

Starbucks
Reading Link Retail Park
Rose Kiln Lane
Reading
RG2 0SN

**Plant Noise
Impact Assessment**

On behalf of

Architecture Design Limited

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1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned by Architecture Design Limited to undertake a noise impact assessment for plant serving the Starbucks coffee shop within the Reading Link Retail Park, Reading.
- 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 plant serving the coffee shop have been predicted at the most affected noise sensitive receptors and assessed following Reading Borough 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 Starbucks coffee shop occupies a commercial retail space within the Reading Link Retail Park, Reading.
- 2.2. Plant is located along the north and west facades of the coffee shop. External plant will comprises a general BOH extract fan (EF1), a counter extract fan (EF2), a WC extract fan (EF3) and two condensing units (CU-1/2).
- 2.3. Mitigation is to be installed in the form of a circular attenuator fitted to EF1.
- 2.4. All plant will operate when the restaurant is trading. Proposed opening hours are 06.00 hours to 22.00, daily. Plant will not operate when the premises are unoccupied.
- 2.5. **Appendix B** contains a table with the manufacturer's published sound pressure levels for the plant serving the coffee shop.

4.0 Nearest noise sensitive receptors

- 4.1. The area surrounding the site is a mix of commercial and residential properties.
- 4.2. The nearest residential properties are understood to be the residential dwellings to the north of the coffee shop (Receptor R1/R2).
- 4.3. 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](#).

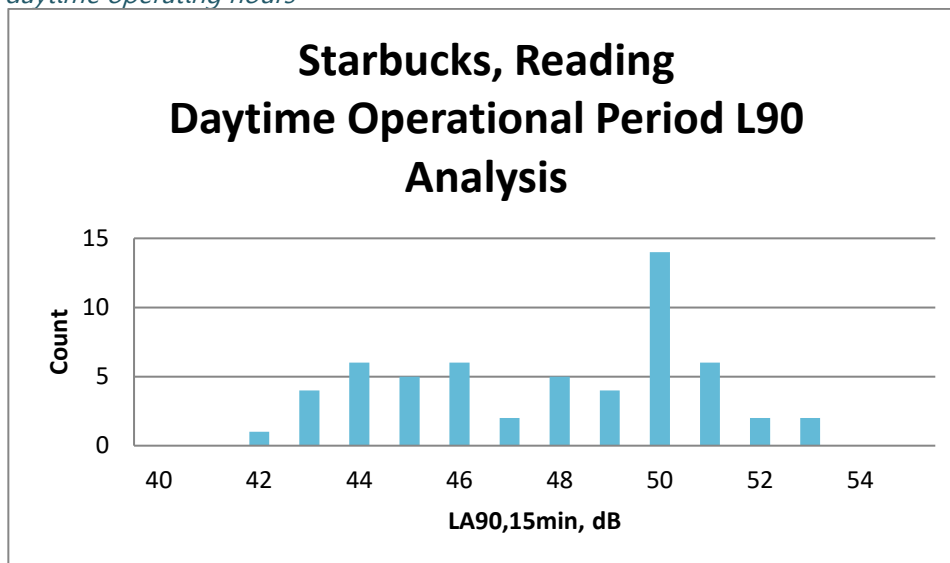
5.0 Existing noise climate

- 5.1. 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 plant, during the quietest times at which the plant will operate.
- 5.2. 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)
Operating hours (06.00 hours – 07.00 hours)	52-56	68-76	54-58	46-48
Operating hours (07.00 hours – 22.00 hours)	50-70	66-90	52-76	42-53
Non-operating hours (22.00 hours – 06.00 hours)	39-64	44-79	41-69	36-46

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



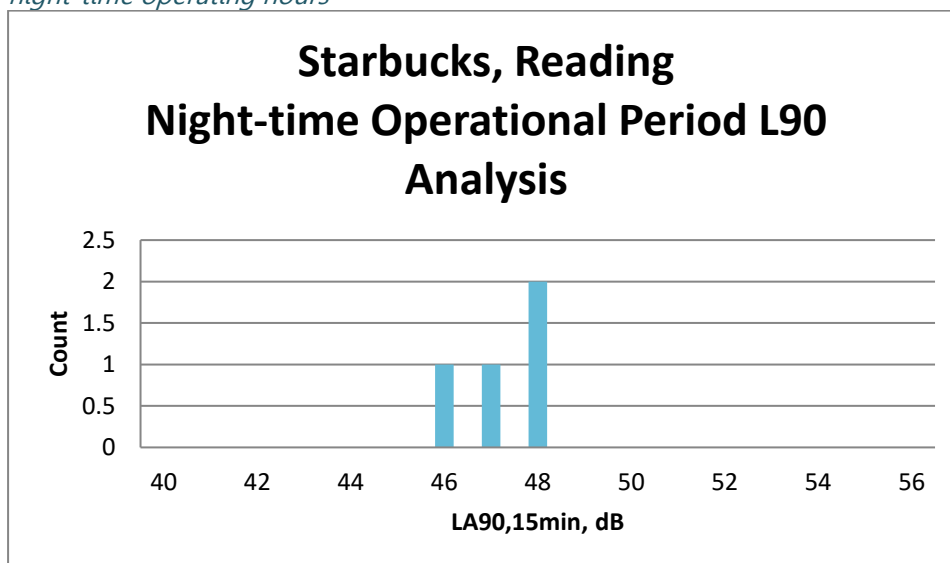
- 5.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

Table 2 Statistical analysis of $L_{A90,5min}$ levels during the proposed plant operating period

dB, L_{A90} 08.00 hours - midnight	
Mean	48
Modal	50
Median	48

- 5.4. From review of the histogram in Figure 1 it is considered that 44dB(A) is a robust representation of the background sound level outside the nearest premises, during the coffee shop's daytime operating hours.

Figure 2 Histogram of LA90 background sound pressure levels during the proposed coffee shop night-time operating hours



- 5.5. 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 LA90,15min levels during the night-time period

dB, LA90 non-operational period	
Mean	47
Modal	48
Median	47

- 5.6. From the histogram analysis, 46dB(A) has been chosen as a robust representation of the background sound level outside the nearest premises, during the 'night-time' coffee shop operating hours.
- 5.7. Therefore, the following values are considered representative of the existing background sound pressure levels at nearby noise sensitive premises:
- 44dB LA90 during the daytime operational period (07.00-22.00); and
 - 46dB LA90 during the night-time operational period (06.00-07.00)

6.0 Plant noise design criteria

Reading Borough Council

- 6.1. For similar applications for fixed plant, Reading Borough Council usually applies the following condition:

"The rating level of the plant/equipment hereby approved, LAr,Tr (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to sensitive facades, shall be at least 10 dB below the existing background sound level, LA90,T when all plant/equipment (or any part of it) is in operation.

Reason: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CS34 of the Reading Borough LDF Core Strategy 2008 (Altered 2015) and Policy DM4 of the Reading Borough LDF Sites and Detailed Policies Document 2012 (Altered 2015)"

- 6.2. The reference to "rating" and "LAr,Tr" implies that the assessment is to be made using the methodology set out in BS 4142:2014+A1:2019.

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

- 6.3. 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 4142:2014+A1:2019 includes "sound from fixed plant installations which comprise mechanical and electrical plant and equipment".
- 6.4. The procedure contained in BS 4142:2014+A1:2019 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.
- 6.5. 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.
- 6.6. 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."
- 6.7. 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."
- 6.8. 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.*
- 6.9. 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."
- 6.10. 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."
- 6.11. 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."
- 6.12. BS 4142:2014+A1:2019 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

- 6.13. In accordance with Reading Borough Council's usual requirements, it is proposed that the rating level of the new plant is at least 10dBA below the pre-existing representative background sound level. The proposed plant noise limit is presentation in Table 3.

Table 4 Proposed plant noise rating level limits at a point 1m from the nearest receptors

Period	Cumulative plant rating level, dB(A)
All plant operating (06.00 hours to 22.00 hours)	34
All other times (22.00 hours – 06.00 hours)	–*

**Plant non-operational*

7.0 Plant noise impact assessment

- 7.1. 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 (06.00 hours to 22.00 hours) have been based on the proposed plant all operating at full capacity. Plant will not operate when the premises are unoccupied.
- 7.2. Calculations have been produced on the assumption that EF1 will operate at the duty 'Working Point 1' and EF2/3 will operate at the duty 'Working Point 7'.
- 7.3. Predictions are inclusive of an atmospheric-side attenuator fitted to EF1 as shown in the table below:

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 BOH Extract	1	2	4	9	11	10	9	7

- 7.4. It should be noted that all installed plant is high-quality and no impulsive characteristics are anticipated provided the equipment is well maintained. It should be noted that, the discharge fans will operate steadily in the shop's operational period and the condenser units 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 condenser unit manufacturers to assess tonality, experience of comparable plant operating at other similar sites indicates that no tonal components will be present.
- 7.5. A feature correction 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...".

- 7.6. 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 E**.

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

Receptor	Operational Periods	Predicted rating level at receptor, dB $L_{Ar,Tr}$	Design criterion dB $L_{Ar,Tr}$	Difference (dB)
R1. Residential	Proposed operating hours (06.00 hours – 22.00 hours)	34	34	0
R2. Residential	Proposed operating hours (06.00 hours – 22.00 hours)	34	34	0

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

Context and uncertainties

- 7.8. 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.
- 7.9. 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.
 - 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.

8.0 Summary

- 8.1. Noise Solutions Ltd (NSL) has been commissioned by Architecture Design Limited to undertake a noise impact assessment for new plant serving the Starbucks coffee shop within the Reading Link Retail Park, Reading.
- 8.2. 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 plant areas.
- 8.3. The cumulative plant noise emission levels for the plant been predicted at the most affected noise sensitive receptor locations and determined to be in compliance with Reading Borough Council's usual requirements, provided an attenuator is fitted to EF1. 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 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 Plant information and manufacturer published sound pressure levels

[illegible]

Appendix C Aerial photograph site showing areas of interest

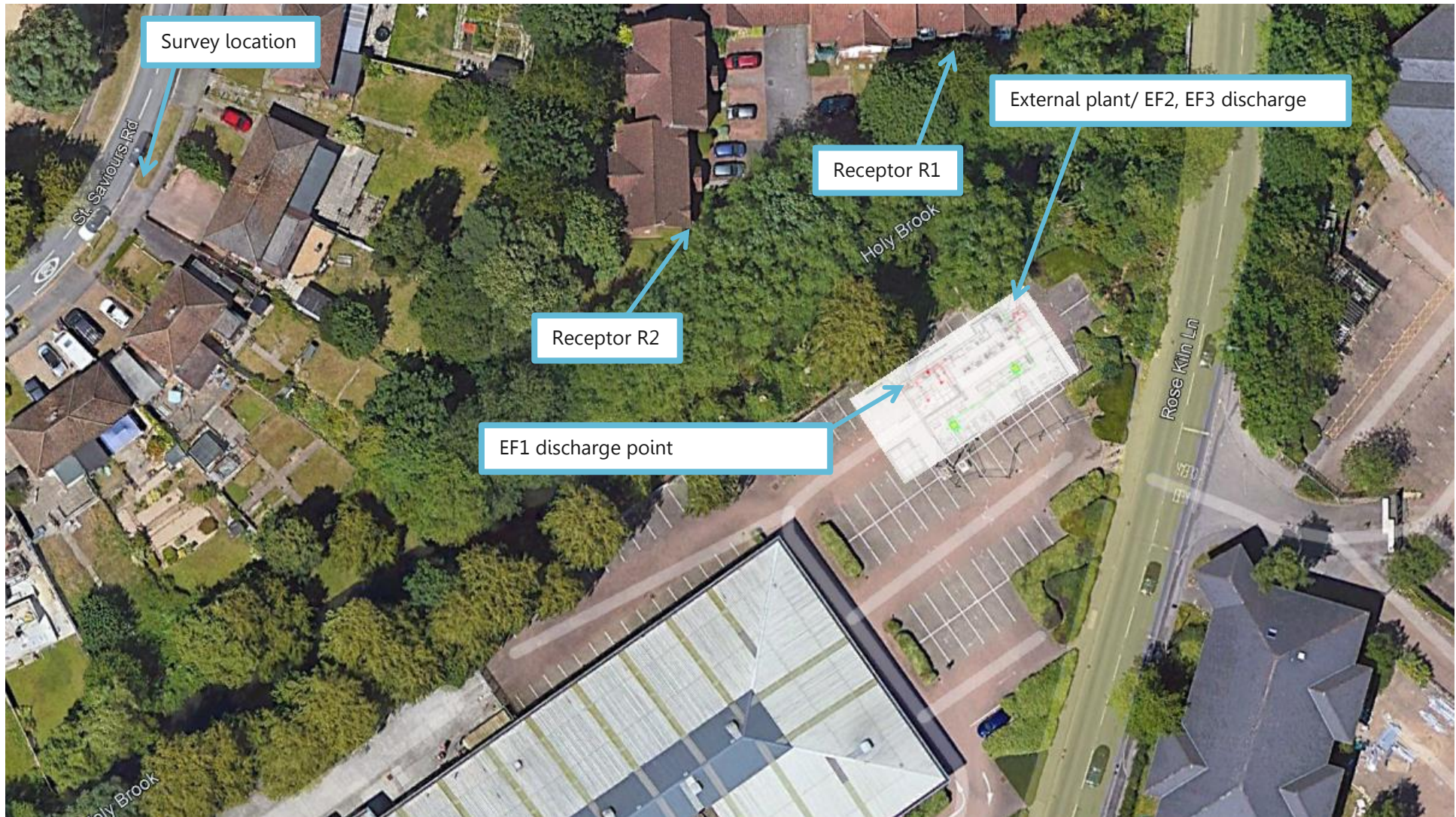


Image © Google 2023

Appendix D Environmental sound survey

Details of sound surveys

- D.1 Measurements of the existing background sound levels were undertaken between 13.45 hours on Thursday 11th May and 13.00 hours on Friday 12th May 2023.
- 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 along saviours road (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

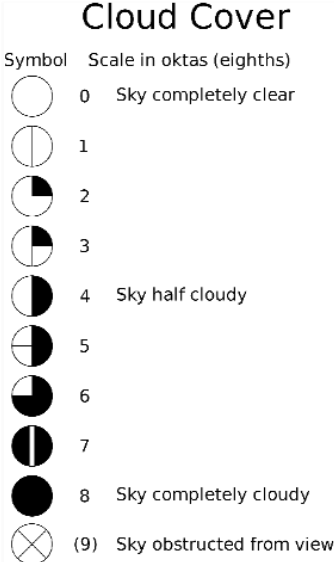
- D.5 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Environmental noise survey

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Svantek 977/ 97446	16/01/2023	1504305-1
Condenser microphone	Microtech MK255 / 20194		
Preamplifier	Svantek SV12L / 106487		
Calibrator	Svantek SV 30A / 10847	06/06/2022	1500577-1

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.

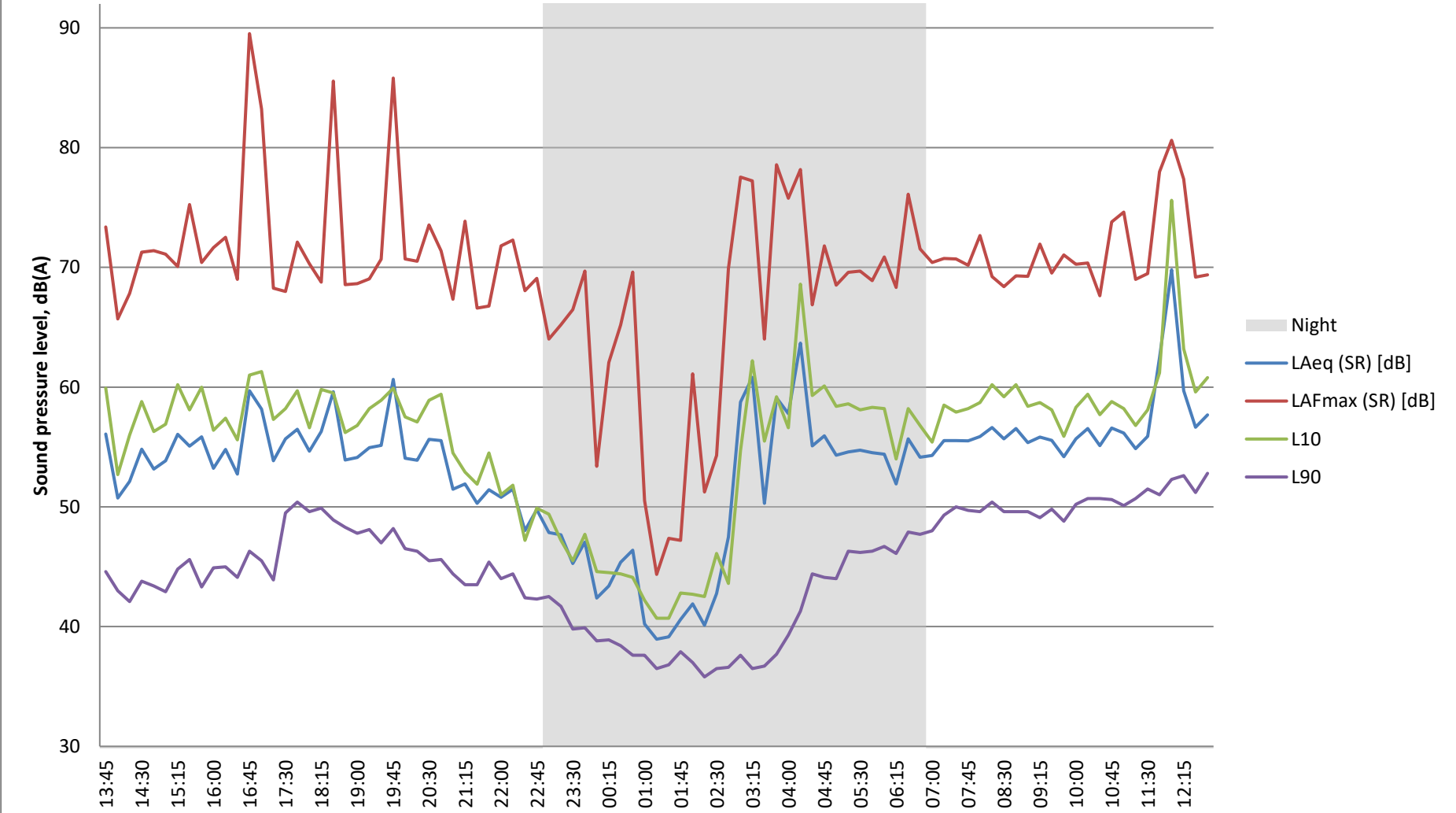
Weather Conditions				
Measurement Location	Time/Date	Description	Beginning of Survey	End of Survey
As indicated on Appendix C	13.45 11/5/23 - 13.00 12/5/23	Temperature (°C)	15	12
Cloud Cover  Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view		Precipitation:	Yes	Yes
		Cloud cover (oktas - see guide)	8	8
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Yes	Yes
		Wind Speed (m/s)	<1	2
		Wind Direction	-	W
		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 road traffic, pedestrians and birdsong. The results of the survey are presented in a time history graph overleaf.

Starbucks, Reading

Thursday 11 - Friday 12 May 2023



Appendix E Noise level predictions

Summary of predictions

Plant	Resultant at receptor (dBA)	Resultant at receptor (dBA)
	R1	R2
General Extract EF1	5	29
Counter Extract EF2	22	19
WC Extract EF3	21	18
CU-1	27	20
CU-2	27	20
BS 4142:2014 feature correction	3	3
Opening Hours Cumulative	34	34
Outside of Opening Hours Cumulative	-	-

Condensers

Receptor R1

Unit	Distance				Directivity	Screening	Result
	L _{pA}	at / m	m	dB			
CU-1	52	1	34	-31	6	0	27
CU-2	52	1	34	-31	6	0	27

Receptor R2

Unit	Distance				Directivity	Screening	Result
	L _{pA}	at / m	m	dB			
CU-1	52	1	40	-32	0	0	20
CU-2	52	1	40	-32	0	0	20

EF1 - 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 Lw	60	71	69	74	74	68	67	57	77
System losses		-9	-5	-1	0	0	0	0	0	
Atmospheric side attenuator		-1	-2	-4	-9	-11	-10	-9	-7	
Sound power level leaving terminal		50	64	64	65	63	58	58	50	68
Receptor 1										
Directivity correction	450 x 450 (0,130)	-1	-1	-2	-4	-9	-8	-8	-8	
Distance correction	43 m	-41	-41	-41	-41	-41	-41	-41	-41	
Screening Correction	$\delta = 0.5\text{m}$	-8	-10	-12	-15	-18	-21	-24	-27	
Resultant at Receptor R1	Lp	0	12	9	5	-5	-12	-15	-26	5
Receptor 2										
Directivity correction	450 x 450 (0,80)	0	1	1	1	-1	-5	-5	-5	
Distance correction	32 m	-38	-38	-38	-38	-38	-38	-38	-38	
Screening Correction		0	0	0	0	0	0	0	0	
Resultant at Receptor R2	Lp	12	27	27	28	24	15	15	7	29

EF2 - Counter 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 Lw	51	45	51	51	52	49	42	35	56
System losses		-13	-9	-5	-1	0	0	0	0	
Atmospheric side attenuator		0	0	0	0	0	0	0	0	
Sound power level leaving terminal		38	36	46	50	52	49	42	35	55
Receptor 1										
Directivity correction	250 x 250 (0,5)	1	2	3	4	5	6	6	6	
Distance correction	34 m	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Correction		0	0	0	0	0	0	0	0	
Resultant at Receptor R1	Lp	0	-1	10	15	18	16	9	2	22
Receptor 2										
Directivity correction	250 x 250 (0,45)	1	2	2	3	3	4	4	4	
Distance correction	41 m	-40	-40	-40	-40	-40	-40	-40	-40	
Screening Correction		0	0	0	0	0	0	0	0	
Resultant at Receptor R2	Lp	-1	-2	8	13	15	13	6	-1	19

EF3 – WC Extract

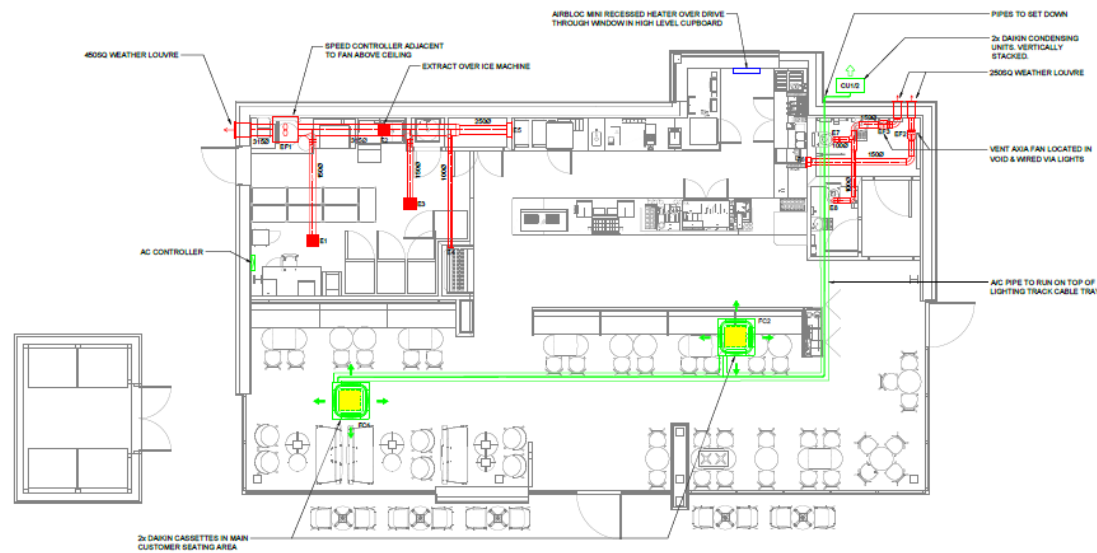
Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (unattenuated)	In-duct Lw	51	45	51	51	52	49	42	35	56
System losses		-13	-9	-5	-1	0	-1	-2	-2	
Atmospheric side attenuator		0	0	0	0	0	0	0	0	
Sound power level leaving terminal		38	36	46	50	52	48	40	33	55
Receptor 1										
Directivity correction	250 x 250 (0,5)	1	2	3	4	5	6	6	6	
Distance correction	34 m	-39	-39	-39	-39	-39	-39	-39	-39	
Screening Correction		0	0	0	0	0	0	0	0	
Resultant at Receptor R1	Lp	0	-1	10	15	18	15	7	0	21
Receptor 2										
Directivity correction	250 x 250 (0,45)	1	2	2	3	3	4	4	4	
Distance correction	41 m	-40	-40	-40	-40	-40	-40	-40	-40	
Screening Correction	-41	0	0	0	0	0	0	0	0	
Resultant at Receptor R2	Lp	-1	-2	8	13	15	12	4	-3	18

Appendix F Proposed plant layout

Ref	Make	Model	Location	Type	Electrical Requirement
FC1	Dalkin	FOAG100A	Customer seating area	Grilling Cassette	Interconnecting
FC2	Dalkin	FOAG100A	Customer seating area	Grilling Cassette	Interconnecting
CU1	Dalkin	AZAS100MV1	External unit	Condenser	1ph 32A
CU2	Dalkin	AZAS100MV1	External unit	Condenser	1ph 32A

Ref	Make	Model	Function	Location	Controller	Electrical Req
EF1	Soler & Palou	3150Da mixed flow in-line	Back of House Extract	Vault above staff room	SP5030	TBC
EF2	Soler & Palou	1500Da mixed flow in-line	W.C. Extract	Vault above Dia W.C.	N/A	TBC
EF3	Soler & Palou	1500Da mixed flow in-line	W.C. Extract	Vault above Dia W.C.	N/A	TBC

Ref	Type	Size
E1	Advanced Air GC Eggcrate	595SQ
E2	Advanced Air GC Eggcrate	595SQ
E3	Advanced Air GC Eggcrate	595SQ
E4	Air Valve	100g
E5	Louver	400SQ
E6	Louver	250SQ
E7	Air Valve	100g
E8	Air Valve	100g



NOTES

THE FOLLOWING INFORMATION MAY BE OF SOME INTEREST:

PI	10.03.22	Prepared HGA Fee	WHT
Source	Date	Revision details	Owner

Scale	1:50 @ A1	Design		PM	MR	Date	Mar 2
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Project	STARBUCKS DRIVE THROUGH READING
---------	------------------------------------

Title

PROPOSED MECHANICAL
LAYOUT PLAN

Drawing No. XXX/X/XXX	Rev. P
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