapet wall east of the plant area.

6.6. All other nearby receptors benefit from increased distance/screening to the plant such that resulting noise levels will be lower than at the receptor considered. The full set of calculations can be found in **Appendix E**.

Table 6 Assessment of predicted noise levels at the nearest noise sensitive receptors

Receptor	Period	Predicted sound level at receptor, L_{Aeq} (dB)	Design criterion (dB(A))	Difference (dB)
R1. Residential (height equal to the plant area)	Proposed operating hours (08.00 hours – midnight)	50	50	0
	All other times (midnight to 08.00 hours)	46	46	0
R2. Residential (overlooking plant area from upper floors)	Proposed operating hours (08.00 hours – midnight)	50	50	0
	All other times (midnight to 08.00 hours)	46	41	-5

6.7. The noise level calculations demonstrate that cumulative noise emissions from the proposed plant will comply with the proposed limits at the nearest residential windows.

Context and uncertainties

6.8. 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.
- Care was taken to ensure that the measurement positions were representative of the noise climate outside the nearby noise sensitive receptors and not in positions where higher noise levels were present.

6.9. 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 windows will be lower due to screening and distance attenuation.

- The site is located within a busy commercial area. Many of these premises will have existing building services plant and, therefore, noise emitted from the restaurant will be in keeping with the existing noise climate.

- It should be noted that the above assessment is based on all plant operating at maximum duty. Given that the plant will not operate at maximum design duty all of the time the above assessment is considered to be representative of the worst case.

Vibration isolation

6.10. To control plant vibration into the building structure it is recommended that all plant is installed on suitable anti-vibration mounts.

7.0 Summary

7.1. Noise Solutions Ltd (NSL) has been commissioned by Bee World UK Limited to undertake a noise impact assessment for new plant serving the proposed Jollibee restaurant at 82-84 Market Street, Manchester.

7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at locations representative of the noise climate outside the nearest noise sensitive receptors to the proposed plant area.

7.3. The cumulative plant noise emission levels for the proposed plant have been predicted at the most affect noise sensitive receptor location and assessed taking into consideration Manchester City Council's usual requirements. Therefore, the plant proposals should not be a reason for refusal of planning permission.

Appendix A Acoustic terminology

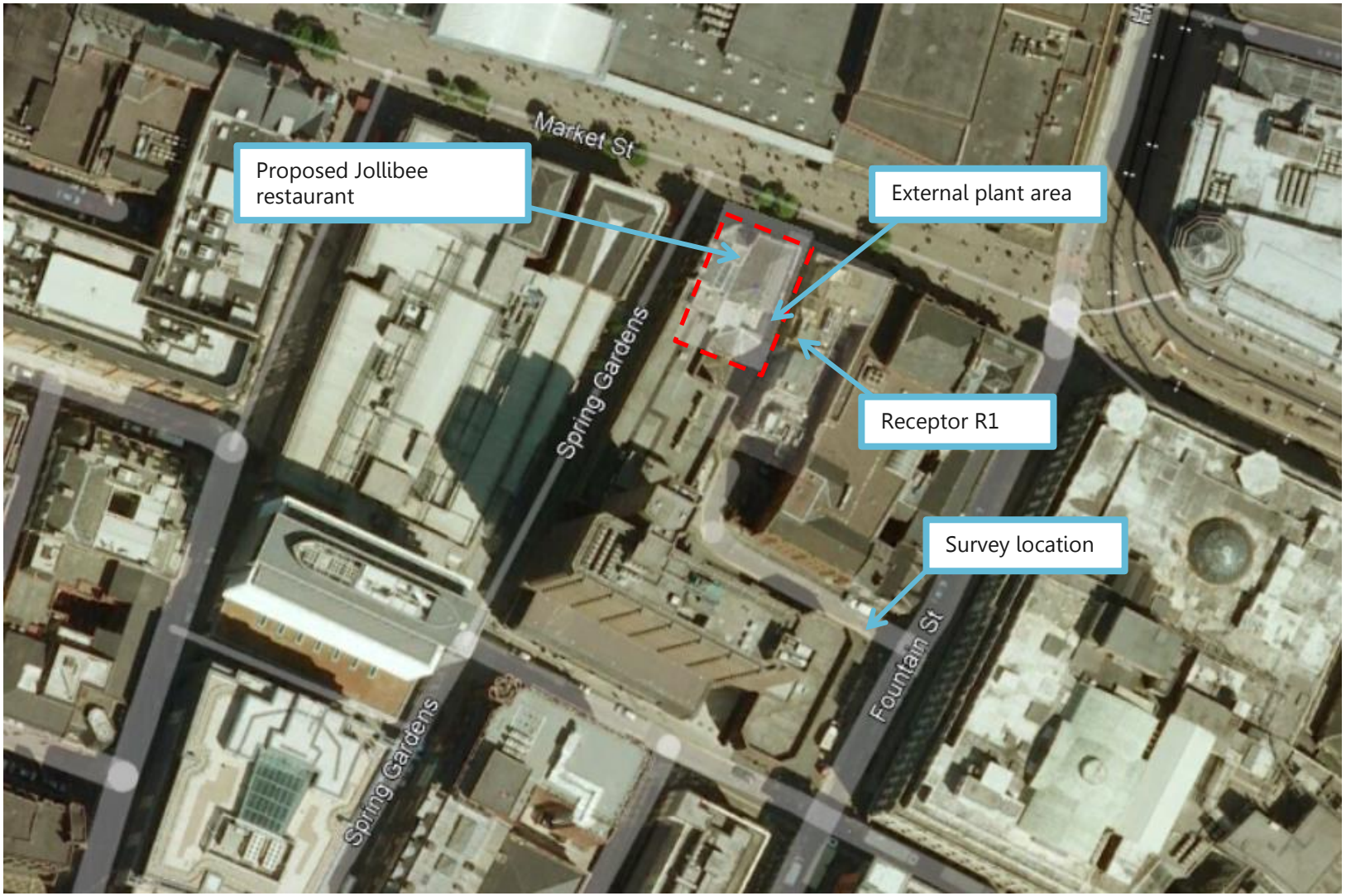
Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 $\log_{10}$ (s1/s2). 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 20µPa. 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 Plant information and manufacturer published sound pressure levels

Plant Reference	Unit/Model	No. of units	Description	Sound power level (dB) at octave band centre frequencies (Hz)								dBA (dB)
				63	125	250	500	1k	2k	4k	8k	
Kitchen Extract Fan (EF1)	FlaktWoods/ESTOC TARGE 102-630-3	1	Discharge L_w	116	88	87	85	85	84	80	70	
General Extract Fan (EF2)	Systemair/ K 250 L	1	Discharge L_w	74	78	72	64	65	63	60	53	
			Casing L_w	56	45	51	47	45	42	39	30	
Supply Fan (SF1)	FlaktWoods/ ESTOC 80-630-3	1	Inlet L_w	**	84	78	75	71	70	67	63	
Air Conditioning Condensers (ACU1-ACU3)	Panasonic PACi NX Outdoor	3	Sound pressure level at 1m (each)									55
Catering Condensers (CC1 & CC2)	Storer Refrigeration	2	Sound pressure level at 10m (each)									33

**Data not supplied by manufacturer.*

Appendix C Aerial photograph site showing areas of interest



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Appendix D Environmental sound survey

Details of sound surveys

D.1 Measurements of the existing background sound levels were undertaken between 15.15 hours on Thursday 28th October and 10.00 hours on Friday 29th October 2021.

D.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 15-minute sample periods for the duration of the noise survey.

Measurement position

D.3 The representative measurement position was located on a lamppost on the corner of Phoenix Street and Fountain Street, southeast of the proposed Jollibee location (location indicated on the site plan in **Appendix C**).

D.4 In accordance with BS 7445-2:1991 *'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

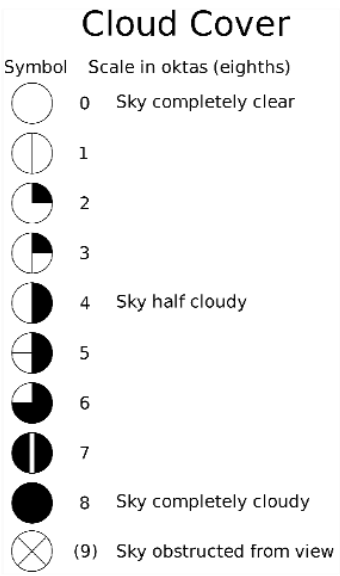
D.5 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Environmental noise survey

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Svantek 971 / 111625	18/06/2021	Factory conformation certificate
Condenser microphone	ACO Pacific 7052E / 80034		
Preamplifier	Svantek SV18 / 112630		
Calibrator	Rion NC-74 / 35094453	13/08/2021	1500814-1

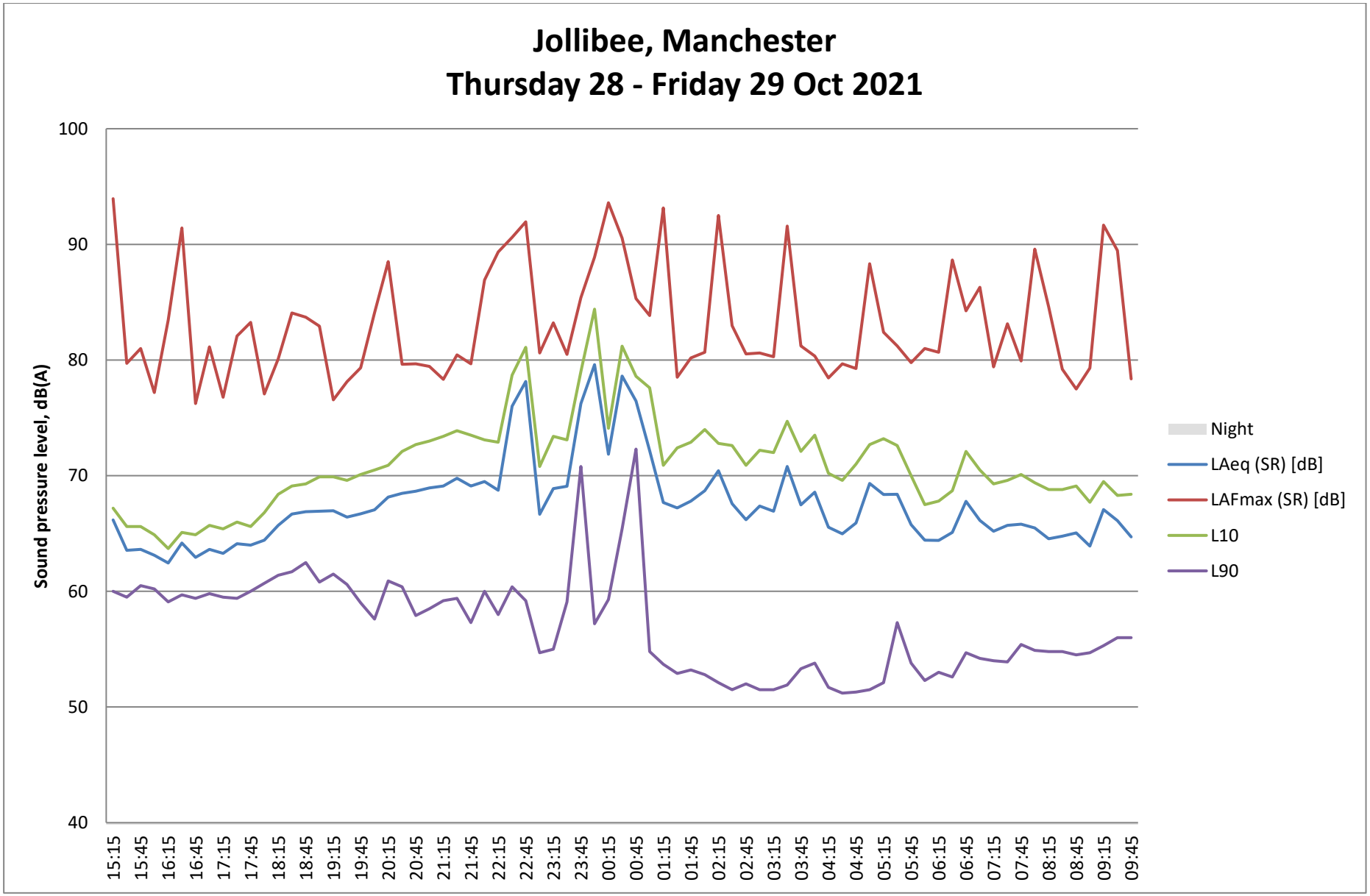
Weather Conditions

D.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were 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 C	15.15 28 Oct - 10.00 29 Oct 2021	Temperature (°C)	19	15
		Precipitation:	None	None
		Cloud cover (oktas - see guide)	8	7
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Wet	Wet
		Wind Speed (m/s)	2	2
		Wind Direction	SE	SE
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

D.7 The results of the environmental survey are considered to be representative of the background sound pressure levels at the façades of the nearest noise sensitive receptors during the quietest times at which the plant will operate. The noise climate during the survey period was dominated by traffic from Fountain Road and pedestrians, with engine idol, plant and light construction also audible. The results of the survey are presented in a time history graph overleaf.


Jollibee, Manchester
Thursday 28 - Friday 29 Oct 2021
Sound pressure level, dB(A)
100
90
80
70
60
50
40
15:15
15:45
16:15
16:45
17:15
17:45
18:15
18:45
19:15
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06:45
07:15
07:45
08:15
08:45
09:15
09:45
Night
LAeq (SR) [dB]
LAFmax (SR) [dB]
L10
L90

Appendix E Noise level predictions

Summary of predictions

Plant	Resultant at receptor (dBA)	
	R1	R2
Kitchen Extract EF1	46	48
General Extract EF2	39	33
Supply Air SF1	39	35
ACU-1	35	37
ACU-2	38	37
ACU-3	38	37
CC-1*	41	38
CC-2*	44	38
General Extract Breakout	26	26
Opening Hours Cumulative	**50**	**50**
Outside of Opening Hours Cumulative	**46**	**41**

*Note: *Plant operating outside opening hours*

Condensers

Receptor R1

Unit	Noise data and distance correction				Directivity	Screening	Result
	L_{pA}	at / m	m	dB			
ACU-1	55	1	3.3	-10	0	-9.7	35
ACU-2	55	1	2.2	-7	0	-9.7	38
ACU-3	55	1	2.2	-7	0	-9.7	38
CC-1	33	10	2.8	11	3	-5.9	41
CC-2	33	10	4	8	3	0	44

Receptor R2

Unit	Noise data and distance correction				Directivity	Screening	Result
	L_{pA}	at / m	m	dB			
ACU-1	55	1	7.5	-18	0	0	37
ACU-2	55	1	7.5	-18	0	0	37
ACU-3	55	1	7.5	-18	0	0	37
CC-1	33	10	7.5	2	3	0	38
CC-2	33	10	8	2	3	0	38

EF1 - Kitchen Extract

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (unattenuated)	In-duct L_w	116	88	87	85	85	84	80	70	**93**
System losses		-11	-7	-2	-2	-4	-6	-6	-6	
Atmospheric side attenuator		-12	-27	-44	-40	-40	-36	-31	-27	
Sound power level leaving terminal		**93**	**54**	**41**	**43**	**41**	**42**	**43**	**37**	**67**
Receptor 1										
Directivity correction	400 x 400 (130,0)	-1	-1	-2	-4	-9	-8	-8	-8	
Distance correction	3.8 m	-20	-20	-20	-20	-20	-20	-20	-20	
Resultant at Receptor R1	**L_p**	**72**	**33**	**19**	**19**	**12**	**14**	**15**	**9**	**46**
Receptor 2										
Directivity correction	400 x 400 (30,0)	1	2	3	4	5	6	6	6	
Distance correction	3.8 m	-20	-20	-20	-20	-20	-20	-20	-20	
Resultant at Receptor R2	**L_p**	**74**	**36**	**24**	**27**	**26**	**28**	**29**	**23**	**48**

EF2 – General Extract

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (unattenuated)	In-duct L_w	74	78	72	64	65	63	60	53	**71**
System losses		-13	-9	-5	-1	0	0	0	0	
Sound power level leaving terminal		**61**	**69**	**67**	**63**	**65**	**63**	**60**	**53**	**70**
Receptor 1										
Directivity correction	250 x 250 (0,135)	-1	-1	-3	-6	-9	-8	-8	-8	
Distance correction	6.4 m	-24	-24	-24	-24	-24	-24	-24	-24	
Resultant at Receptor R1	**L_p**	**36**	**44**	**40**	**33**	**32**	**31**	**28**	**21**	**39**
Receptor 2										
Directivity correction	250 x 250 (60,135)	-2	-2	-4	-9	-12	-13	-13	-13	
Distance correction	8.5 m	-27	-27	-27	-27	-27	-27	-27	-27	
Resultant at Receptor R2	**L_p**	**32**	**40**	**36**	**27**	**26**	**23**	**20**	**13**	**33**

EF2 – General Extract Breakout

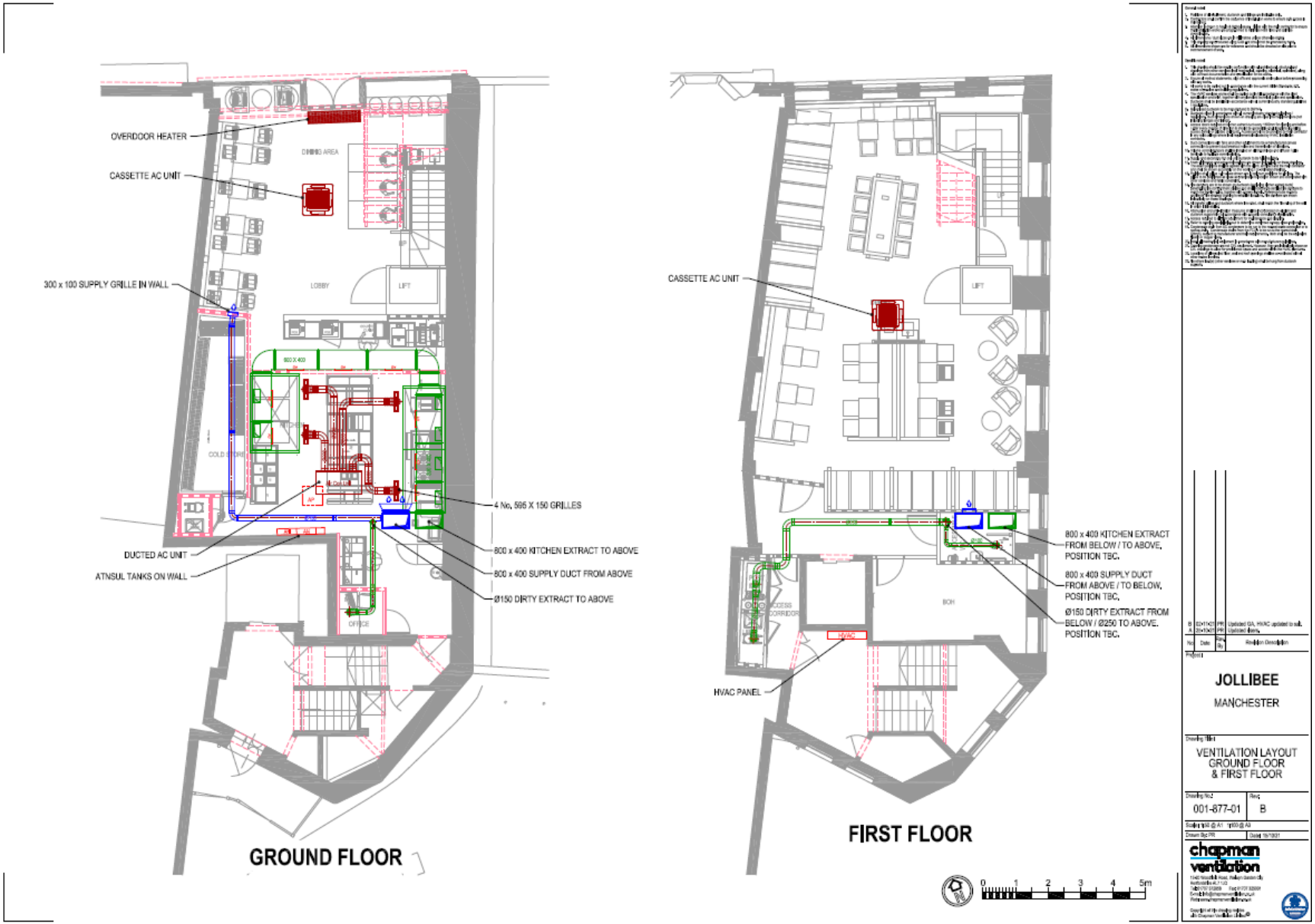
Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (unattenuated)	L_w	56	45	51	47	45	42	39	30	50
Receptor 1										
Distance correction	6 m	-24	-24	-24	-24	-24	-24	-24	-24	
Resultant at Receptor R1	**L_p**	**32**	**21**	**27**	**23**	**21**	**18**	**15**	**6**	**26**
Receptor 2										
Distance correction	6 m	-24	-24	-24	-24	-24	-24	-24	-24	
Resultant at Receptor R2	**L_p**	**32**	**21**	**27**	**23**	**21**	**18**	**15**	**6**	**26**

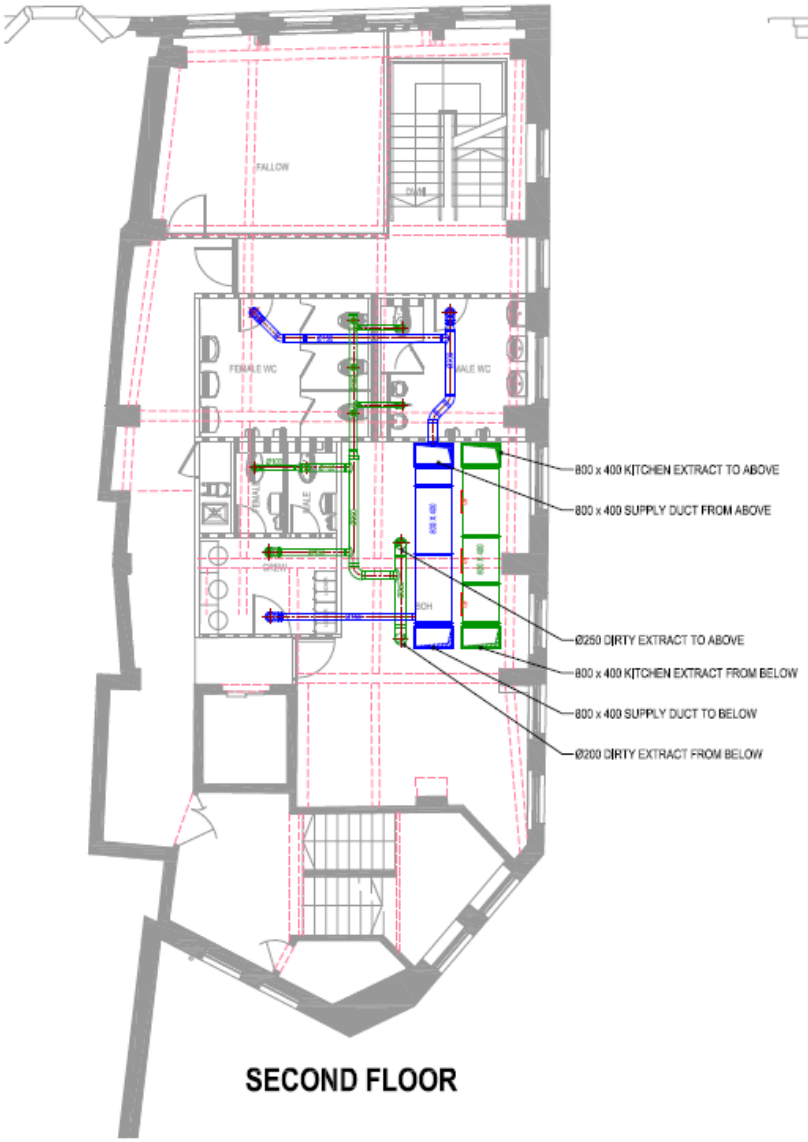
SF1 - Supply Air

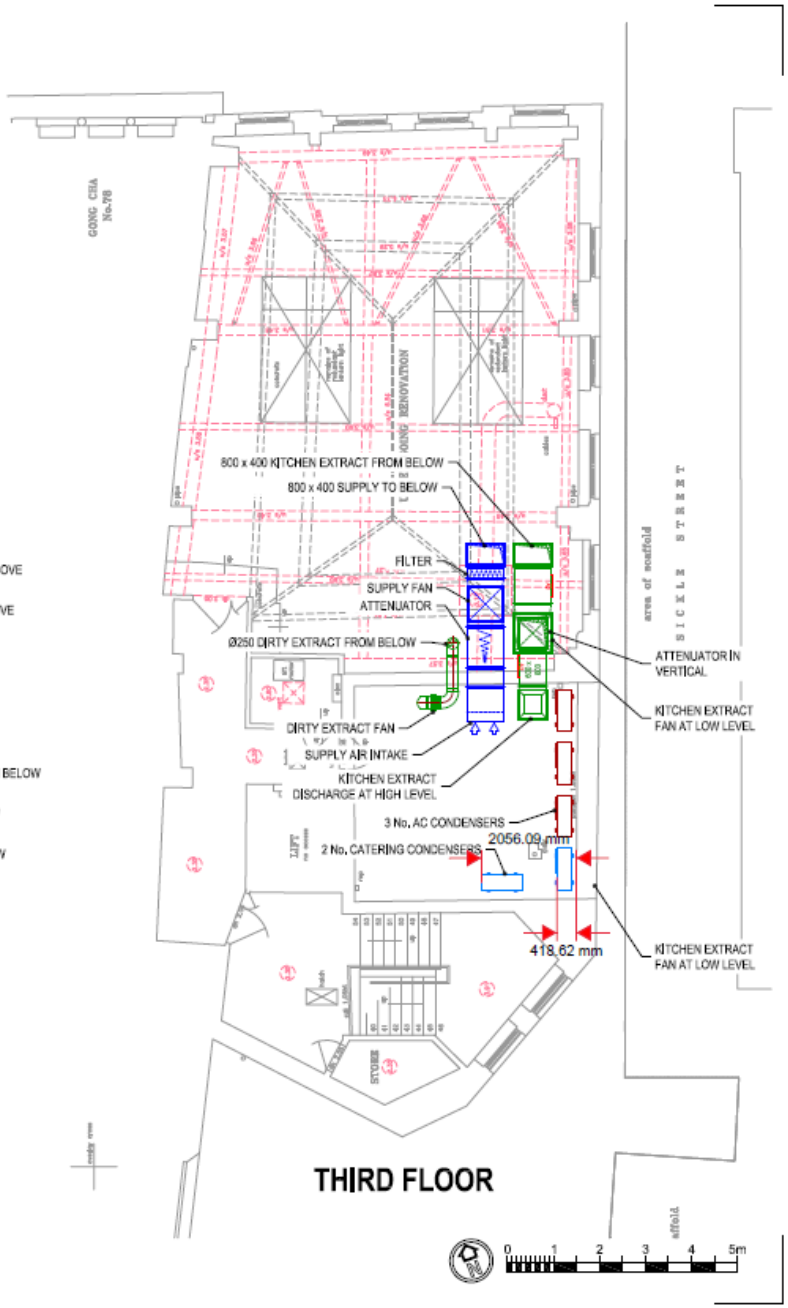
Receptor R1

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (unattenuated)	In-duct L_w	N/A	84	78	75	71	70	67	63	**78**
System losses		N/A	-2	0	0	0	0	0	0	
Atmospheric side attenuator		N/A	-6	-11	-21	-28	-25	-21	-16	
Sound power level leaving terminal		**N/A**	**76**	**67**	**54**	**43**	**45**	**46**	**47**	**63**
Receptor 1										
Directivity correction	800 x 800 (0,90)	N/A	0	0	0	0	-4	-7	-7	
Distance correction	6.5 m	N/A	-24	-24	-24	-24	-24	-24	-24	
Resultant at Receptor R1	**L_p**	**N/A**	**52**	**43**	**30**	**15**	**14**	**15**	**16**	**39**
Receptor 2										
Directivity correction	800 x 800 (60,90)	N/A	-1	-1	-3	-7	-12	-12	-12	
Distance correction	8 m	N/A	-26	-26	-26	-26	-26	-26	-26	
Resultant at Receptor R2	**L_p**	**N/A**	**49**	**40**	**25**	**10**	**7**	**8**	**9**	**35**

Appendix F Proposed plant layout




800 x 400 KITCHEN EXTRACT TO ABOVE
800 x 400 SUPPLY DUCT FROM ABOVE
Ø250 DIRTY EXTRACT TO ABOVE
800 x 400 KITCHEN EXTRACT FROM BELOW
800 x 400 SUPPLY DUCT TO BELOW
Ø200 DIRTY EXTRACT FROM BELOW
SECOND FLOOR


800 x 400 KITCHEN EXTRACT FROM BELOW
800 x 400 SUPPLY TO BELOW
FILTER
SUPPLY FAN
ATTENUATOR
Ø250 DIRTY EXTRACT FROM BELOW
ATTENUATOR IN VERTICAL
KITCHEN EXTRACT FAN AT LOW LEVEL
DIRTY EXTRACT FAN
SUPPLY AIR INTAKE
KITCHEN EXTRACT DISCHARGE AT HIGH LEVEL
3 No. AC CONDENSERS
2 No. CATERING CONDENSERS
2056.09 mm
418.62 mm
KITCHEN EXTRACT FAN AT LOW LEVEL
THIRD FLOOR
JOLLIBEE
MANCHESTER
VENTILATION LAYOUT SECOND FLOOR & THIRD FLOOR
001-877-02
D
chapman ventilation

THIRD FLOOR
0 2 4 6 8 10m
SECTION A-A
0 1 2 3 4 5m
JOLLIBEE
MANCHESTER
VENTILATION LAYOUT
PLANT SECTION
001-877-10
A
chapman
ventilation