NSL
Noise Solutions Ltd

Sainsbury's Local

Belsize Park
Abbey Road
Camden
NW6 4AD

Plant Noise
Impact Assessment

On behalf of

JLA

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T: 01252 519881
W: noisesolutions.co.uk
E: hello@noisesolutions.co.uk
Noise Solutions Ltd, 5 Oriel Court, Omega Park, Alton, GU34 2YT Reg no. 3483481

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Prepared by:	Dean Bowden	BSc (Hons), MIOA	DMB	6th April 2020
Reviewed and approved by:	Jon Stump	BSc (Hons), MIOA	JS	6th April 2020
For and on behalf of Noise Solutions Ltd				

Revision	Date	Description	Prepared	Reviewed/ Approved

Reg no. 3483481 Trading office, 5 Oriel Court, Omega Park, Alton, GU34 2YT

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Executive Summary

Noise Solutions Ltd (NSL) has been commissioned by JLA to provide an impact assessment of noise emissions from new internal plant serving the proposed Sainsbury's store located on the corner of Abbey Road and Belsize Road in London.

The results of the assessment demonstrate that cumulative noise emissions from the proposed plant room will comply with the requirements of London Borough of Camden at the nearest noise sensitive receptors, inclusive of the proposed plantroom attenuation.

Therefore, noise from the proposed fixed plant should not be a reason for refusal of planning permission.

1.0 Introduction

1.1. Noise Solutions Ltd (NSL) has been commissioned by JLA to undertake a noise impact assessment for new internal plant serving a proposed Sainsbury's Local unit on the corner of Abbey Road and Belsize Road.

1.2. A noise survey has been undertaken to establish prevailing background noise levels at a location representative of the nearest noise sensitive receptors to the site. Cumulative noise levels for the proposed plant have been predicted at the most affected noise sensitive receptor locations and assessed using London Borough of Camden's typical emissions criteria.

1.3. 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 Sainsbury's is to be located on the ground floor of the building at the corner of Abbey Road and Belsize Road. The retail unit occupies the whole of the ground floor with residential flats on the upper floors.

2.2. It is proposed to install refrigeration and air conditioning (AC) plant in an internal plantroom located at the rear of the store. Air will intake through a louvre located within the plantroom on the south side of the store. Discharge air will be ducted from the plant room at high level, venting through a wall in the south elevation leading on to the fire escape route.

2.3. Atmospheric-side attenuators will be fitted to the intake louvre and discharge ducts in order to control noise breakout from the louvres. In addition, all plant and associated pipework will be fitted with suitable anti-vibration mounts. An acoustic ceiling is proposed within the plant room in order to control noise transfer through the slab to the residential premises above. **Appendix C** contains a layout drawing for the plant room.

2.4. The proposed AC unit will operate only during the daytime period when the store is open. The refrigeration gas cooler and pack may operate at any time of the day or night. **Appendix D** contains the manufacturers' published noise output data for the proposed plant.

3.0 Nearest noise sensitive receptors

3.1. The area surrounding the site is predominantly residential in nature.

3.2. The nearest noise sensitive receptor to the intake louvre (receptor R1) is the flat directly above the louvre on the south elevation. The flat window is screened from the louvre by an external lean-to. This receptor is also screened from the nearest proposed discharge apertures, which front on to the nearby railway tracks.

3.3. The noise sensitive receptor most affected by noise from the proposed discharge apertures is a flat on the south elevation of the building on the east side of the development (Receptor R2). Although this receptor is screened from the proposed intake louvre and the discharge louvres fronting the railway tracks, the receptor has line of sight to a louvred door at the end of the fire escape where discharge will breakout to external.

3.4. A site plan showing the site and surrounding area, the nearest noise sensitive properties and noise monitoring location used in this assessment is presented in **Appendix B**.

4.0 Existing noise climate

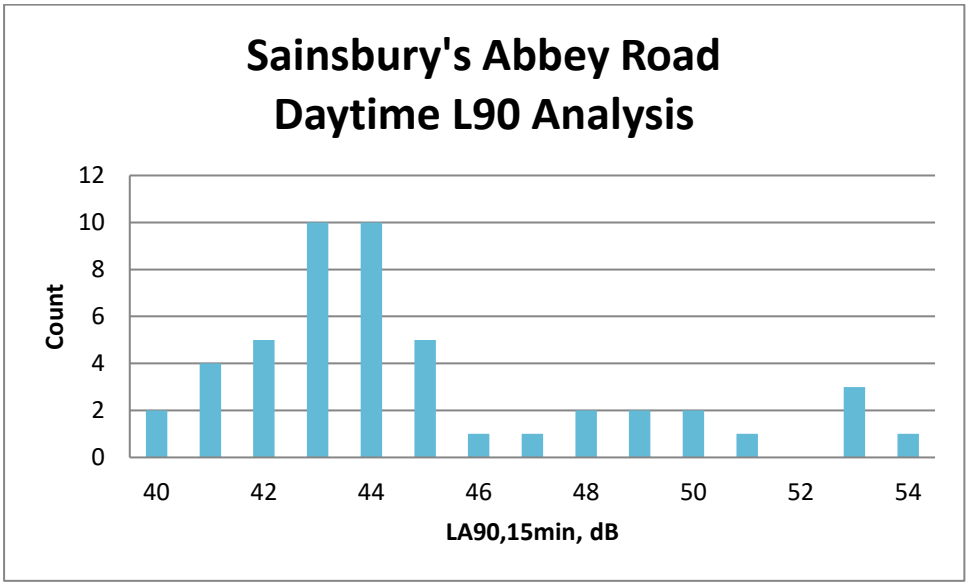
4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.

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 E**.

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	$L_{Aeq(15mins)}$	$L_{AFmax(15mins)}$	$L_{A10(15mins)}$	$L_{A90(15mins)}$
Daytime (07.00 – 23.00 hours)	59-75	76-96	54-80	40-54
Night-time (23.00 – 07.00 hours)	40-71	52-90	44-72	33-43

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



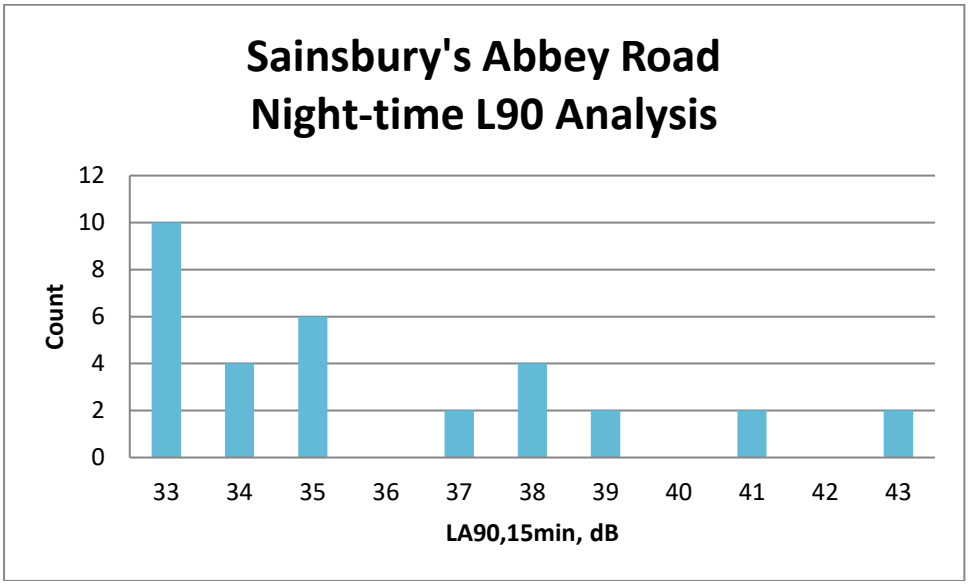
4.3. Further statistical analysis has been carried out on the data, and the mean and median values are shown in Table 2 below.

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

dB, L_{A90} daytime period	
mean	45
modal	44
median	44

4.4. In order to be robust, 43dB has been selected to be representative of the background noise level during the daytime period.

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



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 night-time period

dB, L_{A90} night-time period	
mean	36
modal	33
median	35

4.6. From reviewing the histogram, 33dB(A) has been selected to be representative of the background sound level in the area.

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

- 43dB L_{A90} during the daytime period; and
- 33dB L_{A90} during the night-time period.

5.0 Plant noise design criteria

London Borough of Camden

5.1. The following is taken from planning Condition 46 from the decision notice for the planning application 2012/0096/P for this development:

> *At 1 metre outside the windows of any neighbouring habitable room the level of noise from all plant and machinery shall be at all times at least 5 decibels below the existing background noise levels, expressed in dB(A) at such locations. Where the noise from the plant and machinery is tonal in character the differences in these levels shall be at least 10 dB(A).*
>
> *Reason: To safeguard the amenities of the adjoining premises and the area generally in accordance with the requirements of policy CS5 of the London Borough of Camden Local Development Framework Core Strategy and policies DP26 and DP28 of the London Borough of Camden Local Development Framework Development Policies*

National Planning Policy Framework

5.2. A new edition of NPPF was published in February 2019 and came into effect immediately. The original National Planning Policy Framework (NPPF[1]) was published in March 2012, with a revision

[1] National Planning Policy Framework, DCLG, March 2012

in July 2018 - this document replaced the existing Planning Policy Guidance Note 24 (PPG 24) "Planning and Noise." The 2019 revised edition contains no new directions or guidance with respect to noise, and hence, all previous references remain extant. The paragraph references quoted below relate to the February 2019 edition.

5.3. Paragraph 170 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"preventing both 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 stability."*

5.4. The NPPF goes on to state in Paragraph 180:

"planning policies and decisions should ...

a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development, - and avoid noise giving rise to significant adverse impacts on health and 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 ...

5.5. The NPPF document does not refer to any other documents or British Standards regarding noise other than the Noise Policy Statement for England (NPSE[2]).

5.6. 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."*

5.7. 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"*.

5.8. Paragraph 117 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"*.

[2] Noise Policy Statement for England, DEFRA, March 2010

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings.

5.9. This Standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999[3]). These guideline noise levels are shown in Table 4, below:

Table 4 BS 8233 Desirable Internal Ambient Noise Levels for Dwellings

Activity	Location	07:00 to 23:00 hours	23:00 to 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

5.10. BS 8233:2014 advises that: *"regular individual noise events…can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values."*

Proposed criteria

5.11. In order to comply with the local authority criteria outlined above, the plant noise levels at the receptor should not exceed the limits specified in Table 5 below. Due to the exceptionally low background noise during the night-time period, it has been deemed appropriate to limit the night-time noise level to 30 dBA. Based on guidance provided in BS 8233:2014, this will result in plant noise levels being no greater than 15dBA inside nearby residential properties when windows are left partially open for natural ventilation.

Table 5 Plant noise emissions limits at residences

Period	Cumulative plant noise rating level, dB(A)
Daytime (07.00 – 23.00 hours)	38
Night-time (23.00 – 07.00 hours)	30

5.12. The above limits have not been approved by the local authority at this stage.

[3] World Health Organisation Guidelines for Community Noise, 1999

6.0 Noise Impact Assessment

6.1. The cumulative plant noise levels at the nearest noise sensitive receptors has been predicted. The assessment has considered the reverberant conditions within the plantroom, aperture sizes, directivity, screening and distance attenuation. The predictions are inclusive of the losses due to attenuators with the following acoustic performance:

Table 6 Insertion losses(dB) for plantroom attenuators at octave band centre frequencies (Hz)

Attenuator	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Intake	10	18	27	40	45	45	45	39
Refrigeration Discharge	7	14	25	39	36	35	34	26
VRF Discharge	7	14	25	39	36	35	34	26

6.2. The predictions are based on all plant operating during the daytime, with the AC unit switched off at night.

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. The significant level of attenuation proposed will ensure no tonal characteristics are perceivable externally. All proposed plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems.

6.4. Table 7 below summarises the results of the assessment at the most affected residential properties. All other nearby receptors benefit from increased distance and/or screening to the plant such that compliance with the proposed criteria will be achieved. The full set of calculations can be found in **Appendix F**.

Table 7 Predicted noise levels at nearest noise sensitive receptor

Receptor	Period	Predicted rating level at receptor, $L_{Ar,Tr}$ (dB)	Design criterion (dB)	Difference (dB)
R1	Daytime (07.00 - 23.00 hours)	37	38	-1
	Night-time (23.00 - 07.00 hours)	30	30	0
R2	Daytime (07.00 - 23.00 hours)	34	38	-4
	Night-time (23.00 - 07.00 hours)	29	30	-1

6.5. The noise level predictions demonstrate that cumulative noise emissions from the proposed plantroom will comply with the proposed criteria, inclusive of suitable attenuators fitted to the plant room louvres.

6.6. Subject to review of the acoustic performance of the separating floor between the plantroom and the residences above, it may be necessary to install an acoustic ceiling within the plantroom to control noise to acceptable levels. The typical acoustic ceiling Sainsbury's install in this circumstance comprises 2No. layers 15mm SoundBloc plasterboard supported on resilient hangers to create a 270mm cavity loosely filled with mineral wool. In addition, any exposed soil vent pipes or other services which penetrate the slab will be boxed-in with 2No. layers 15mm SoundBloc plasterboard to create a 50mm deep cavity loosely filled with mineral wool.

6.7. To control structure borne noise and vibration, all plant and associated pipework/ductwork should be fitted with suitable anti-vibration mounts to provide an isolation efficiency of at least 95%.

Context and uncertainties

6.8. Where possible uncertainty in the above assessments has been minimised by taking the following steps:

- Uncertainty in the calculated impacts has been reduced by the use of a well-established calculation method.
- The environmental noise monitoring position was located directly outside the intake louvre. It is conceivable that background noise levels may be higher outside receptor R2, which is nearer to the junction between Belsize Road and Abbey Road and less screening to the carriageways. The use of this measured survey data at Receptor R2 makes for a robust assessment at this location.

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.
- It should be noted that the above assessment is based on all plant operating at maximum duty.

6.10. Given the results of the above assessment, cumulative noise emissions from fixed plant can be considered of 'low impact' in accordance with BS 4142:2014 methodology.

7.0 Summary

7.1. Noise Solutions Ltd (NSL) has been commissioned by JLA to undertake a noise impact assessment for new internal plant serving a proposed Sainsbury's Local unit on the corner of Abbey Road and Belsize Road.

7.2. A noise survey has been undertaken to establish prevailing background noise levels at a location representative of the nearest noise sensitive receptors to the site. Cumulative noise levels for the proposed plant have been predicted at the most affected noise sensitive receptor locations and assessed using London Borough of Camden's typical emissions criteria.

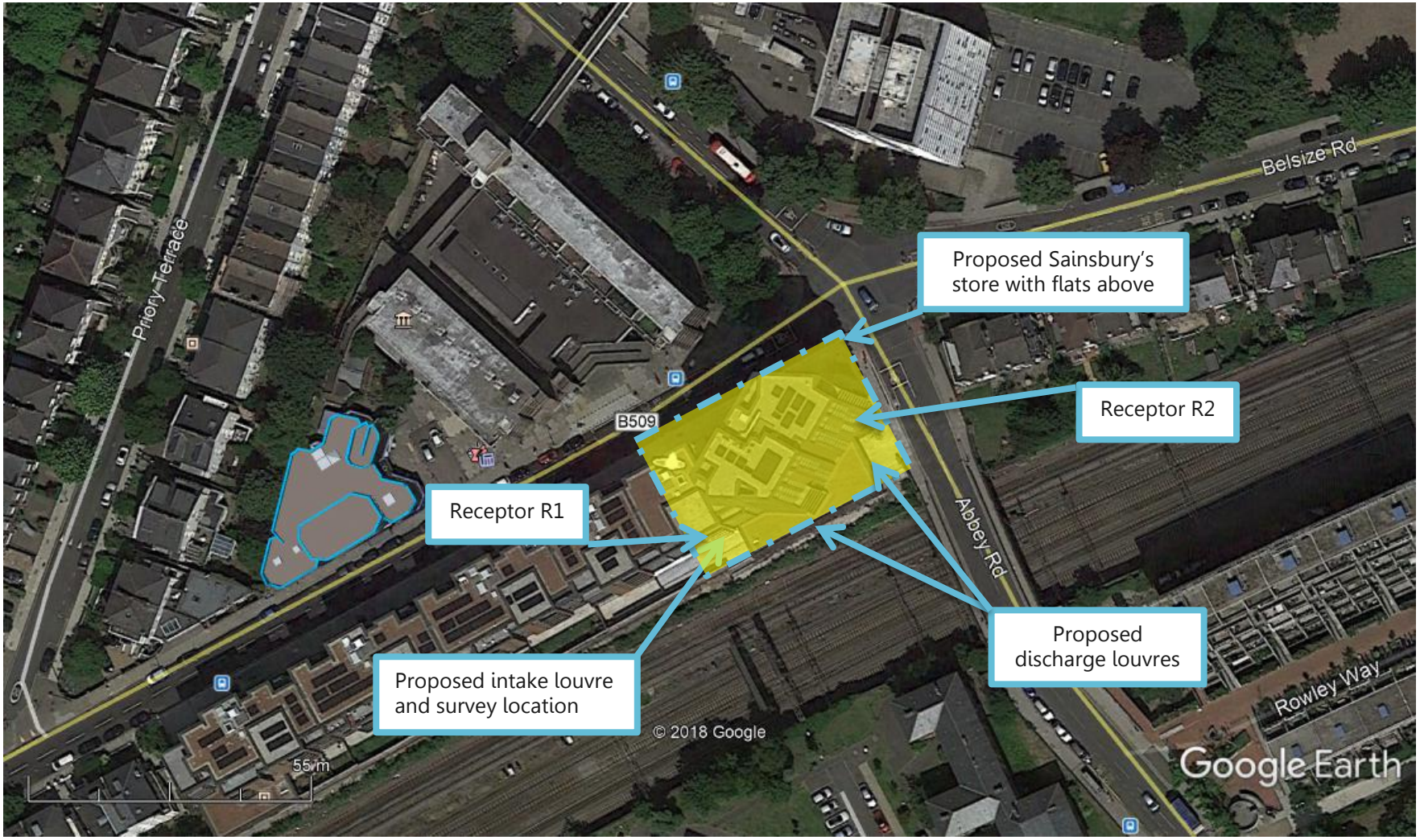
7.3. Cumulative plant noise levels have been predicted outside the most affected noise sensitive windows based on manufacturer noise data for the proposed plant. The predictions demonstrate that cumulative noise emissions from the proposed plant room will comply with London Borough of Camden's noise emissions criteria, inclusive of suitable attenuators being fitted to the intake louvre and discharge ductwork. In addition, all proposed plant and associated pipework will be fitted with suitable anti-vibration mounts in order to control structure-borne sound transmission to the adjoining residential premises. An acoustic ceiling is also proposed within the plant room space.

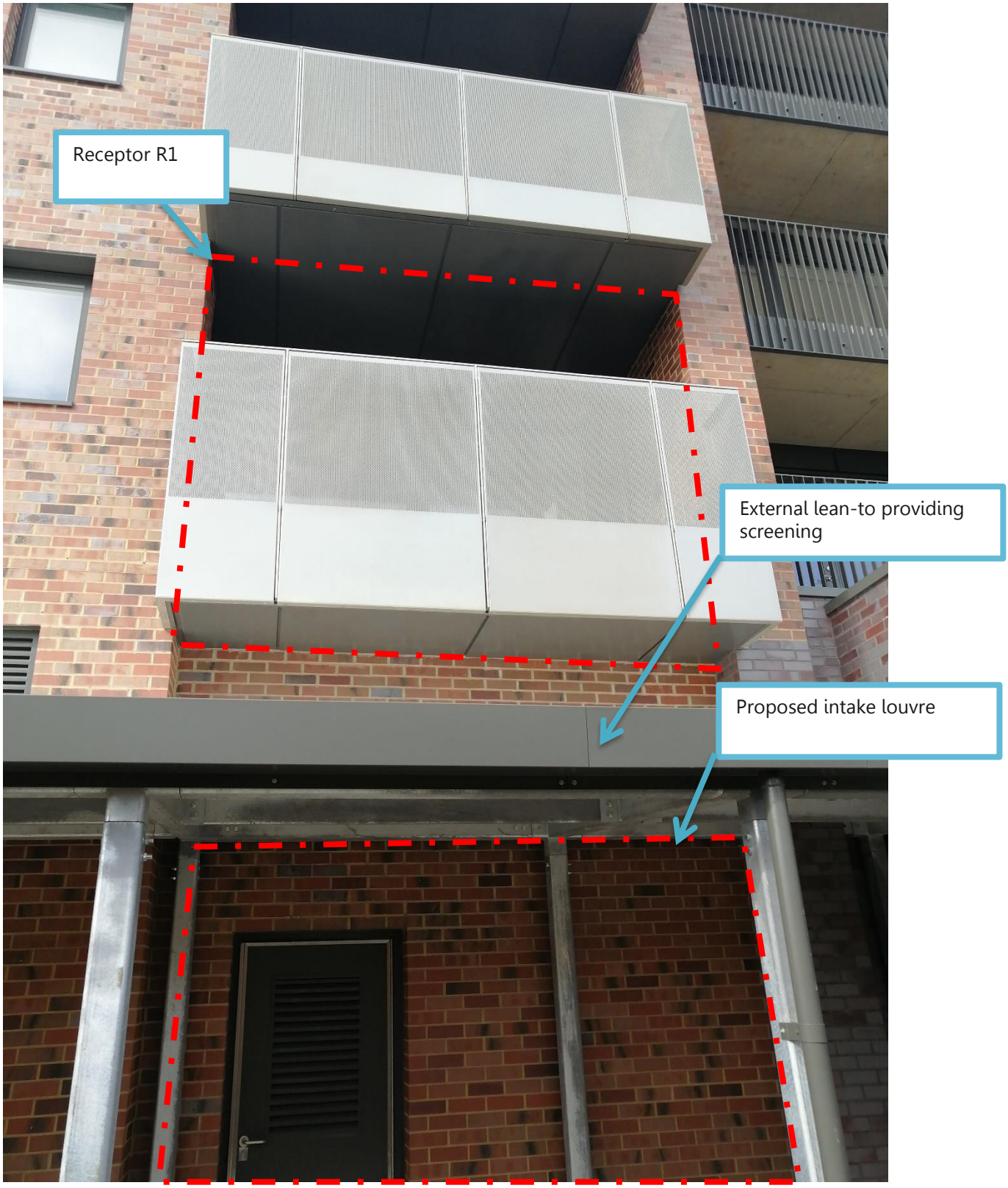
7.4. Given the results of the above assessment, noise from the fixed plant should not be grounds for refusal of planning permission.

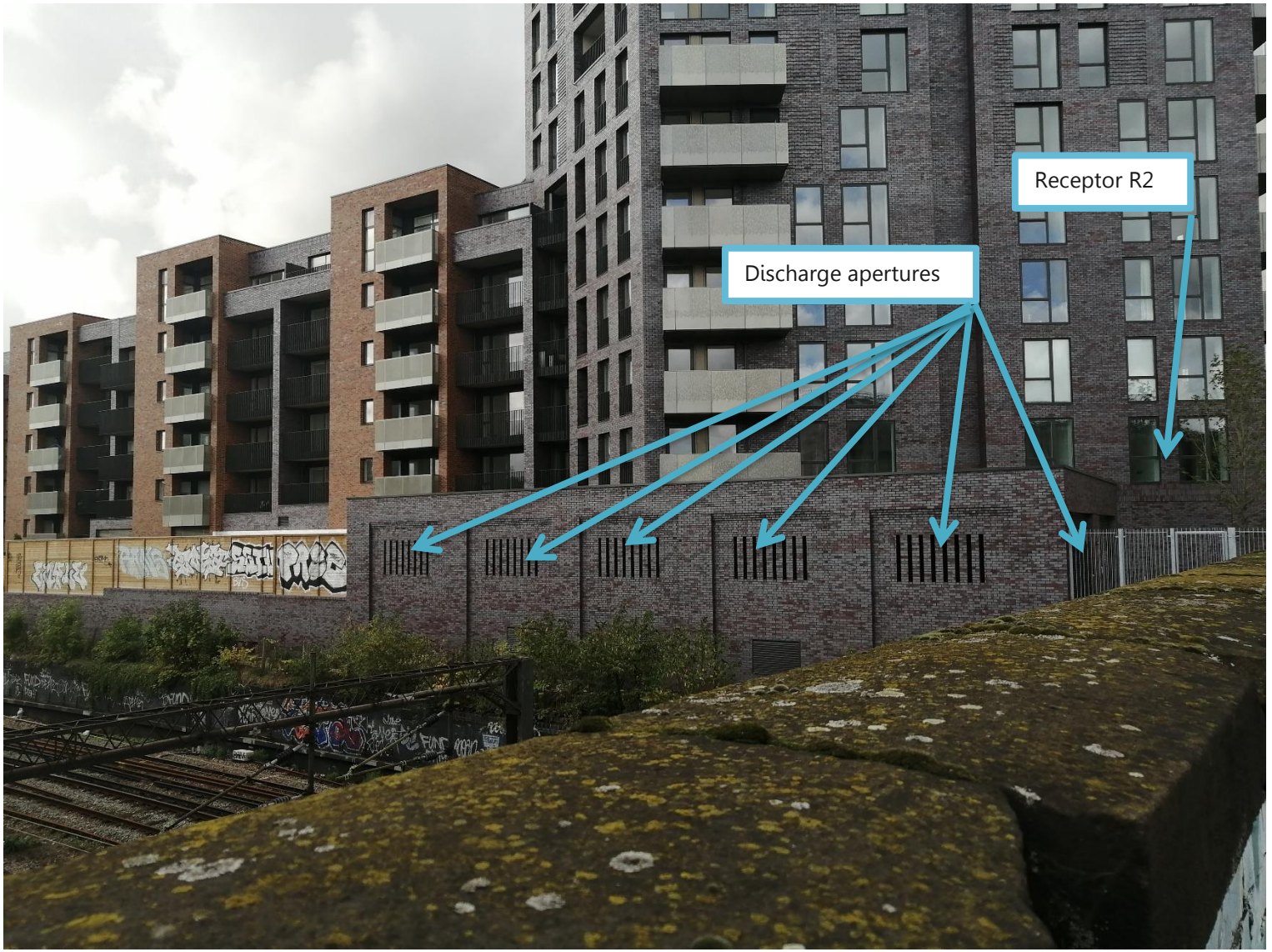
Appendix A Acoustic terminology

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 log10 (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 Leq 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.

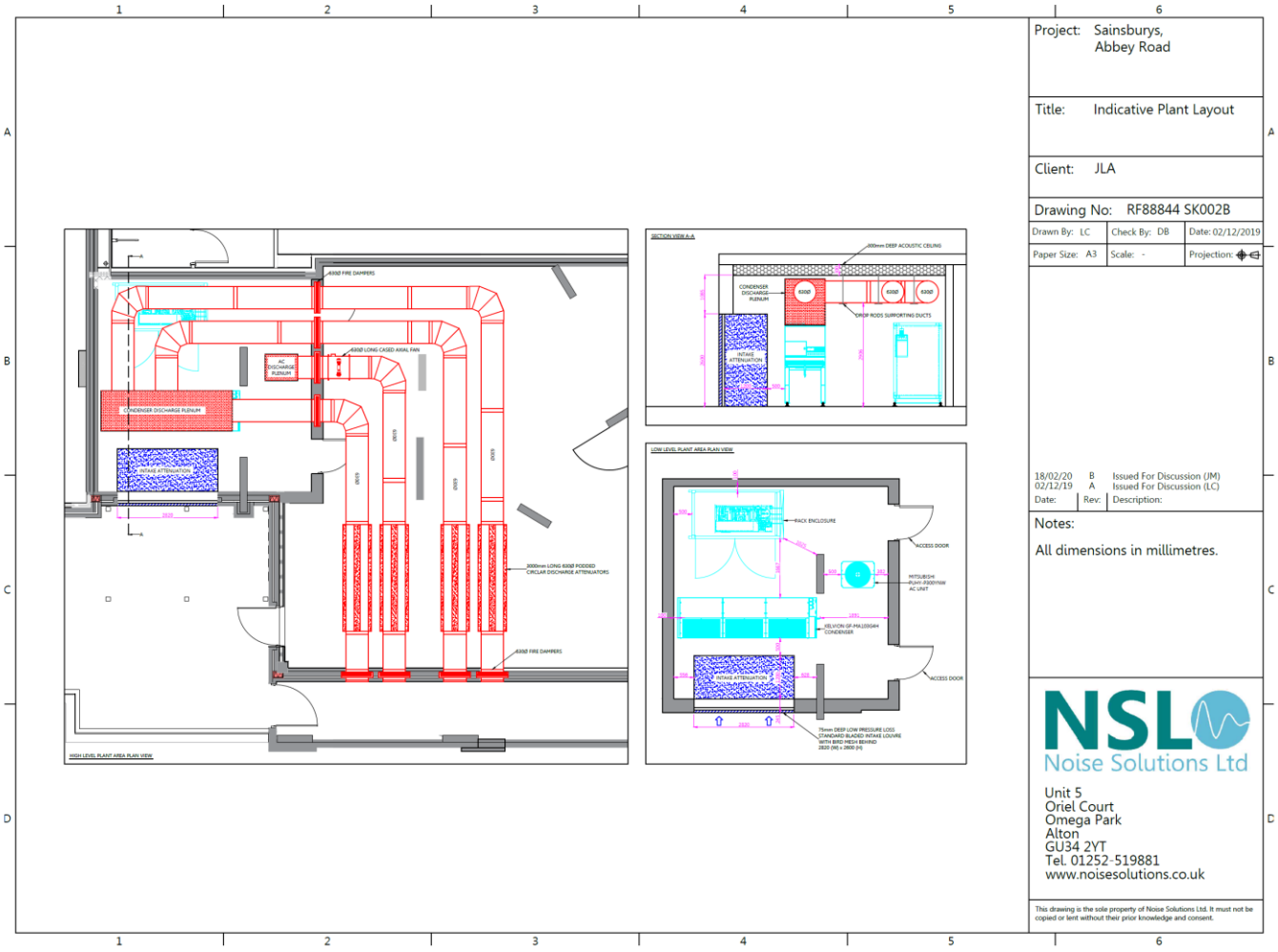
Appendix B Aerial photograph site showing areas of interest




Receptor R1
External lean-to providing screening
Proposed intake louvre


Receptor R2
Discharge apertures

Appendix C Proposed plant room layout



Appendix D Manufacturer noise data

Unit	Make/model	Measurement unit	dB								dBA
			63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Refrigeration condenser	Kelvion / GE-MA103G4/5676959	Lw (per fan), daytime	87	87	83	77	77	75	71	67	82
		Lw (per fan), night-time	84	84	80	74	74	72	68	64	79
AC unit	Mitsubishi / PUHY-P300YNW	Lp @ 1m (heating)	72	70.5	64	62	57	54	52	48	64
AC extract fan	Elta / SLC630/4B-3AC	Lw (inlet)	84	81	84	82	81	80	77	73	87
		Lw (outlet)	89	84	84	83	81	81	78	75	87
Refrigeration pack	SCM / MWS 3096 MTDX/S	Lp @ 10m	46	40	42	37	34	31	27	19	40

Appendix E Environmental sound survey

Details of sound surveys

E.1 Measurements of the existing background sound levels were undertaken between 15:00 hours on Tuesday 1st October and 11:30 hours on Wednesday 2nd October 2019.

E.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

E.3 The representative measurement position was located outside the proposed intake louvre in an area representative of the nearest noise sensitive receptors (location indicated on the site plan in **Appendix B**).

E.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

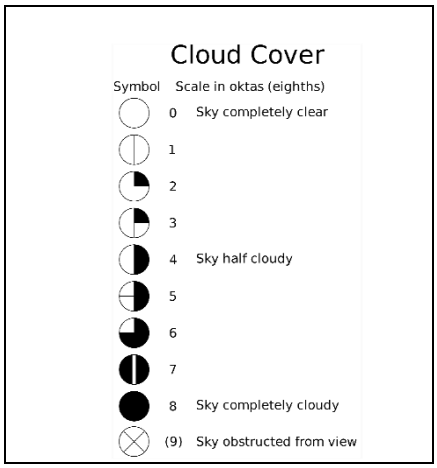
E.5 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Environmental noise survey

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Svantek 949 / 12262	12/04/2019	TCRT19/1290
Condenser microphone	MCE212 / 42528		
Preamplifier	Svantek SV12L / 13163		
Calibrator	Svantek SV 30A / 10847	11/04/2019	TCRT19/1284

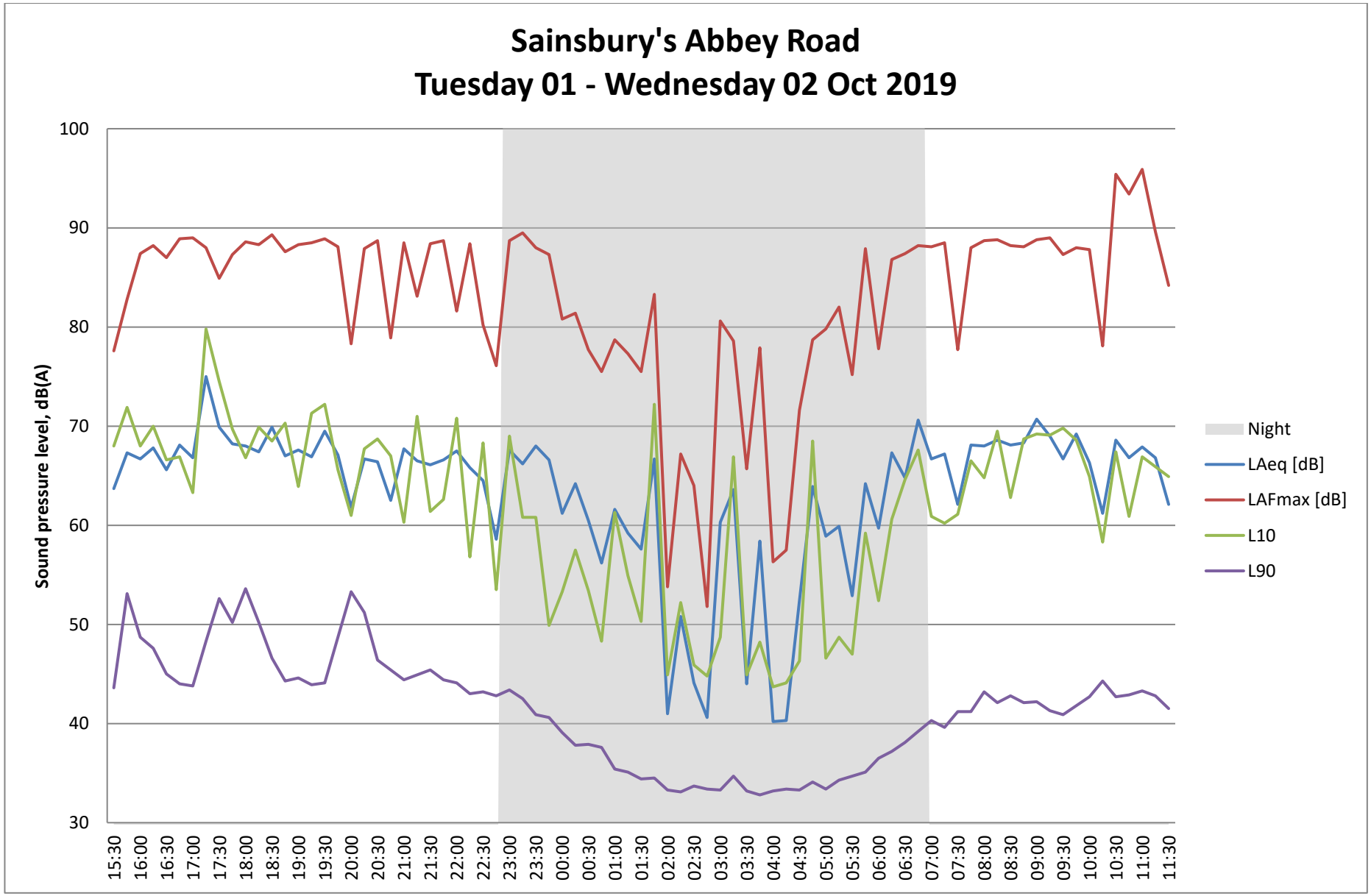
Weather Conditions

E.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	**Date/Time**	**Description**	**Beginning of Survey**	**End of Survey**
As indicated on Appendix B	15:00 01/10/2019 – 11:30 02/10/2019	Temperature (°C)	20	13
		Precipitation:	No	No
		Cloud cover (oktas - see guide)	6	1
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	No	No
		Wind Speed (m/s)	<1	<1
		Wind Direction	SW	N/A
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

E.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 noise from Abbey Road and frequent passing trains. The results of the survey are presented in a time history graph overleaf.


Sainsbury's Abbey Road
Tuesday 01 - Wednesday 02 Oct 2019
Sound pressure level, dB(A)
100
90
80
70
60
50
40
30
15:30
16:00
16:30
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07:30
08:00
08:30
09:00
09:30
10:00
10:30
11:00
11:30
Night
LAeq [dB]
LAFmax [dB]
L10
L90

Appendix F Noise level predictions

F.1 Receptor R1 (daytime)

Description	Notes	dB								dBA
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Intake										
Reverberant level in plant room	Rev Lp	88	86	80	74	72	69	66	62	79
Opening area	7	9	9	9	9	9	9	9	9	
SRI of opening	I.L.	-10	-18	-27	-40	-45	-45	-45	-39	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	81	71	56	37	29	27	23	25	58
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	3	-18	-18	-18	-18	-18	-18	-18	-18	
Screening correction		-5	-5	-5	-5	-5	-5	-5	-5	
Resultant at receptor	Lp @ R1	60	49	35	11	0	-3	-6	-4	37
Discharge										
Sound power of grille terminations into fire escape										
Sound power of 3No refrigeration fans	Lw	89	89	85	79	79	77	73	69	84
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of refrig termination into fire escape		81	75	60	40	40	39	36	40	61
Sound power level of VRV	Lw	91	90	83	81	76	73	71	67	83
Sound power level of extract fan	Lw	89	84	84	83	81	81	78	75	87
Cumulative Lw in duct	Lw	93	91	87	85	82	82	79	76	89
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of AC termination into fire escape		85	77	62	46	43	44	42	47	63
Impact on receptor										
Reverberant level in fire escape		79	70	53	33	30	29	27	32	56
Opening area	4	6	6	6	6	6	6	6	6	
Inside-to-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	6	-24	-24	-24	-24	-24	-24	-24	-24	
Screening correction		-8	-10	-15	-15	-15	-15	-15	-15	
Resultant at receptor	Lp @ R1	48	37	15	-9	-16	-17	-19	-14	25
Cumulative										
Resultant at receptor	Lp @ R1	60	50	35	11	0	-3	-6	-4	37

F.2 Receptor R1 (night-time)

Description	Notes	dB								dBA
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Intake										
Reverberant level in plant room	Rev Lp	81	79	74	65	64	61	57	53	71
Opening area	7	9	9	9	9	9	9	9	9	
SRI of opening	I.L.	-10	-18	-27	-40	-45	-45	-45	-39	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	74	64	50	28	21	18	14	16	51
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	3	-18	-18	-18	-18	-18	-18	-18	-18	
Screening correction		-5	-5	-5	-5	-5	-5	-5	-5	
Resultant at receptor	Lp @ R1	52	43	28	2	-8	-11	-15	-13	30
Discharge										
Sound power of grille terminations into fire escape										
Sound power of 3No refrigeration fans	Lw	86	86	82	76	76	74	70	66	81
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of refrig termination into fire escape		78	72	57	37	37	36	33	37	58
Impact on receptor										
Reverberant level in fire escape		73	66	49	26	25	23	20	24	52
Opening area	4	6	6	6	6	6	6	6	6	
Inside-to-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	6	-24	-24	-24	-24	-24	-24	-24	-24	
Screening correction		-8	-10	-15	-15	-15	-15	-15	-15	
Resultant at receptor	Lp @ R1	43	33	11	-16	-21	-23	-26	-22	20
Cumulative										
Resultant at receptor	Lp @ R1	53	43	28	2	-8	-11	-15	-13	30

F.3 Receptor R2 (daytime)

Description	Notes	dB								dBA
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Intake										
Reverberant level in plant room	Rev Lp	88	86	80	74	72	69	66	62	79
Opening area	7	9	9	9	9	9	9	9	9	
SRI of opening	I.L.	-10	-18	-27	-40	-45	-45	-45	-39	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	81	71	56	37	29	27	23	25	58
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	30	-38	-38	-38	-38	-38	-38	-38	-38	
Screening correction		-15	-15	-15	-15	-15	-15	-15	-15	
Resultant at receptor	Lp @ R2	30	19	5	-19	-30	-33	-36	-34	7
Discharge										
Sound power of grille terminations into fire escape										
Sound power of 3No refrigeration fans	Lw	89	89	85	79	79	77	73	69	84
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of refrig termination into fire escape		81	75	60	40	40	39	36	40	61
Sound power level of VRV	Lw	91	90	83	81	76	73	71	67	83
Sound power level of extract fan	Lw	89	84	84	83	81	81	78	75	87
Cumulative Lw in duct	Lw	93	91	87	85	82	82	79	76	89
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of AC termination into fire escape		85	77	62	46	43	44	42	47	63
Impact on receptor										
Reverberant level in fire escape		79	70	53	33	30	29	27	32	56
Opening area	4	6	6	6	6	6	6	6	6	
Inside-to-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	6	-24	-24	-24	-24	-24	-24	-24	-24	
Screening correction										
Resultant at receptor	Lp @ R2	56	47	30	6	-1	-2	-4	1	34
Cumulative										
Resultant at receptor	Lp @ R2	56	47	30	6	-1	-2	-4	1	34

F.4 Receptor R2 (night-time)

Description	Notes	dB								dBA
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Intake										
Reverberant level in plant room	Rev Lp	81	79	74	65	64	61	57	53	71
Opening area	7	9	9	9	9	9	9	9	9	
SRI of opening	I.L.	-10	-18	-27	-40	-45	-45	-45	-39	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	74	64	50	28	21	18	14	16	51
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	30	-38	-38	-38	-38	-38	-38	-38	-38	
Screening correction		-15	-15	-15	-15	-15	-15	-15	-15	
Resultant at receptor	Lp @ R2	22	13	-2	-28	-38	-41	-45	-43	0
Discharge										
Sound power of grille terminations into fire escape										
Sound power of 3No refrigeration fans	Lw	86	86	82	76	76	74	70	66	81
Duct loss		-1	0	0	0	-3	-3	-3	-3	
Attenuator		-7	-14	-25	-39	-36	-35	-34	-26	
Lw of refrig termination into fire escape		78	72	57	37	37	36	33	37	58
Impact on receptor										
Reverberant level in fire escape		73	66	49	26	25	23	20	24	52
Opening area	4	6	6	6	6	6	6	6	6	
Inside-to-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Directivity correction		1	1	1	-4	-7	-7	-7	-7	
Distance correction	6	-24	-24	-24	-24	-24	-24	-24	-24	
Screening correction										
Resultant at receptor	Lp @ R2	51	43	26	-1	-6	-8	-11	-7	29
Cumulative										
Resultant at receptor	Lp @ R2	51	43	26	-1	-6	-8	-11	-7	29