SHARPS REDMORE

ACOUSTIC CONSULTANTS

Report

Tesco Metro, Richmond upon Thames

Noise assessment of a proposed residential development and new fixed plant equipment

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1.0 Introduction

1.1 Sharps Redmore (SR) have been instructed to undertake an environmental noise assessment of a proposal to convert office space above the Tesco Metro store in George Street Richmond upon Thames to residential accommodation and to consider noise from replacement Tesco fixed mechanical services plant equipment. A site location plan is attached at Appendix A.

1.2 The proposed residential units would overlook George Street at the front of the site; this is the dominant noise source affecting the proposed residential units. With regard to the proposed replacement fixed mechanical services plant the closest existing residential properties are the properties in Church Court to the west and south.

1.3 This assessment is based on the following ttg Architects drawings:

- Site location plan drawing 3341 110;
- Proposed first floor plan drawing 3341 101;
- Proposed second floor plan drawing 3341 102;
- Proposed third floor plan drawing 3341 103;

1.4 The objective of the assessment is to determine how existing noise sources may affect the proposed residential units and how noise from the proposed replacement fixed mechanical services plant equipment may affect the residential amenity of existing residences.

1.5 Section 2 of this report contains a discussion of the available methods of assessment and assessment criteria.

1.6 Section 3 of this report presents details of the environmental noise survey undertaken at the site.

1.7 An assessment of noise associated with the proposed residential development is presented in Section 4. Noise from the proposed replacement plant equipment is considered in section 5; the assessment conclusions are contained in section 6.

1.8 A guide to the acoustic terminology used in this report is shown in Appendix D.

2.0 Assessment methodology and criteria

2.1 The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 123 of the NPPF states the following:

- *Planning policies and decisions should aim to:*
- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions, while recognising that many developments will create some noise; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*

2.2 The NPPF reinforces the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

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

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.3 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.4 It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

i) The effect may be determined by reference to guideline noise values. British Standard (BS) 8233:1999 and World Health Organisation (WHO) "*Guidelines for Community Noise"* contain such guidelines.

ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.

iii) Another method is to compare the resultant sound level against the background sound level (L_{A90}) of the area. This is the method employed by BS 4142:2014 to determine the significance of sound impact from sources of industrial and/or commercial nature. The sources that the new standard is intended to assess are sound from industrial and manufacturing processes, sound from fixed plant installations, sound from loading and unloading of goods at industrial and/or commercial premises and the sound from mobile plant and vehicles, such as forklift, train or ship movements.

Guideline noise values

2.5 There are a number of guidance documents that contain recommended guideline noise values. These are discussed below.

2.6 British Standard 8233:2014 is principally intended to assist in the design of new dwellings; however, the Standard does state that it may be used in the assessment of noise from new sources being brought to existing dwellings.

2.7 The WHO guideline values are appropriate to what are termed "critical health effects". This means that the limits are at the lowest noise level that would result in any psychological or physiological effect.

2.8 The World Health Organisation/BS 8233 guideline noise values are summarised in the following table:

TABLE 1: WHO/BS 8233 guideline noise values

Document	Level	Guidance
World Health Organisation "Community Noise 2000"	L_{AeqT} = 55 dB	Serious annoyance, daytime and evening. (Continuous noise, outdoor living areas)
	L_{AeqT} = 50 dB	Moderate annoyance, daytime and evening. (Continuous noise, outdoor living areas).
	L_{AeqT} = 35 dB	Moderate annoyance, daytime and evening. (Continuous noise, dwellings, indoors)
	L_{AeqT} = 30 dB	Sleep disturbance, night-time (indoors)
	L_{AMAX} = 60 dB	Sleep disturbance, windows open at night. (Noise peaks outside bedrooms, external level).
	L_{AMAX} = 45 dB	Sleep disturbance at night (Noise peaks inside bedrooms, internal level)
BS 8233:2014 "Sound Insulation and noise reduction for buildings"	L_{AeqT} = 55 dB	Upper limit for external steady noise. (gardens and patios).
	L_{AeqT} = 50 dB	Desirable limit for external steady noise. (gardens and patios).
	$L_{Aeq\ 16\ hours}$ = 35 dB	Resting, living room day. (Internal – steady noise)
	$L_{Aeq\ 16\ hours}$ = 40 dB	Dining, dining room day. (Internal – steady noise)
	$L_{Aeq\ 16\ hour}$ = 35 dB	Sleeping, bedroom day (Internal – steady noise)
	$L_{Aeq\ 8\ hours}$ = 30 dB	Sleeping, bedroom night (Internal – steady noise)

2.9 In respect of providing suitable internal noise levels within the proposed residential units it is proposed to adopt the $L_{Aeq\ T}$ criteria from BS 8233:2014 and the L_{Amax} criterion from the WHO guidelines.

2.10 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. When assessing impact, this has the tendency to smooth out the hourly variations in noise level. As such, our calculations are carried out to a 1 hour time base, which is a more stringent assessment than is given in the guidance documents.

Changes in noise level

2.11 Changes in noise levels of less than 3 dBA are not perceptible under normal conditions and changes of 10 dBA are equivalent to a doubling of loudness. This guidance has been accepted by inspectors, at inquiry, to encompass changes in noise levels in the index L_{AeqT}.

2.12 The following table shows the response to changes in noise (known as a semantic scale); this table has been developed from general consensus opinion of acousticians.

TABLE 2: Change in noise level

Change in noise level L_{AeqT} dB	Response	Impact
<3	Imperceptible	None
3 – 5	Perceptible	Slight/moderate
6 – 10	Up to a doubling	Moderate/significant
11 – 15	More than a doubling	Substantial
>15	-	Severe

Assessment using BS 4142:2014

2.13 As outlined, this British Standard enables the significance of sound impact to be determined in relation to industrial and commercial sources. The significance of sound impact is to be determined according to the following summary process:

i) Determine the background sound levels, in terms of the index L_{A90}, at the receptor locations of interest.

ii) Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 15 minutes for night), at the receptor location of interest.

iii) Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.

iv) Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.

v) A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. 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 upon context.

vi) The general intent of the planning system is to ensure that a development avoids significant adverse noise impact. BS 4142:2014 considers that the threshold of significant adverse impact is "a difference around +10 dB or more … depending upon the context".

3.0 Noise survey details

3.1 A noise survey was undertaken between Thursday 5th June and Friday 6th June 2015 at two measurement locations to be representative of the noise climate at the proposed residential façade (measurement location A) and of the noise climate at the closest existing residential properties to the proposed fixed plant equipment (measurement location B – see Appendix A).

3.2 Noise measurements were taken using two Norsonic 118 sound level meters fitted with environmental microphone kits. The sound level meters were calibrated at the start and end of the measurements and no variation in levels noted.

3.3 Weather conditions during the survey were dry, partly cloudy (<30% cover) and warm (14 to 20°C) with light southerly winds (<5 m/s).

3.4 Noise measurements were made every 15 minutes during the survey. The sound level meter microphone at location A was located out of a second floor window overlooking George Street at approximately 1 metre from the façade; measurement location B was located with the microphone in free field conditions approximately 1.5 metres above Tesco flat roof level.

3.5 The purpose of the noise survey was twofold; firstly to establish the noise climate to which the proposed residential units would be exposed, and secondly to establish the daytime and night time background noise levels for use in the assessment of noise from the proposed replacement fixed plant equipment.

3.6 The noise levels measured during the survey were dominated by local road traffic, aircraft and fixed plant sources.

3.7 The results of the noise survey are summarised below and presented in full in Appendix B.

TABLE 3: Summary of measured noise levels

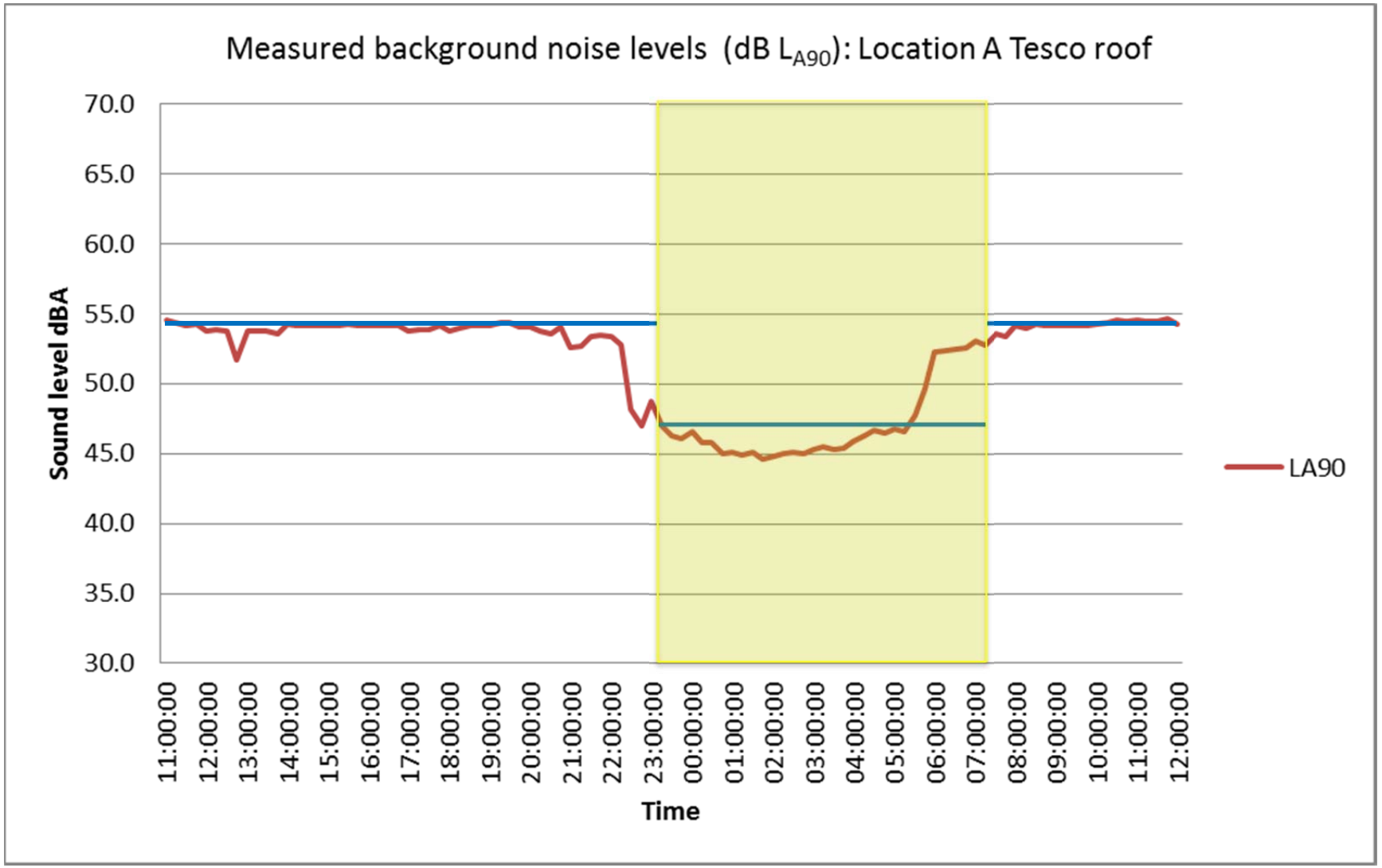
Measurement location	Measured noise levels (dB)			
	Daytime (0700 – 2300)		Night time (2300 – 0700)	
	L_{A90}	L_{AeqT}	L_{A90}	L_{AeqT}
A	47.0-54.6	52.8-60.2	44.6-52.6	46.3-55.1
B	54.6-64.8	64.7-74.0	39.1-61.8	53.5-70.3

3.8 The following measured octave band levels, associated with the levels above will be used to assess the glazing requirements.

TABLE 4: Octave band spectra

Location	Parameter	dBA	Octave Band Centre Frequency Hz						
			63	125	250	500	1k	2k	4k
A	Daytime L_{eq}	68	75	68	67	64	64	61	56
	Night L_{eq}	65	71	62	63	60	60	58	54
	Typical L_{max}	84	87	86	83	79	76	75	78

FIGURE 1: Identification of 'typical' background noise levels (dB L_{A90})



4.0 Proposed residential development

4.1 It is recognised that the only realistic means of providing a suitable internal noise climate within the proposed residential units will be to have windows closed and an alternative means of providing ventilation.

4.2 It is proposed that the building envelope and glazing should be specified such that the internal noise levels within the new residential units meet the criteria presented in BS 8233:2014 (and WHO guideline values in terms of peak noise).

TABLE 5: BS 8233 internal noise levels

Room/conditions	Noise level dB
Resting, living room day. (Internal – steady noise)	$L_{Aeq\ 16\ hours}$ = 35 dB
Dining, dining room day. (Internal – steady noise)	$L_{Aeq\ 16\ hours}$ = 40 dB
Sleeping, bedroom day (Internal – steady noise)	$L_{Aeq\ 16\ hour}$ = 35 dB
Sleeping, bedroom night (Internal – steady noise)	$L_{Aeq\ 8\ hours}$ = 30 dB

4.3 In addition to the internal noise levels specified in BS 8233:2014, the WHO Guidelines for Community Noise state that internal peak noise levels at night should not exceed 45 dB L_{Amax}.

4.4 The calculations presented below are based on the reasonable assumption that the external wall construction provides a sound reduction index at least 10 dB higher than the most onerous glazing performance.

4.5 The acoustic performance of the elements will be expressed in terms of Sound Reduction Index (R) in octave bands. Suitable products will have been tested to ISO 140/3 to determine compliance with the specified values.

4.6 The calculations are based on the room dimensions and glazing areas taken from the ttg architects proposed second and third floor plan drawings and proposed elevations drawings.

4.7 The required sound insulation performance for glazing will be based on calculations performed using the typical external measured noise levels presented in Table 4.

4.8 In L_{eq} terms this will be the spectrum relating to the log average façade corrected values; L_{Aeq} 68 dB daytime and 65 dB night time.

4.9 In L_{fmax} terms the spectrum will relate to a typical L_{Afmax} value during the relevant time period discounting exceptional levels that are high but occur occasionally. This relates to façade corrected levels of L_{Afmax} 84 dB at night time.

4.10 In order to achieve the BS 8233:2014/WHO internal noise levels from external noise intrusion the following glazing specifications are required in the indicated locations.

TABLE 6: Glazing performance specification and typical glass build-up

Type	Sound Reduction Index dB - Octave band centre frequency Hz						Typical R_W	Typical system glass-air gap-glass mm
	125	250	500	1k	2k	4k		
Living Room	27	28	35	45	45	45	41	6.4-9-10.4
Bedroom	28	36	39	45	45	45	44	8-16-16.8

4.11 This above sound insulation requirement is the overall performance for the window system (including frame, seal and glass).

4.12 In order to meet the BS 8233 internal noise level requirement it is necessary that windows will be closed to provide the stated level of sound reduction. With the windows closed it is necessary to provide an alternative means of background ventilation. This applies to habitable rooms on all elevations.

4.13 If the ventilation is to be provided through the façade the necessary sound attenuation required will need to be assessed by SR following receipt of information about the number of vents per room and ventilation free area required.

4.14 An assessment of glazing requirements can be secured by imposition of a suitable planning condition.

5.0 Mechanical services plant

5.1 The Proposed second floor plan drawing (ttg architects drawing 3341 102) shows the replacement plant equipment located within the screened enclosure at roof level.

5.2 Since the proposed refrigeration units are to replace the existing internally housed refrigeration compressors it is proposed that the existing measured background noise level at the nearest residential properties is maintained.

5.3 The noise survey measured the follow typical background noise level at a position (measurement location A) representative of the flats in Church Court to the west of the Tesco roof. These measured noise levels are dominated by noise from existing Tesco plant equipment.

TABLE 7: Typical background noise levels

Measured background noise level dB $L_{A90\,T}$	
Daytime	Night time
54	47

5.4 In order to maintain the background noise levels in Table 7 above the rating level of noise from the replacement refrigeration units should not exceed 44 dB during the daytime and 37 dB at night at the nearest residential properties in Church Court.

5.5 The proposed noise control system involves a combination of intrinsically quiet equipment and the replacement plant operating slower/quieter at night.

5.6 The schedule of source noise data produced by the noise model is presented in Appendix C1.

5.7 SR uses an environmental noise modelling software package called 'NoysPlot'. This software enables coordinates to be entered for the relative positions of noise sources, receivers and barriers to calculate a resultant noise level at a given noise receptor. The software carries out 'text book' atmospheric side calculations with regard to distance and screening attenuation by referencing relative source and receiver positions.

5.8 The height coordinates used in the 'NoysPlot' model have been taken from the ttg Architects drawings and from site observations. The horizontal coordinates are referenced from an arbitrary 'x', 'y' position on a grid system.

5.9 NoysPlot uses operating time information to calculate noise levels for daytime and night time operation. The time period that the equipment is assumed to be operating is denoted by 'D' to indicate daytime only operation; an 'N' to denote night time usage and 'A' to indicate that the equipment runs all the time.

5.10 NoysPlot has the capability to accept input noise data in a number of formats. Where available, the ventilation plant manufacturer's sound power level data (designated by the letter W in the L_p/L_w column of the input schedule) is used. Where the sound power level data is not available the manufacturer's un-weighted octave band sound pressure levels at a stated distance are used (designated P but with an N in the dBA column of the schedule to indicate un-weighted). Alternatively the manufacturer's A-weighted, single figure, averaged level at the stated distance is used (designated 'P' with 'Y' in the dBA column of the schedule). For this assessment single figure A-weighted noise level data has been used.

5.11 The surface directivity is also assessed for all cases – this depends on the number of adjacent reflective surfaces – the number can be seen in the column headed Q in the input schedule.

5.12 A summary of the atmospheric noise calculations for daytime and night time are displayed in Appendices C3 and C4. Calculations for each source to receiver can be made available upon request. These calculations take into account the attenuation afforded by distance, outlet reflection, angular and surface directivity and acoustic screening. The software maintains a logarithmic summation for each receiver position and ranks the individual noise sources in order of contribution to the overall noise level (highest at the top of the list). This assists with the identification of those noise sources requiring additional noise control.

5.13 The input data defining the locations of the noise sources, the receivers and screening are shown in Appendix C2. The NoysPlot noise model principally considers two noise barrier types; the barrier descriptor 'R' is used in the schedule to denote a ring type whereby only noise transmitted over the top of the barrier is considered; whilst noise barriers denoted 'F' for finite consider noise transmitted over the top and around the ends of the barrier. A ring barrier has been used in this assessment to model the screen around the roof plant and a finite barrier to represent the Tesco roof area.

5.14 The NoysPlot calculations (see Appendices C3 and C4) show the following resultant plant rating noise levels:

TABLE 8: Predicted plant (rating) noise levels

Noise sensitive receptor	Predicted rating noise level dB(A)	
	Daytime	Night time
Flat 1 Church Court	38	33
Flat 2 Church Court	39	34
Flat 3 Church Court	40	35
Flat 4A Church Court	41	36

5.15 The predicted noise levels in Table 8 above demonstrate that the proposed plant scheme would comply with the suggested plant noise limits in paragraph 5.4.

8.0 Assessment conclusions

8.1 Having undertaken this assessment against objective criteria, it is concluded that the residential development could proceed without the likelihood of existing noise sources harming the amenity of future residents.

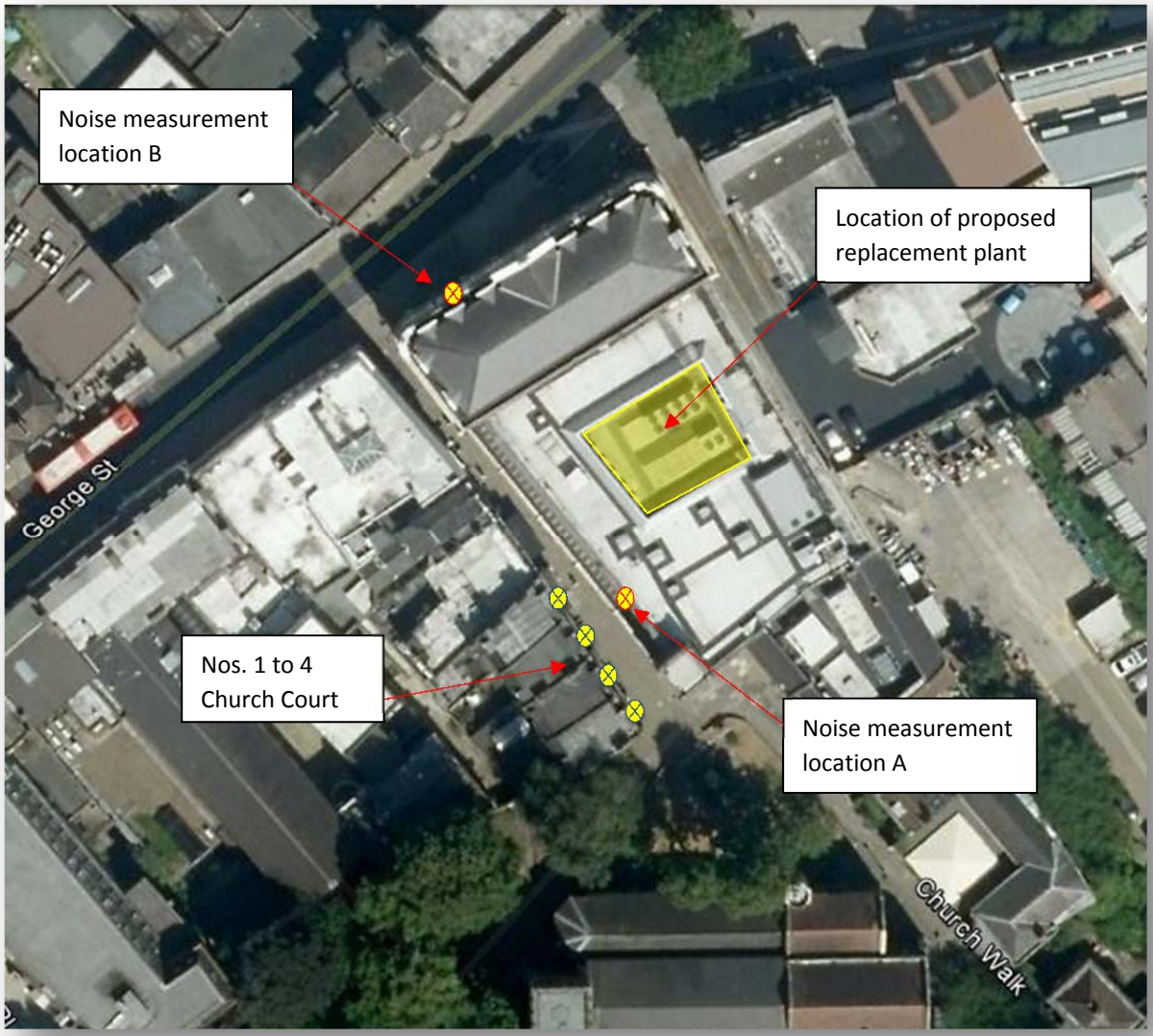
8.2 This report has demonstrated that the internal noise level requirements contained in BS 8233:2014 and the WHO Guidelines for Community Noise can be met if windows remain closed and an alternative means of ventilation provided.

8.3 This assessment objectively demonstrates that noise from the proposed replacement refrigeration equipment would not lead to an increase in the existing measured background noise levels at the closest residential properties. To this end, predicted noise levels from the replacement plant equipment would comply with the requirements of the NPPF to avoid significant adverse impact.

APPENDIX A

SITE LOCATION PLAN

Appendix A: **Site location plan showing noise measurement location and receptors**



APPENDIX B

NOISE SURVEY RESULTS

Appendix B1	Title: Noise survey results

Measurement location A - Tesco roof adjacent to Church Court

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{AFmin}
4.6.15	11:00:00	57.7	54.5	58.9	89.3	53.4
	11:15:00	56.0	54.3	55.1	62.7	53.2
	11:30:00	55.4	54.1	54.8	62.4	53.1
	11:45:00	56.1	54.2	55.2	65.6	53.3
	12:00:00	57.2	53.7	56.4	81.1	52.3
	12:15:00	55.7	53.8	54.7	63.6	52.8
	12:30:00	55.8	53.7	54.8	62.7	52.6
	12:45:00	55.4	51.7	54.5	69.5	49.6
	13:00:00	57.2	53.7	56.2	72.7	52.6
	13:15:00	56.3	53.7	55.8	73.0	52.8
	13:30:00	55.2	53.7	54.5	65.5	52.6
	13:45:00	55.7	53.6	54.7	63.5	52.4
	14:00:00	56.3	54.2	55.3	68.8	53.1
	14:15:00	55.7	54.1	54.9	63.8	52.9
	14:30:00	57.6	54.1	56.2	70.3	53.0
	14:45:00	56.5	54.1	55.4	66.9	53.1
	15:00:00	55.9	54.1	55.1	67.1	53.2
	15:15:00	57.0	54.1	55.5	65.2	53.2
	15:30:00	56.1	54.2	55.1	64.0	53.2
	15:45:00	55.9	54.1	55.3	73.0	53.2
	16:00:00	55.7	54.1	55.0	62.6	53.2
	16:15:00	55.8	54.1	55.1	64.4	53.2
	16:30:00	55.9	54.1	55.0	64.2	53.1
	16:45:00	56.7	54.1	55.8	74.5	53.2
	17:00:00	57.4	53.7	55.6	64.9	52.4
	17:15:00	58.1	53.8	56.3	69.6	52.6
	17:30:00	57.8	53.8	56.3	75.2	52.6
	17:45:00	59.5	54.1	57.5	76.9	52.6
	18:00:00	57.9	53.7	56.3	71.2	52.3
	18:15:00	58.4	53.9	56.4	71.1	52.5
	18:30:00	58.8	54.1	56.8	70.4	52.7
	18:45:00	59.1	54.1	57.0	70.6	52.6
	19:00:00	59.4	54.1	57.1	68.1	52.2
	19:15:00	60.2	54.3	58.1	77.4	52.3
	19:30:00	59.9	54.3	57.5	70.5	52.8
	19:45:00	58.9	54.0	57.3	73.2	52.2
	20:00:00	58.6	54.0	56.6	68.5	52.2
	20:15:00	58.8	53.7	56.7	74.4	52.0
	20:30:00	58.4	53.6	56.2	66.4	51.8
	20:45:00	59.4	54.0	57.1	73.4	52.1
	21:00:00	58.5	52.6	56.1	68.1	49.8
	21:15:00	58.7	52.7	56.3	69.7	50.3
	21:30:00	59.7	53.4	57.2	69.8	50.0
	21:45:00	60.8	53.5	58.1	70.7	48.5
	22:00:00	60.5	53.4	58.0	75.3	49.2
	22:15:00	60.2	52.8	57.5	70.2	47.0
	22:30:00	55.7	48.2	52.8	65.5	45.1
	22:45:00	56.2	47.0	54.7	70.0	44.8

Appendix B2	Title: Noise survey results

Measurement location A - Tesco roof adjacent to Church Court

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{AFmin}
4.6.15	23:00:00	57.5	48.7	54.5	73.6	45.1
	23:15:00	56.2	47.0	53.2	65.8	44.6
	23:30:00	51.1	46.3	49.5	64.4	44.5
	23:45:00	49.7	46.1	48.1	56.5	44.5
5.6.15	00:00:00	51.2	46.6	49.4	59.6	44.6
	00:15:00	49.7	45.8	48.0	58.5	44.5
	00:30:00	50.9	45.8	49.3	63.1	44.0
	00:45:00	48.4	45.0	46.8	55.4	43.0
	01:00:00	50.2	45.1	48.0	61.7	43.4
	01:15:00	47.9	44.9	46.5	55.2	43.6
	01:30:00	48.6	45.1	46.9	56.1	43.4
	01:45:00	49.4	44.6	47.1	62.3	43.3
	02:00:00	48.4	44.8	46.6	61.0	43.5
	02:15:00	47.6	45.0	46.3	53.5	43.6
	02:30:00	47.8	45.1	46.4	57.0	43.8
	02:45:00	48.7	45.0	46.7	57.1	43.7
	03:00:00	48.0	45.3	46.6	52.5	44.0
	03:15:00	48.1	45.5	47.0	55.9	44.1
	03:30:00	48.0	45.3	46.7	53.0	43.9
	03:45:00	48.6	45.4	46.9	53.5	44.2
	04:00:00	50.0	45.9	48.0	55.9	44.5
	04:15:00	49.4	46.3	48.2	67.5	44.2
	04:30:00	50.1	46.7	49.0	65.9	45.3
	04:45:00	50.7	46.5	49.1	64.7	44.8
	05:00:00	51.5	46.8	50.2	69.7	45.2
	05:15:00	49.4	46.6	48.4	68.7	45.3
	05:30:00	50.7	47.8	49.4	61.3	46.0
	05:45:00	58.4	49.6	55.1	67.5	47.8
	06:00:00	54.9	52.3	53.9	65.0	49.2
	06:15:00	55.4	52.4	54.0	68.3	51.4
	06:30:00	55.3	52.5	54.0	62.9	51.6
	06:45:00	55.5	52.6	54.3	72.1	51.5
	07:00:00	55.8	53.1	54.5	63.9	51.9
	07:15:00	56.1	52.8	54.4	63.0	51.7
	07:30:00	56.3	53.6	55.0	65.7	52.4
	07:45:00	57.4	53.4	57.4	87.8	52.1
	08:00:00	56.4	54.1	55.3	62.8	52.6
	08:15:00	58.9	53.9	60.2	77.9	52.2
	08:30:00	59.2	54.2	60.0	76.9	53.0
	08:45:00	56.9	54.1	57.9	73.6	52.7
	09:00:00	58.5	54.1	60.1	77.4	53.0
	09:15:00	57.5	54.1	56.2	69.3	53.1
	09:30:00	56.8	54.1	57.3	72.3	53.1
	09:45:00	56.8	54.1	56.1	69.3	53.3
	10:00:00	56.9	54.2	55.5	62.8	53.2
	10:15:00	57.3	54.3	56.3	69.3	53.3
	10:30:00	58.2	54.5	57.7	75.3	53.4
	10:45:00	57.0	54.4	56.7	71.4	53.3

Appendix B3	Title: Noise survey results

Measurement location A - Tesco roof adjacent to Church Court

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{AFmin}
5.6.15	11:00:00	56.9	54.5	55.7	67.7	53.4
	11:15:00	57.1	54.4	55.8	65.0	53.3
	11:30:00	58.2	54.4	56.9	70.0	53.3
	11:45:00	57.3	54.6	57.3	74.2	53.5
	12:00:00	56.9	54.2	55.6	66.7	53.1

Appendix B4	Title: Noise survey results

Measurement location B - 2nd floor overlooking George Street

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{AFmin}
4.6.15	11:45:00	69.8	59.4	66.7	80.5	55.8
	12:00:00	68.4	58.8	65.5	79.7	54.2
	12:15:00	71.3	61.7	68.6	88.3	56.1
	12:30:00	69.4	59.8	66.6	79.3	54.9
	12:45:00	69.3	60.3	66.2	78.3	55.6
	13:00:00	70.4	61.2	67.7	82.0	56.5
	13:15:00	69.5	60.8	66.4	80.4	54.1
	13:30:00	69.4	59.9	66.5	83.4	55.0
	13:45:00	70.0	60.6	67.3	89.6	55.1
	14:00:00	68.6	59.7	66.0	79.5	55.1
	14:15:00	69.1	58.5	66.1	83.6	52.8
	14:30:00	69.6	60.0	66.5	85.6	53.6
	14:45:00	69.5	60.5	68.5	92.3	56.1
	15:00:00	68.7	59.1	66.3	85.0	54.4
	15:15:00	70.8	61.0	67.5	81.9	55.1
	15:30:00	69.4	61.5	66.7	84.5	58.2
	15:45:00	68.3	58.0	65.4	81.1	54.4
	16:00:00	68.5	58.5	65.6	90.0	53.2
	16:15:00	70.2	60.5	67.4	86.4	54.7
	16:30:00	69.5	60.9	67.0	87.5	55.8
	16:45:00	69.9	59.7	73.7	100.5	53.6
	17:00:00	69.3	59.8	66.8	82.0	54.1
	17:15:00	68.7	58.6	65.7	84.6	53.7
	17:30:00	70.3	60.3	67.2	79.1	53.8
	17:45:00	72.9	63.4	69.7	80.3	58.1
	18:00:00	71.5	62.8	68.5	82.4	55.0
	18:15:00	71.2	62.6	68.9	91.2	57.0
	18:30:00	71.4	61.1	68.2	79.5	55.5
	18:45:00	71.4	61.7	68.6	90.2	55.6
	19:00:00	72.2	62.0	68.9	82.1	55.5
	19:15:00	72.0	63.6	74.0	98.6	57.2
	19:30:00	71.5	60.2	68.4	89.2	55.1
	19:45:00	71.3	61.1	68.2	80.3	54.2
	20:00:00	71.0	58.6	69.5	89.6	53.1
	20:15:00	70.5	59.9	67.4	84.5	55.8
	20:30:00	68.5	57.6	65.3	80.0	53.1
	20:45:00	68.0	58.3	64.7	77.8	53.2
	21:00:00	69.3	58.4	66.1	81.7	53.7
	21:15:00	69.5	57.8	66.2	81.2	52.3
	21:30:00	69.3	57.8	66.7	85.2	52.7
	21:45:00	69.9	59.9	67.1	80.9	53.9
	22:00:00	70.9	59.0	73.0	97.6	52.4
	22:15:00	68.7	57.6	65.9	83.1	50.5
	22:30:00	67.6	54.6	64.8	81.5	48.4
	22:45:00	69.2	57.5	66.1	84.8	53.0
	23:00:00	69.7	58.3	66.5	81.1	52.8
	23:15:00	69.0	56.9	66.3	87.8	50.3
	23:30:00	67.9	57.3	65.2	86.5	53.6

Appendix B5	Title: Noise survey results

Measurement location B - 2nd floor overlooking George Street

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{AFmin}
4.6.15	23:45:00	69.0	55.5	65.7	85.2	46.6
5.6.15	00:00:00	68.6	57.7	66.3	90.6	52.5
	00:15:00	67.4	53.1	63.9	85.1	45.8
	00:30:00	67.4	51.1	65.2	87.4	44.2
	00:45:00	66.7	50.8	62.6	75.3	42.6
	01:00:00	65.6	48.9	62.2	82.8	42.4
	01:15:00	66.0	47.2	61.9	79.0	39.7
	01:30:00	62.9	40.1	59.4	77.5	38.7
	01:45:00	67.2	44.8	64.7	89.8	38.9
	02:00:00	65.9	44.8	62.9	86.2	38.8
	02:15:00	62.9	41.2	58.6	74.1	38.4
	02:30:00	59.6	39.3	59.1	81.2	38.2
	02:45:00	62.8	40.0	59.2	76.7	38.4
	03:00:00	55.7	39.3	53.5	70.0	38.2
	03:15:00	64.1	39.5	60.4	75.8	38.2
	03:30:00	59.2	39.1	56.8	73.7	38.0
	03:45:00	60.2	39.9	57.0	73.1	38.2
	04:00:00	61.2	40.5	58.2	76.5	38.8
	04:15:00	65.6	42.3	63.9	91.0	38.9
	04:30:00	66.6	49.1	62.5	84.1	41.5
	04:45:00	67.6	45.7	64.2	88.8	40.7
	05:00:00	73.0	50.4	67.9	84.6	41.8
	05:15:00	67.1	48.5	63.2	79.0	42.5
	05:30:00	68.2	51.6	63.9	78.7	45.2
	05:45:00	70.3	56.2	66.6	85.2	52.0
	06:00:00	71.7	56.1	67.7	84.1	51.6
	06:15:00	72.9	57.4	69.5	90.1	47.9
	06:30:00	73.3	58.1	69.7	83.9	49.4
	06:45:00	73.6	61.8	70.3	89.8	53.7
	07:00:00	73.5	64.8	71.0	81.9	60.1
	07:15:00	73.1	59.0	70.2	91.1	53.3
	07:30:00	72.7	63.3	70.2	88.1	57.2
	07:45:00	72.7	62.4	70.3	89.2	54.7
	08:00:00	70.8	61.9	68.2	83.4	54.0
	08:15:00	70.3	60.7	67.7	80.9	54.8
	08:30:00	72.0	63.7	69.6	90.7	55.2
	08:45:00	72.1	60.9	69.2	84.3	54.8
	09:00:00	71.2	61.7	68.4	82.3	56.8
	09:15:00	70.9	60.9	68.5	82.1	58.0
	09:30:00	71.6	62.6	68.8	83.5	57.7
	09:45:00	71.4	61.0	68.2	83.5	55.6
	10:00:00	72.1	62.1	69.4	82.8	58.1
	10:15:00	69.8	61.1	67.1	81.8	54.2
	10:30:00	71.0	60.4	69.0	91.4	55.8
	10:45:00	70.1	61.0	67.1	80.7	56.4
	11:00:00	70.3	58.6	67.8	92.6	54.6
	11:15:00	71.1	60.4	68.4	88.3	56.6
	11:30:00	70.8	61.5	68.5	88.5	57.2

APPENDIX C

PREDICTED FIXED PLANT NOISE LEVELS

SHARPS REDMORE PARTNERSHIP, THE WHITE HOUSE, LONDON ROAD, COPDOCK, IPSWICH. IP8 3JH
Telephone: 44(0)1473 730073 Facsimile: 44(0)1473 730030 Email: srp@sharpsredmore.co.uk

CLIENT :Tesco Stores Limited	Appendix C1 Sht: 1 of 1
PROJECT :Tesco Metro Richmond on Thames	PROJECT No:1414281
CONSULTANT:K J Metcalfe	DATE :24 June 2015

SOUND POWER LEVELS (Lw) & SOUND PRESSURE LEVELS (Lp)
FOR FANS AND OTHER EQUIPMENT

EQUIPMENT NAME/REFERENCE	Lw/Lp	DIST. (m)	OP. TIME DNA	MID FREQUENCY OCTAVE BANDS (HZ) 63	125	250	500	1k	2k	4k	8k
HT Sigma #1 refrigeration unit	Lp	10	D	Maximum 48dBA at 10 metres							
HT Sigma #1 refrigeration unit	Lp	10	N	Maximum 43dBA at 10 metres							
HT Sigma #2 refrigeration unit	Lp	10	D	Maximum 48dBA at 10 metres							
HT Sigma #2 refrigeration unit	Lp	10	N	Maximum 43dBA at 10 metres							
LT Sigma refrigeration unit	Lp	10	D	Maximum 48dBA at 10 metres							
LT Sigma refrigeration unit	Lp	10	N	Maximum 43dBA at 10 metres							

NOTES:

1. Lw/Lp:
   Lw means sound power level (dB)
   Lp means sound pressure level at stated distance (dB/m)
2. Operational time (OP.TIME D/N/A):
   D (Day) - could operate at any time between 0700 & 2300
   N (Night) - could operate at any time between 2300 & 0700
   A (All) - could operate at any time during the day and night

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Filename : p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant

Date : 24 June 2015

Entries by : K J Metcalfe

Project number : 1414281

Project title : Tesco Metro Richmond on Thames

Client's name : Tesco Stores Limited

Map/plot details :

Length :3200
Width :3200
Height :250

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The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Source data - description, coordinates, outlet size, percentage to atmosphere, directivity, sound levels and running period.

Filename : p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant

Source Description	Coordinates X(m)	Y(m)	Z(m)	Outlet details A(mm)	B(mm)	Ang.	%	Q	Run DNA	Lp/ Lw	dBA Y/N	Dist. (m)	Mid frequency octave bands 63	125	250	500	1k	2k	4k	8k
HT Sigma #1 refrigeration unit	104.0	136.5	10.6	0	0	0	100	1	D	P	Y	10.0	48	0	0	0	0	0	0	0
HT Sigma #1 refrigeration unit	104.0	136.5	10.6	0	0	0	100	1	N	P	Y	10.0	43	0	0	0	0	0	0	0
HT Sigma #2 refrigeration unit	110.0	136.0	10.6	0	0	0	100	1	D	P	Y	10.0	48	0	0	0	0	0	0	0
HT Sigma #2 refrigeration unit	110.0	136.0	10.6	0	0	0	100	1	N	P	Y	10.0	43	0	0	0	0	0	0	0
LT Sigma refrigeration unit	110.0	131.5	10.6	0	0	0	100	1	D	P	Y	10.0	48	0	0	0	0	0	0	0
LT Sigma refrigeration unit	110.0	131.5	10.6	0	0	0	100	1	N	P	Y	10.0	43	0	0	0	0	0	0	0

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Receptor data - description and coordinates

Filename : p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant

Receptor Description	Coordinates X(m)	Y(m)	Z(m)	DNA
Flat 1 Church Court	86.0	118.0	9.4	A
Flat 2 Church Court	87.0	122.0	9.4	A
Flat 3 Church Court	88.0	126.0	9.4	A
Flat 4A Church Court	89.0	131.0	9.4	A

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Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Barrier data - description and coordinates

Filename : p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant

Barrier type	Coordinates Start X(m)	Start Y(m)	Start Z(m)	Finish X(m)	Finish Y(m)	Finish Z(m)
F	100.0	113.0	9.5	95.0	114.0	9.5
F	95.0	114.0	9.5	95.0	114.0	13.0
F	95.0	114.0	13.0	91.0	114.0	13.0
F	91.0	114.0	13.0	91.0	114.0	9.5
F	91.0	114.0	9.5	92.0	148.0	9.5
F	92.0	148.0	9.5	120.5	144.0	9.5
F	120.5	144.0	9.5	116.0	113.0	9.5
F	116.0	113.0	9.5	100.0	113.0	9.5
R	100.0	129.5	10.5	100.0	140.5	10.5
R	100.0	140.5	10.5	114.5	138.5	10.5
R	114.5	138.5	10.5	113.0	128.0	10.5
R	113.0	128.0	10.5	100.0	129.5	10.5

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The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Day time overall receptor listings

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Flat 4A Church Court	59	49	42	36	32	29	28	28	41
Flat 3 Church Court	58	48	41	34	30	29	27	27	40
Flat 2 Church Court	57	47	40	34	30	28	27	28	39
Flat 1 Church Court	56	46	39	33	30	28	27	28	38

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Day time source sound pressure levels at receptor: Flat 4A Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	56	46	39	33	29	27	26	26	38
LT Sigma refrigeration unit	54	44	36	30	26	23	21	20	35
HT Sigma #2 refrigeration unit	53	43	35	29	25	22	20	19	34
Total Free field Lp and dBA	59	49	42	36	32	29	28	28	41

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Day time source sound pressure levels at receptor: Flat 3 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	54	44	37	31	27	26	24	25	36
LT Sigma refrigeration unit	53	43	36	29	25	23	21	21	34
HT Sigma #2 refrigeration unit	52	42	35	28	24	22	20	19	33
Total Free field Lp and dBA	58	48	41	34	30	29	27	27	40

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The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Day time source sound pressure levels at receptor: Flat 2 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	53	43	36	30	27	25	24	25	35
LT Sigma refrigeration unit	52	42	35	29	26	24	23	23	34
HT Sigma #2 refrigeration unit	51	41	34	27	23	21	19	19	32
Total Free field Lp and dBA	57	47	40	34	30	28	27	28	39

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Day time source sound pressure levels at receptor: Flat 1 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	52	42	35	29	26	24	23	24	34
LT Sigma refrigeration unit	51	41	34	28	25	24	23	24	34
HT Sigma #2 refrigeration unit	50	40	33	27	23	21	20	20	32
Total Free field Lp and dBA	56	46	39	33	30	28	27	28	38

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Night-time overall receptor listings

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Flat 4A Church Court	54	44	37	31	27	24	23	23	36
Flat 3 Church Court	53	43	36	29	25	24	22	22	35
Flat 2 Church Court	52	42	35	29	25	23	22	23	34
Flat 1 Church Court	51	41	34	28	25	23	22	23	33

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Night-time source sound pressure levels at receptor: Flat 4A Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	51	41	34	28	24	22	21	21	33
LT Sigma refrigeration unit	49	39	31	25	21	18	16	15	30
HT Sigma #2 refrigeration unit	48	38	30	24	20	17	15	14	29
Total Free field Lp and dBA	54	44	37	31	27	24	23	23	36

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Night-time source sound pressure levels at receptor: Flat 3 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	49	39	32	26	22	21	19	20	31
LT Sigma refrigeration unit	48	38	31	24	20	18	16	16	29
HT Sigma #2 refrigeration unit	47	37	30	23	19	17	15	14	28
Total Free field Lp and dBA	53	43	36	29	25	24	22	22	35

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Night-time source sound pressure levels at receptor: Flat 2 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	48	38	31	25	22	20	19	20	30
LT Sigma refrigeration unit	47	37	30	24	21	19	18	18	29
HT Sigma #2 refrigeration unit	46	36	29	22	18	16	14	14	27
Total Free field Lp and dBA	52	42	35	29	25	23	22	23	34

SHARPS REDMORE PARTNERSHIP

The White House, London Road, Copdock, Ipswich, IP8 3JH
Tel: 44 (0) 1473 730073 Fax: 44 (0) 1473 730030 Email: srp@sharpsredmore.co.uk

Night-time source sound pressure levels at receptor: Flat 1 Church Court

Filename: p:\15 - Projects\1515281 Tesco Richmond Metro plant and resi-KJM\NoysPlot\Richmond plant
Date: 24/06/2015

	Mid frequency Octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
HT Sigma #1 refrigeration unit	47	37	30	24	21	19	18	19	29
LT Sigma refrigeration unit	46	36	29	23	20	19	18	19	29
HT Sigma #2 refrigeration unit	45	35	28	22	18	16	15	15	27
Total Free field Lp and dBA	51	41	34	28	25	23	22	23	33

APPENDIX D

ACOUSTIC TERMINOLOGY

Appendix D: Acoustic Terminology

D1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible.

3 dB increase - just noticeable.

10 dB increase - perceived as twice as loud.

D2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

D3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

D4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

D5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

D6 The main noise indices in use in the UK are:

L_{A90}: The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10}: The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given

sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX}: The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

D7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB}.$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

D8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = 20 Log (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \text{ Log } {}^{160}/_{10} = 60 - 24 = 36 \text{ dB}.$$