373-375 Euston Road

Acoustic Assessment

Prepared by Hoare Lea
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Tel: +44 (0) 1202 654 600
Fax: +44 (0) 1202 654 601

Enterprise House
Old School Close
Ferndown
Bournemouth
Dorset
BH22 9UN

Audit Sheet

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1.0 Introduction

Hoare Lea Acoustics has been appointed by S2 Estates LLP to conduct an environmental noise survey in order to support the planning application for a mixed use development comprising a ground floor commercial unit with multiple residential apartments above, at 373-375 Euston Road within the London Borough of Camden.

The proposed development comprises the redevelopment of the existing site at 373-375 Euston Road to provide sixteen residential apartments (six one-bedroom apartments, seven two-bedroom apartments and three three-bedroom apartment) across six storeys with a commercial unit at ground floor. The development will also include the installation of mechanical services plant.

An environmental noise survey is required to quantify the existing ambient and background noise levels at the site in order to establish the design constraints on noise emissions from the operation of plant. The noise survey will also provide information required to establish the acoustic performance of the building façade and ventilation strategy to ensure that the internal living accommodation is in accordance with the Local Authority requirements.

This report provides a description of the results from the noise survey undertaken, an assessment to determine the external noise limits for building services plant required to meet the Local Authority's general noise emission limits and advice regarding the building envelope and ventilation strategy.

2.0 Site Description

2.1 Existing Site

373 - 375 Euston Road is an existing ground floor commercial unit with vacant office space above, on the corner of Euston Road and Cleveland Street, within the London Borough of Camden.

The surrounding buildings along Euston Road and Cleveland Street are generally commercial in nature, providing a mixture of office and café/restaurant units. There are existing residential dwellings along Cleveland Street to the west and Warren Street to the South.

It should also be noted that Great Portland Street underground station is located to the west of the existing site.

The proposed development site (indicative only) is identified in Figure 1 attached.

2.2 Local Noise Conditions

The surrounding noise climate is formed predominantly by road traffic noise typical of a busy city centre from the immediate road network around the site, in particular Euston Road (A5011) a dual carriageway immediately to the north, but also from more distant roads including Albany Street (A4201) to the west.

It should be noted that Euston Road (A5011) and Osnaburgh Street form a traffic lighted junction immediately to the west of the proposed development; as such the noise climate is frequently formed of idling vehicles (with engines running).

It should also be noted that pedestrian activity serving Great Portland Street underground station and occasional aircraft noise is also audible.

Figure 1 attached displays a plan view of the existing site with the measurement locations identified.

3.0 Basis of Assessment

3.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (1) sets out the Government's current planning policies for England and how these are expected to be applied.

With regards to local noise planning policies, Section 11 paragraph 123 of the NPPF states:

'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;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put upon them because of changes in nearby land uses since they were established;
- 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.'

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have 'a single objective noise-based measure…that is applicable to all sources of noise in all situations'. It further advises that the sound level at which an adverse effect occurs is 'likely to be different for different noise sources, for different receptors and at different times'.

In the absence of specific guidance for assessment of environmental noise within the NPPF and the NPSfE, it is considered appropriate to base assessment on current British Standards and national guidance. These are considered to be Local Authority guidance, BS 4142, BS 8233 (2) and the World Health Organisations (3) (WHO) guidelines.

3.2 BS 4142

Current Government advice to Local Planning Authorities in both England and Wales makes reference to BS 4142 (4) as being the appropriate guidance for assessing commercial operations and fixed building services plant noise. This British Standard provides an objective method for rating the likelihood of complaint from industrial and commercial operations. It also describes means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The complaints assessment method is based on the subtraction of the measured background noise level from the rating level determined. The rating level is the source noise level (either measured or predicted) corrected for tone or character (if necessary). The difference is compared to the following criteria to evaluate the likelihood of complaint.

- A difference of around +10 dB or more indicates that complaints are likely.
- A difference of around +5 dB indicates a marginal significance for complaint.

– A difference of -10 dB or less is a positive indication that complaints are unlikely.

The objective complaint rating method is only applicable for external noise levels.

3.3 BS 8233: Sound Insulation and Noise Reduction for Buildings

BS 8233 provides guidance for control of noise in and around buildings, and suggests appropriate criteria and limits for different situations. The criteria and limits are primarily intended to guide the design of new or refurbished buildings undergoing a change of use.

Table 5 within BS 8233 provides 'good' and 'reasonable' criterion for indoor ambient noise levels in spaces when they are unoccupied.

Criterion	Typical Situations	Design Range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable speech or telephone communications	Department Store	50	55
Reasonable resting / sleeping conditions	Living Rooms (Day) Bedrooms (Night)[a]	30 30	40 35

Table 1: Indoor Ambient Noise Levels in Spaces when they are Unoccupied

Note [a]: For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45 dB L_{Amax}.

Table 6 within BS 8233 provides indoor ambient noise levels in spaces when they are unoccupied and privacy is important.

Criterion	Typical Situations	Design Range $L_{Aeq,T}$ dB
Reasonable acoustic privacy in shared spaces	Restaurant Open Plan Office	40 - 55 45 - 50

Table 2: Indoor Ambient Noise Levels in Spaces when they are Unoccupied and Privacy is also Important

3.4 Local Planning Policy

3.5 Camden Development Policies 2010-2025, Local Development Framework

Camden's Development Policies form part of the Local Development Framework (LDF) and contains a single policy relating to noise, Development Policy (DP) 28.

3.5.1 Development Policy 28 – Noise and Vibration

DP 28 states the following:

"The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:

a) Development likely to generate noise pollution; or

b) Development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided."

In relation to the control of noise from new sources, the policy states:

"The Council will only grant permission for plant or machinery if it can be operated without causing harm to amenity and does not exceed our noise thresholds."

The policy goes on to provide a table defining noise levels from plant or machinery at which planning permission will not be granted, this table is copied below for reference.

Noise Description and Location of Measurement	Period	Time	Noise Level
Noise at 1 metre external to a sensitive façade	Day, Evening and Night	0000 - 2400	5 dB(A) < L_{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade	Day, Evening and Night	0000 - 2400	10 dB(A) < L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade	Day, Evening and Night	0000 - 2400	10 dB(A) < L_{A90}
Noise at 1 metre external to sensitive façade where L_{A90} > 60 dB	Day, Evening and Night	0000 - 2400	55 dB L_{Aeq}

Table 3: Noise Levels from Plant or Machinery at which Planning Permission will not be Granted

On the basis of DP 28 and as seen in previous conditions imposed by Camden Council, the following requirements with relation to internal noise levels and building services noise are proposed.

3.5.2 Internal Noise Levels – Residential Developments

Camden Council is understood to require that any proposed development exposed to high levels of noise will require design features and sound insulation to enable residents to be protected from such external noise. These should be designed to enable the following WHO guideline levels to be met in all residential developments.

a) For Living Rooms: 35 dB $L_{Aeq,16hour}$ between 0700 and 2300;

b) For Bedrooms: 30 dB $L_{Aeq,8hour}$ between 2300 and 0700; and

c) 45 dB L_{Amax} for any individual noise event (measured with F time weighting) between 2300 and 0700.

3.5.3 Building Services - Noise

On the basis of Table 3 above, Camden Council is understood to require the building services noise emission limit to be 5 dB below the existing background noise level ($L_{A90,T}$) where the measured $L_{A90,T}$ is less than 60 dB, such that noise from building services plant does not increase the existing background noise level. Table 4 below outlines the criterion.

Description of Noise Source	Noise Emission Limit
Building Services	$L_{Ar,Tr} = L_{A90,T} - 5$ dB(A)

Table 4: London Borough of Camden's Noise Emission Limits for Building Services

In addition, plant noise that is tonal, contains a specific character or is intermittent, is required to be an additional 5 dB(A) below the existing background noise level. The methodology used here follows BS 4142.

In instances where the measured background noise level $L_{A90,T}$ exceeds 60 dB, Camden Council is understood to require a fixed building services noise emission limit of 55 dB.

4.0 Environmental Noise Surveying

An acoustic survey has been carried out at the proposed site to establish the prevailing environmental noise conditions local to the site, so as to determine building services plant noise emission limits and to advise upon the building envelope and ventilation strategy.

4.1 Methodology

The survey comprised seven days and an additional one day of unattended automatic noise measurements by two loggers at existing second floor level. The position of these noise monitors is shown as positions one and five in Figure 1 attached. These measurement positions were façade measurements at a height of approximately 7 metres above ground floor level and approximately one metre from the façade.

Measurements recorded consisted of five minute samples of ambient noise levels ($L_{Aeq,5min}$ in dB), maximum noise levels ($L_{Amax,5min}$ in dB) and background noise levels ($L_{A90,5min}$ in dB) between Wednesday 7th August 2013 and Wednesday 14th August 2013 and between Monday 19th August 2013 and Tuesday 20th August 2013. An audio trigger was also set to record events where the instantaneous noise level rose above 90 dB(A) at position one.

Octave band measurements have been conducted at three positions at ground floor level simultaneous with the unattended measurements at position one. The positions of these measurements at ground floor level are shown as position two, three and four in Figure 1 attached. All of these measurements were hand-held samples at a height of approximately 1.2m above ground floor level and considered “free-field”.

The measurement instrumentation used is listed in Appendix A attached and a general acoustic terminology is provided in Appendix B.

During the measurement period, temperatures remained warm with very little precipitation and light winds varying in both direction and strength.

4.2 Results Summary

Time histories of the L_{Aeq}, L_{A90} and L_{Amax} from the unattended measurements recorded at position one and five are shown in Figure 2 and Figure 3 attached respectively.

The results of the unattended measurements at position one and five have been calculated into daytime ($L_{Aeq,16hr}$) and night-time ($L_{Aeq,8hr}$) equivalent levels, and are shown with the associated measured minimum background noise level ($L_{A90,T}$) and maximum instantaneous measured noise level ($L_{Amax,T}$) in Table 5 and Table 6 below. It should be noted that the minimum daytime background noise level ($L_{A90,1hr}$) shown below is the lowest arithmetic average of the measured background noise levels ($L_{A90,5min}$) in an hourly period.

Measurement Position	Position 1					
	Daytime			Night-Time		
	$L_{Aeq,16hr}$	$L_{A90,T}$	$L_{Amax,T}$	$L_{Aeq,8hr}$	$L_{A90,5min}$	$L_{Amax,T}$
Measurement Period	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
Wednesday 7th August 2013 (1245 to 2300)	75	67	104	-	-	-
7th/8th August 2013 (2300 to 0700)	-	-	-	73	58	106
Thursday 8th August 2013 (0700 to 2300)	76	67	109	-	-	-
8th/9th August 2013 (2300 to 0700)	-	-	-	73	59	99
Friday 9th August 2013 (0700 to 2300)	76	67	109	-	-	-
9th/10th August 2013 (2300 to 0700)	-	-	-	74	60	101
Saturday 10th August 2013 (0700 to 2300)	75	65	110	-	-	-
10th/11th August 2013 (2300 to 0700)	-	-	-	74	59	106
Sunday 11th August 2013 (0700 to 2300)	74	64	107	-	-	-
11th/12th August 2013 (2300 to 0700)	-	-	-	72	53	105
Monday 12th August 2013 (0700 to 2300)	75	66	107	-	-	-
12th/13th August 2013 (2300 to 0700)	-	-	-	72	55	106
Tuesday 13th August 2013 (0700 to 2300)	76	66	109	-	-	-
13th/14th August 2013 (2300 to 0700)	-	-	-	73	58	108
Wednesday 14th August 2013 (0700 to 1210)	75	63	103	-	-	-

Table 5: Measured Noise Levels at Position 1

Measurement Position	Position 5					
	Daytime			Night-Time		
	$L_{Aeq,16hr}$	$L_{A90,T}$	$L_{Amax,T}$	$L_{Aeq,8hr}$	$L_{A90,5min}$	$L_{Amax,T}$
Measurement Period	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
Monday 19th August 2013 (1215 to 2300)	60	51	92	-	-	-
19th/20th August 2013 (2300 to 0700)	-	-	-	56	43	89
Tuesday 20th August 2013 (0700 to 1400)	65	54	90	-	-	-

Table 6: Measured Noise Levels at Position 5

As shown in Table 6 above, background noise levels measured by the unattended noise logger at position five indicate that the lowest levels could drop to approximately $L_{A90,1hr}$ 51 dB during the daytime and $L_{A90,5min}$ 43 dB during the night-time.

The results of the unattended measurements at position one have also been calculated into three separate periods, 0700 to 1900 (daytime), 1900 to 2300 (evening) and 2300 to 0700 (night-time) in accordance with Camden Council's Development Policy 28. The minimum background ($L_{A90,T}$) and ambient ($L_{Aeq,T}$) noise levels from these periods are detailed in Table 7 and Table 8 below. It should be noted that the minimum daytime background noise level ($L_{A90,1hr}$) shown below is the lowest arithmetic average of the measured background noise levels ($L_{A90,5min}$) in an hourly period.

Measurement Position / Measurement Period	Position 1					
	Daytime		Evening		Night-Time	
	$L_{Aeq,12hr}$ dB(A)	$L_{A90,T}$ dB(A)	$L_{Aeq,4hr}$ dB(A)	$L_{A90,T}$ dB(A)	$L_{Aeq,8hr}$ dB(A)	$L_{A90,5min}$ dB(A)
Wednesday 7th August 2013 (1245 to 2300)	75	68	75	67	-	-
7th/8th August 2013 (2300 to 0700)	-	-	-	-	73	58
Thursday 8th August 2013 (0700 to 2300)	77	68	74	67	-	-
8th/9th August 2013 (2300 to 0700)	-	-	-	-	73	59
Friday 9th August 2013 (0700 to 2300)	77	67	74	67	-	-
9th/10th August 2013 (2300 to 0700)	-	-	-	-	74	60
Saturday 10th August 2013 (0700 to 2300)	75	66	75	65	-	-
10th/11th August 2013 (2300 to 0700)	-	-	-	-	74	59
Sunday 11th August 2013 (0700 to 2300)	74	64	74	65	-	-
11th/12th August 2013 (2300 to 0700)	-	-	-	-	72	53
Monday 12th August 2013 (0700 to 2300)	76	67	74	66	-	-
12th/13th August 2013 (2300 to 0700)	-	-	-	-	72	55
Tuesday 13th August 2013 (0700 to 2300)	76	66	76	66	-	-
13th/14th August 2013 (2300 to 0700)	-	-	-	-	73	58
Wednesday 14th August 2013 (0700 to 1210)	75	63	-	-	-	-

Table 7: Measured Noise Levels at Position 1

Measurement Position / Measurement Period	Position 1					
	Daytime		Evening		Night-Time	
	$L_{Aeq,12hr}$ dB(A)	$L_{A90,T}$ dB(A)	$L_{Aeq,4hr}$ dB(A)	$L_{A90,T}$ dB(A)	$L_{Aeq,8hr}$ dB(A)	$L_{A90,5min}$ dB(A)
Monday 19th August 2013 (1215 to 2300)	60	54	57	51	-	-
19th/20th August 2013 (2300 to 0700)	-	-	-	-	56	43
Tuesday 20th August 2013 (0700 to 1400)	65	54	-	-	-	-

Table 8: Measured Noise Levels at Position 5

Full details of the hand-held octave band measurements at positions two, three and four during the daytime are shown in Table 17, Table 18 and Table 19 within Appendix C attached.

5.0 Noise Sensitive Areas

A noise sensitive area is defined as landscapes or buildings where the occupiers are likely to be sensitive to noise created by new plant installed in the proposed residential units, including residential areas. The nearest noise sensitive area is therefore identified as the proposed development itself and existing residential dwellings within Howard House on Cleveland Street (approximately 14m to the west) and on Warren Street (approximately 20m to the south), as indicated in Figure 4 attached.

6.0 Noise Emissions of Fixed Plant

Noise levels due to building services serving the proposed residential units are advised to meet the following noise level criteria shown below in Table 9 one metre from the nearest noise sensitive area as defined within Section 0 above. These are based on the background noise levels measured at position five, which are deemed representative of the nearest noise sensitive receptor.

Period	Lowest Prevailing Background Noise Level $L_{A90,T}$ dB	Noise Emission Limit Calculation $L_{Ar,Tr}$ dB
Daytime (0700 to 1900)	54	49
Evening (1900 to 2300)	51	46
Night-Time (2300 to 0700)	43	38

Table 9: Building Services Noise Emission Limits

It should be noted that these are the combined operational noise levels of proposed fixed plant at the nearest noise sensitive façade. As such, the combined operational noise levels of all plant are required to achieve the noise limits defined within Table 9.

For plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 9 above need to be reduced by 5 dB(A). Therefore, a worst case design basis would be to achieve the values of Table 9 minus 5 dB(A).

Additionally, noise levels outside an office building should be acceptable at higher levels than those proposed outside noise sensitive residential façades. Based on the level of noise that should be acceptable inside an office building from external noise sources, the proposed plant could produce a noise level of 45 dB L_{Aeq} at one metre from an office façade with opening windows. This is determined on the basis that the internal noise level would not exceed 35 dB L_{Aeq} when a window is partially opened. Similarly for an office building with a sealed façade, the proposed plant could produce a noise level of 60 dB L_{Aeq} at one metre, assuming that a sealed façade will provide a minimum noise reduction of 25 dB(A).

7.0 Building Envelope and Ventilation Strategy

The sound insulation properties of the building envelope depend upon the external noise levels present at the façade and the proposed design criteria for the internal noise levels of specific rooms, dependant on their use. Table 10 below assumes compliance with the Local Authority's internal noise criterion and shows the level differences for varying spaces within the proposed development. The examples shown represent the highest specification of sound insulation required for each façade as identified in Figure 5, based on the "free-field" corrected unattended measurements (see Appendix D).

Façade	Room Use	Noise Levels (dB)			
		Measured External $L_{Aeq,T}$	Proposed Internal (Maximum) $L_{Aeq,T}$	Minimum Level Difference D	Notional Selection Sound Insulation Value (Minimum) R_w
Euston Road	Commercial	72	40	32	40
	Living Room	72	35	37	45
	Bedroom	70	30	40	48
Cleveland Street#	Living Room	67	35	32	40
	Bedroom	65	30	35	43

Table 10: Notional Sound Insulation Values of Proposed Façade Construction

Note #: A typical -5 dB level difference was measured between the handheld measurements at position three and the unattended measurements at position one. As such, a notional 5 dB decrease has been applied to derive the daytime ($L_{Aeq,16hr}$) and night-time ($L_{Aeq,8hr}$) noise levels on Cleveland Street. Full details demonstrating the derivation of the noise levels are provided in Appendix D attached.

Audio recordings, triggered by instantaneous noise levels rising above 90 dB during the night-time at position one; indicate that the highest maximum noise levels were due to extraneous events (identified as sirens). Infrequent and unpredictable sources such as sirens or car alarms are generally not included within the Local Authority's noise intrusion level criterion. As such, all maximum instantaneous noise levels obtained due to a siren have been removed from the analysis.

Table 11 below shows the range of maximum instantaneous noise levels ($L_{Amax,T}$) measured during the night-time at position one, with all siren events removed. This table also displays the calculated ninetieth percentile maximum instantaneous noise levels during these periods.

Measurement Position / Measurement Period	Position 1	
	$L_{Amax,T}$ Range dB(A)	**90th Percentile** dB(A)
7th/8th August 2013 (2300 to 0700)	76 - 98	84
8th/9th August 2013 (2300 to 0700)	77 - 90	85
9th/10th August 2013 (2300 to 0700)	78 - 94	84
10th/11th August 2013 (2300 to 0700)	77 - 91	85
11th/12th August 2013 (2300 to 0700)	76 - 93	83
12th/13th August 2013 (2300 to 0700)	77 - 87	83
13th/14th August 2013 (2300 to 0700)	76 - 91	85

Table 11: Measured Maximum Instantaneous Noise Levels ($L_{Amax,T}$) without Sirens

Table 12 below assumes compliance with the Local Authority's noise intrusion level criterion (L_{Amax}) and shows the level differences for all bedrooms within the proposed development based on the maximum calculated ninetieth percentile L_{Amax} as displayed in Table 11 above.

It should be noted that applying the corrections detailed in Appendix D corresponds to an 82 dB typical measured external instantaneous noise level on Euston Road. In addition, the maximum instantaneous noise level on Cleveland Street is based on the worst case maximum noise level measured during the daytime.

It should also be noted that the highest sound insulation value (R_w) shown in Table 10 and Table 12 for a bedroom takes precedence.

Façade	Room Use	Noise Levels (dB)			
		Measured External $L_{Amax,T}$	Proposed Internal (Maximum) $L_{Amax,T}$	Minimum Level Difference D	Notional Selection Sound Insulation Value (Minimum) R_w
Euston Road	Bedroom	82	45	37	45
Cleveland Street	Bedroom	75	45	30	38

Table 12: Notional Sound Insulation Values of Proposed Façade Construction

Simple natural ventilation through the use of opening windows will provide a level difference (D) in the order of 10 dB. It can be seen from Table 10 and Table 12 above that all internal spaces require considerably greater levels of sound insulation based on the measured external noise levels. As such, it is clear that natural ventilation via open windows is not permissible and provision for full mechanical ventilation will need to be made such that windows can remain in a closed position.

Passive acoustically attenuated ventilation can generally be designed to provide a level difference (D) in the order of 20 dB to 25 dB. It can be seen that all internal spaces require greater levels of sound insulation.

All spaces are therefore advised to be considered for mechanical ventilation as the level differences required are greater than those achievable by simple means of natural ventilation.

Detailed calculations have been undertaken to determine the sound insulation requirements of the building envelope across all floors to achieve the Local Authority's internal noise criteria based on the proposed layouts and elevations.

The calculations indicate that the external wall on all façades should be capable of achieving a sound reduction of 50 dB R_w. An example of an external wall capable of achieving this requirement is a 200mm light blockwork wall.

Table 13 below details the minimum required R_w for glazed elements as a whole unit (seals, frames etc.) on all facades and provides examples of primary glazing configurations capable of achieving the minimum required R_w and gives the sound insulation values per octave band frequency.

Room Use	Façade	Glazing Construction Configuration	Sound Insulation Values per Octave Band Frequency (Hz) dB						R_w
			125	250	500	1000	2000	4000	
Living Room	All	10mm / 16mm / 8.4mm	26	34	43	49	52	59	45
Bedrooms	Cleveland Street	12mm / 16mm / 8.4mm	27	36	44	47	54	62	46
	Euston Road	8.4mm / 24mm / 14.4mm	31	40	50	53	56	64	51

Table 13: Typical Glazing Constructions

Note [#]: Pilkington Optiphon Glass

Calculations have also been undertaken to determine the sound insulation requirements of the glazing to the winter gardens and ground floor commercial unit. The calculations indicate that glazed elements to the winter gardens are required to achieve a minimum of 48 dB R_w as a whole unit (seals, frames etc.) and 45 dB R_w to the ground floor commercial unit.

The above guidance has been based on the scheme being fully mechanically ventilation and is sufficient to satisfy the requirements of the London Borough of Camden's general noise policy.

8.0 Building Services

The current proposal is understood to enclose all cooling and boiler plant within several basement level plant rooms with local ventilation units provided on each floor for the supplying and extracting of air from bathrooms, WCs and utility rooms. In addition, a single dry air cooler is located in an open top plant room at fifth floor level. The dry air cooler is enclosed to the north by the stair core wall, with a height relative to fifth floor level of four metres. Figure 6 attached displays an indicative layout of the dry air cooler located at fifth floor roof level.

An assessment of the noise emissions from the dry air cooler has been undertaken to ensure compliance with the building noise emission limits with a tonal correction provided in Section 6.0 above. The manufacturers' acoustic data has been used and is provided in Appendix E.

The resultant sound pressure level one metre from the fifth floor terrace has been calculated using the principles of ISO 9613-2 [5]. It should be noted that the effects of acoustic screening, ground absorption and air absorption have been applied where appropriate. The resultant sound pressure level at the nearest noise sensitive receptors is shown in Table 14. The calculation procedure is detailed in Appendix F and full details of the calculations are provided in Appendix G and H.

Nearest Noise Sensitive Receptor	Resultant Sound Pressure Level $L_{Aeq,T}$ dB
Fifth Floor Terrace	50
Sixth Floor Bedroom	35

Table 14: Resultant Sound Pressure Level

Table 14 indicates that the four metre wall provides sufficient acoustic screening to control noise emissions from the dry air cooler to achieve the daytime and evening noise emission limits with a tonal correction, one metre from the sixth floor bedroom window. However, the noise emissions exceed the noise emission limits with a tonal correction at the fifth floor terrace area. As such, noise control measures are required to provide adequate attenuation.

In order to provide sufficient attenuation of the dry air cooler to the fifth floor terrace area, one of the following mitigation measures is required:

- A solid acoustic screen at least one metre higher than the height of the dry air cooler (approximately 2.5m high) between the dry air cooler and fifth floor terrace area, see Figure 7 attached. In addition, the acoustic screen and four metre wall should have an absorptive lining to achieve NRC 0.65 on all internal faces; or

- An acoustic louvre (minimum depth 270 mm) with minimum sound reduction index as stated in Table 15 below, at least one metre higher than the height of the dry air cooler (approximately 2.5m high) between the dry air cooler and fifth floor terrace area, see Figure 7 attached. A suitable acoustic louvre is the KA 300 manufactured by Kingfisher (data provided in Appendix I).

Product Description	Sound Reduction Index per Octave Band Frequency in Hz dB							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Acoustic Louvre – KA 150	2	3	4	8	13	11	9	8

Table 15: Minimum Required Sound Reduction Index of Acoustic Louvre

The level of sound reduction provided by the acoustic screen or acoustic louvre is sufficient in providing noise levels in compliance with the noise emission limits during the daytime and evening, as displayed in Table 16 below. Full details of the calculations are provided in Appendix J and K.

Nearest Noise Sensitive Receptor	Resultant Sound Pressure Level $L_{Aeq,T}$ dB
Fifth Floor Terrace – Acoustic Screen	38
Fifth Floor Terrace – Acoustic Louvre	36

Table 16: Resultant Sound Pressure Level with Acoustic Louvre

The use of inverter drives will be made to limit the load of all items of plant during the night-time but also to reduce the load on all items of plant as the demand decreases. During the night-time the inverter drives will limit the dry air cooler to 75% of the daytime load. This is sufficient to provide noise emissions during the night-time in compliance with the noise emission limits with a tonal correction for both mitigation options. This is therefore sufficient to satisfy the requirements of the London Borough of Camden.

It should be noted that the assessment provided within this Section is considered worst case as it assumes the plant is operating at maximum duty and there is a degree of comfort when comparing the prediction against the proposed noise limits.

Noise emissions from the dry air cooler at other noise sensitive receptors, including residential dwellings on Cleveland Street and Warren Street, will be significantly lower than those provided in this assessment, as these receptors are located at increased distances and do not have a direct line of sight to the dry air cooler.

9.0 Summary and Conclusions

Hoare Lea Acoustics has conducted an environmental noise survey for the proposed redevelopment of 373-375 Euston Road within the London Borough of Camden. Unattended noise monitoring throughout a typical seven day and one day period were conducted. In addition, sample octave band measurements were also conducted.

Background noise levels typical of the daytime, evening and night-time have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptors. The nearest receptors have been identified as the proposed development itself and existing residential dwellings on Cleveland Street to the west and Warren Street to the south.

During the daytime the combined building services plant noise emission contribution limit advised is 49 dB(A), during the evening the combined building services plant noise emission contribution limit advised is 46 dB(A) and during the night-time the combined building services plant noise emission contribution limit advised is 38 dB(A), one metre from the nearest residential façade. A further minus 5 dB correction may be applicable in accordance with the tonal correction defined in BS 4142.

Additionally the total building services noise emissions shall not exceed 45 dB(A) at one metre from an office façade with opening windows and 60 dB(A) with a sealed façade. This assumes a partially opened window provides a 10 dB(A) noise reduction and a sealed façade will provide a minimum noise reduction of 25 dB(A).

An assessment of the building envelope acoustic performance is provided with a level difference (D) and notional acoustic sound reduction index (R_w). The ventilation strategy should allow for full mechanical ventilation as the level differences required are above those achievable by simple means of natural ventilation.

Detailed noise intrusion calculations have also been undertaken to determine the sound insulation performance requirements of the façades in accordance with the Local Authority's internal noise criterion.

The calculations indicate that the non-glazed element of all façades shall achieve a minimum of R_w 50 dB. The minimum required sound insulation (R_w) of all glazed elements on each façade and indicative primary glazing configurations have also been provided.

An assessment of the dry air cooler located at fifth floor level has been undertaken. The assessment indicates that sufficient acoustic screening is provided by the stair core wall (height four metres) to receivers at the sixth floor level to provide noise emissions in compliance with the daytime and evening noise emission limits with a tonal correction. However, the predicted noise level to receivers on the fifth floor terrace area exceeds the defined noise emission limit with a tonal correction by up to 6 dB(A) during the daytime. As such, noise control measures are required.

In order to provide sufficient attenuation of the dry air cooler to the fifth floor terrace area, one of the following mitigation measures is required:

- A solid acoustic screen at least one metre higher than the height of the dry air cooler (approximately 2.5m high) between the dry air cooler and fifth floor terrace area. Additionally, the acoustic screen and four metre wall should have an absorptive lining to achieve NRC 0.65 on all internal faces; or

- An acoustic louvre (minimum depth 270 mm) at least one metre higher than the height of the dry air cooler (approximately 2.5m high) between the dry air cooler and fifth floor terrace area.

The provision of one of the above mitigation measures is sufficient to provide noise emissions in compliance with the daytime and evening noise emission limits with a tonal correction.

During the night-time the use of inverter drives will limit the dry air cooler to 75% of the daytime load. This is sufficient to limit noise emissions during the night-time to levels below the noise emission limits with a tonal correction.

The guidance provided within this report is sufficient to satisfy the requirements of the London Borough of Camden, in our opinion.

10.0 References

1. *National Planning Policy Framework, Department for Communities and Local Government, March 2012.*

2. *BS 8233: 1999, 'Sound Insulation and Noise Reduction for Buildings - Code of Practice'.*

3. *World Health Organisation (WHO) - Guidelines for Community Noise, 1999.*

4. *BS 4142: 1997: 'Method for rating industrial noise affecting mixed residential and industrial areas'.*

5. *ISO 9613-2: 1996, 'Acoustics - Attenuation of Sound during Propogation Outdoors - Part 2'.*

FIGURES

Figure 1: Plan of Existing Site – Noise Survey (Indicative Only)

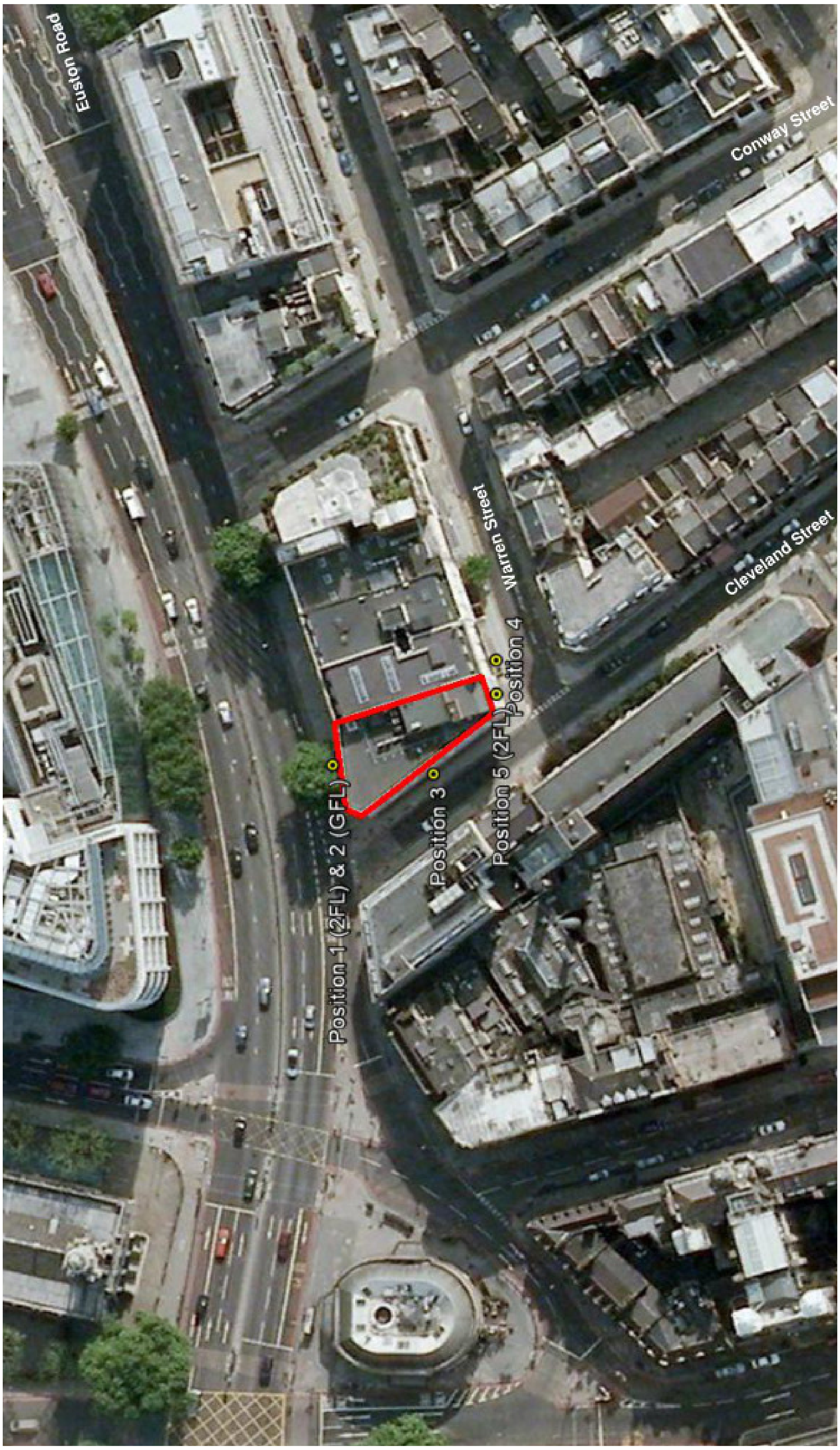


Figure 2: Time History of Unattended Measurements at Position 1

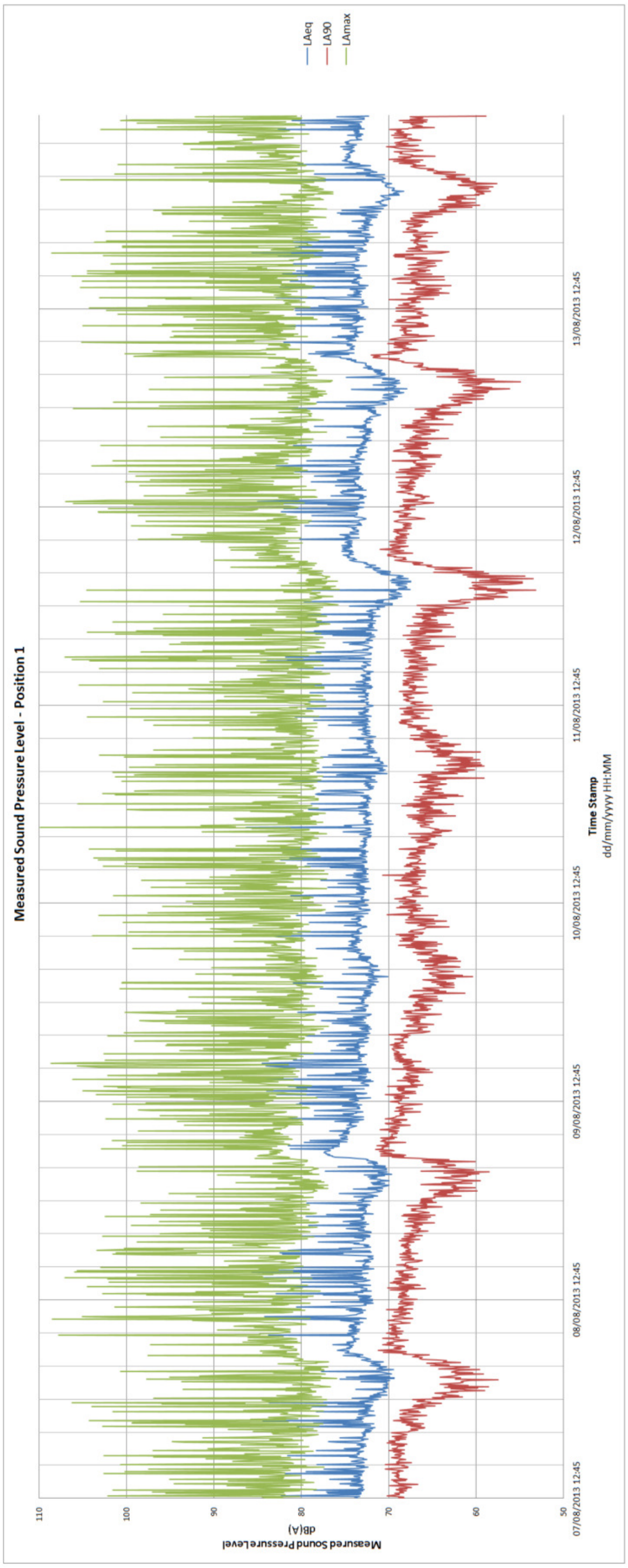


Figure 3: Time History of Unattended Measurements at Position 5

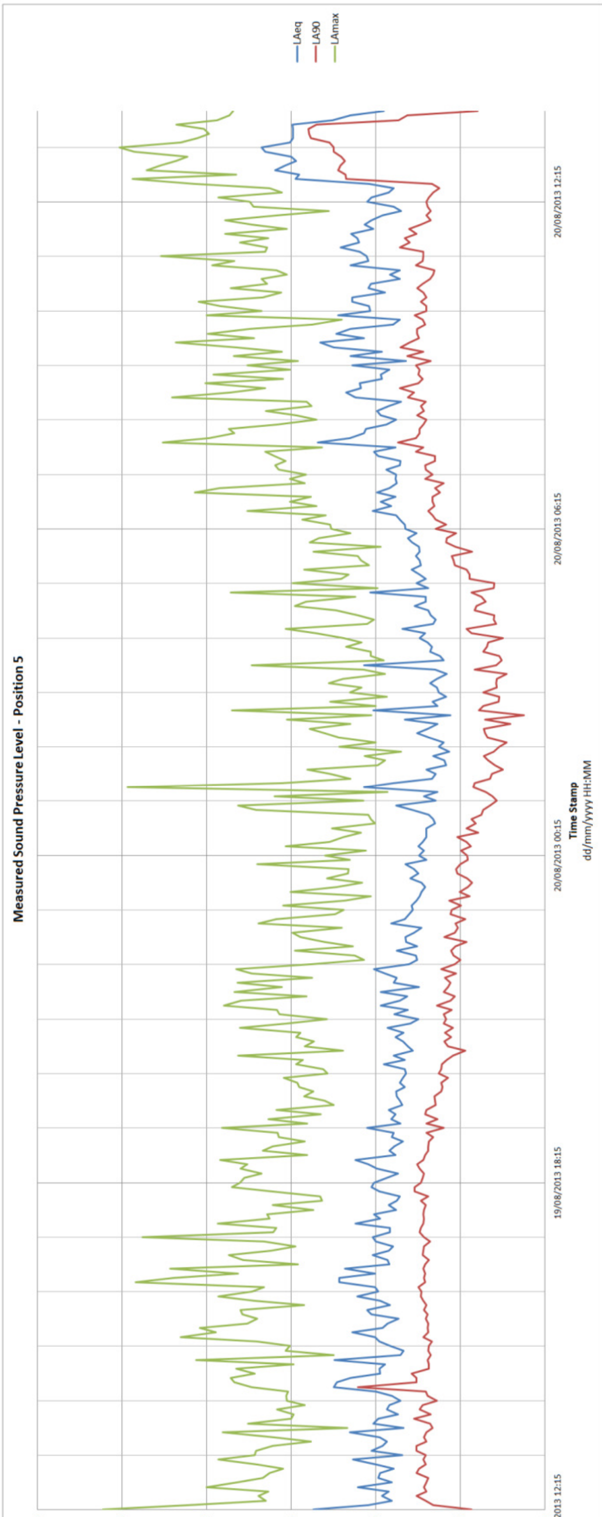


Figure 4: Nearest Noise Sensitive Receptor

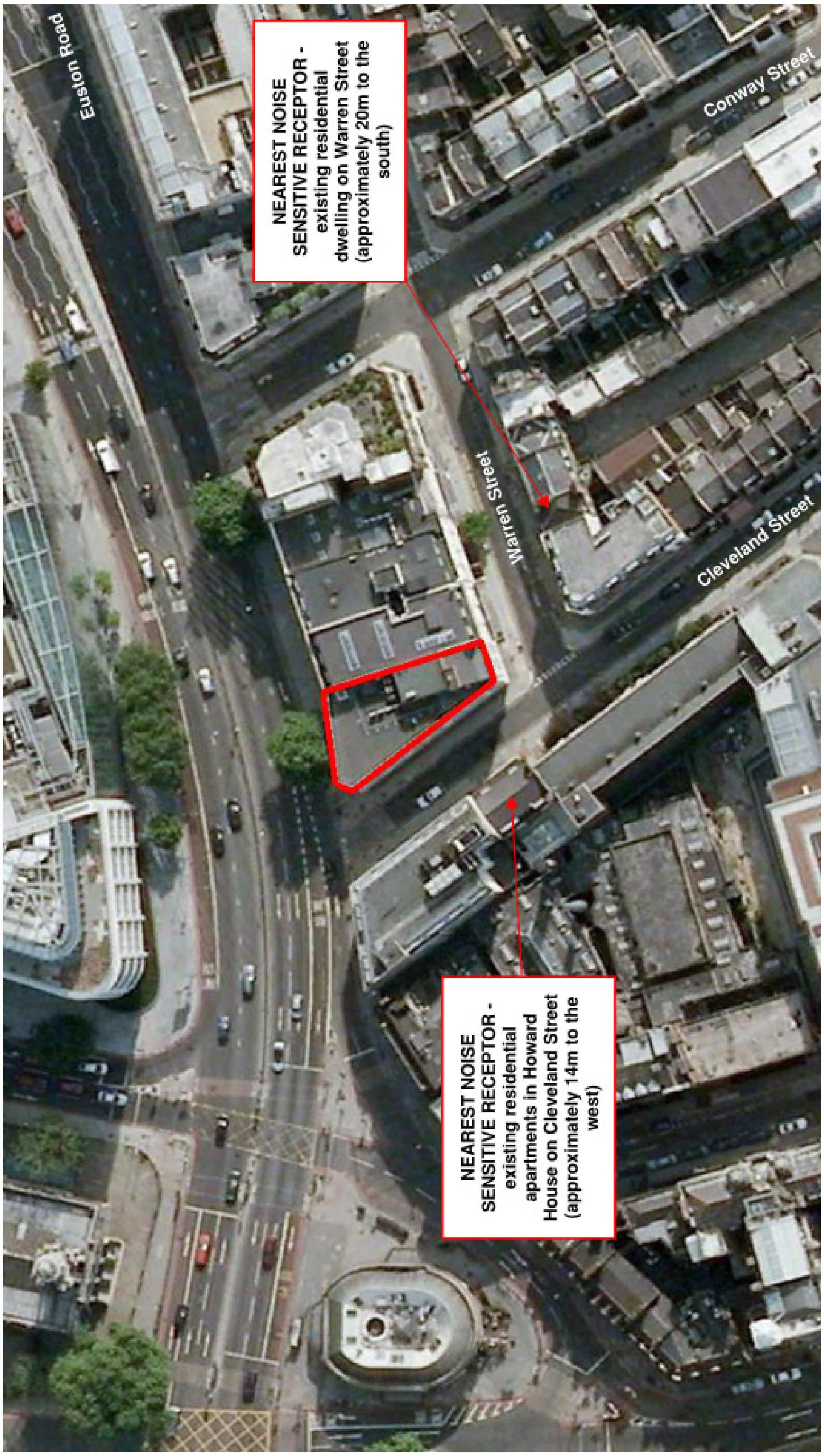


Figure 5: Façade Locations

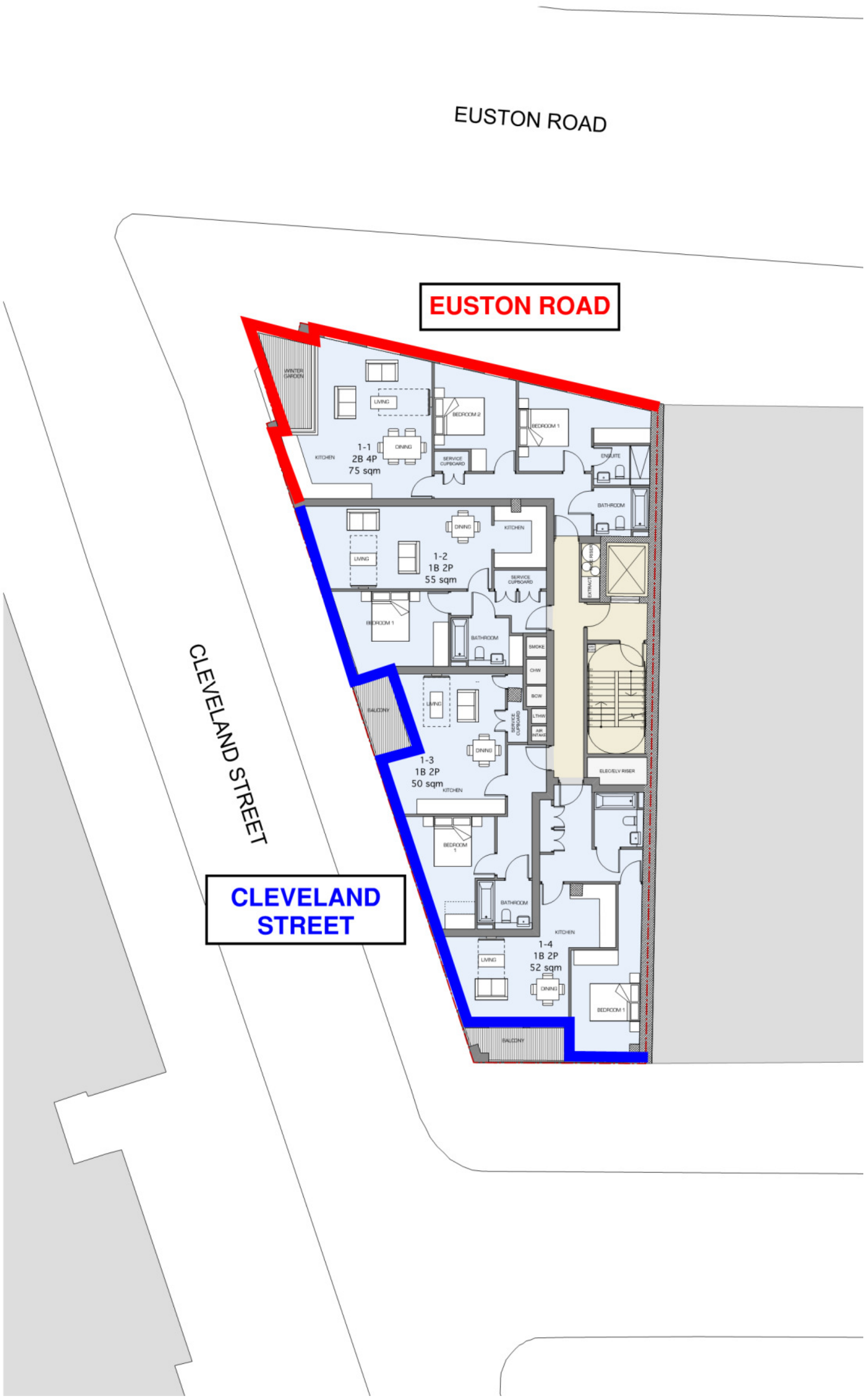
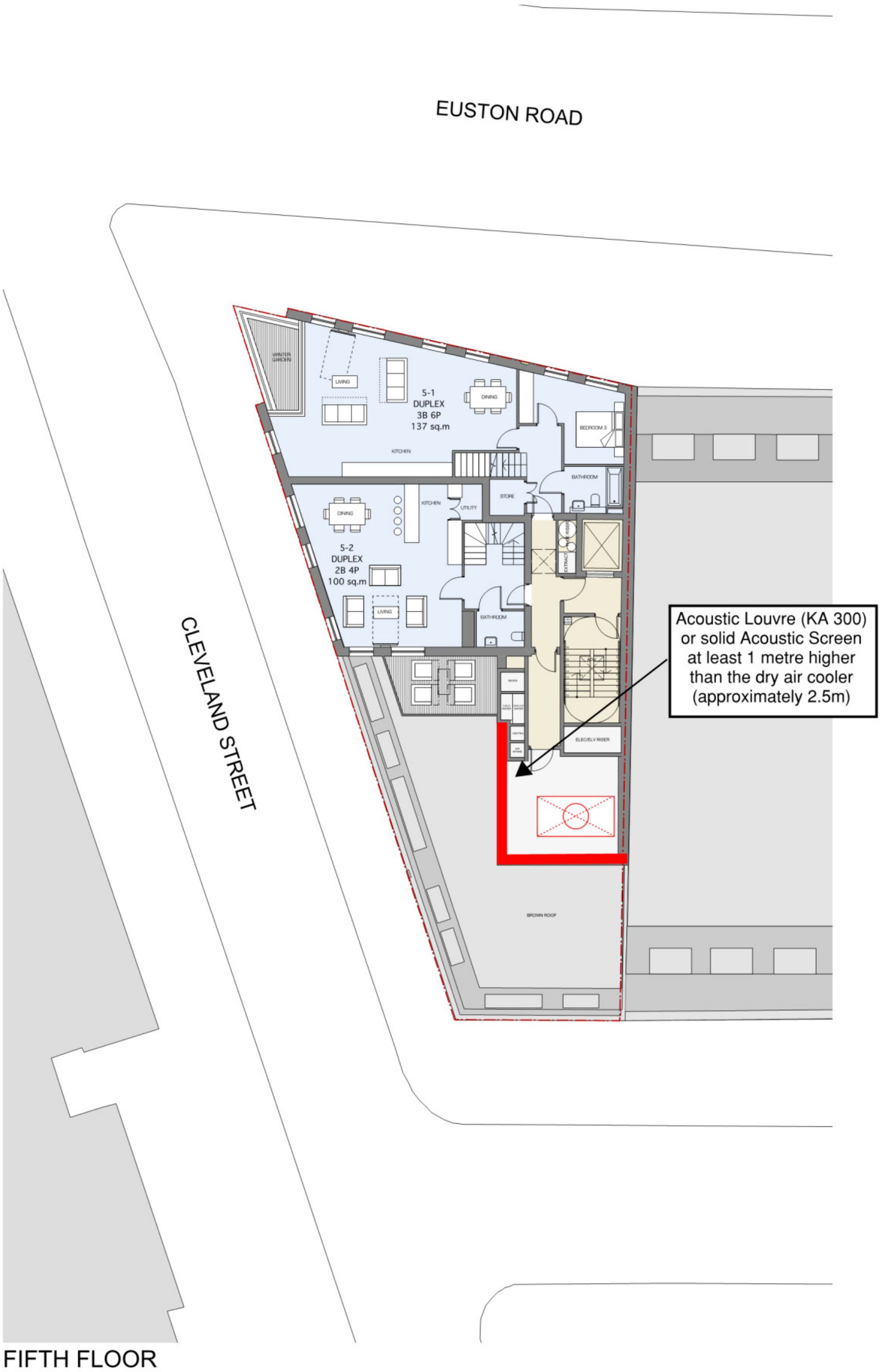


Figure 6: Indicative Plant Layout

Figure 7: Required Acoustic Screen / Louvre Location



APPENDICES

Appendix A: List of Measurement Equipment

Sound Level Meter (Position 1 - Unattended)

- Rion NL-32 Sound Level Meter (Serial Number 01161938)
- Rion NH-21 Pre-Amplifier (Serial Number 21973)
- Brüel and Kjær 4231 Sound Calibrator (Serial Number 34172704)
- Rion UC-53A Microphone (Serial Number 311039)

Sound Level Meter (Position 5 - Unattended)

- Svantek 949 Sound Level Meter (Serial Number 6751)
- Svantek SV12 Pre-Amplifier (Serial Number 5918)
- Brüel and Kjær 4231 Sound Calibrator (Serial Number 2094559)
- GRAS 40AE Microphone (Serial Number 49541)

Noise Spectral Analyser (Octave Band Measurements at all Positions - Attended)

- Rion NA-28 Sound Level Meter (Serial Number 01260201)
- Rion NH-23 Pre-Amplifier (Serial Number 60104)
- Rion NC-74 Sound Calibrator (Serial Number 35173534)
- Rion UC-59 Microphone (Serial Number 00281)

Sound level meters were field calibrated before and after noise survey and no discernible variations occurred.

Appendix B: Acoustic Terminology

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

The Sound Pressure

The Sound Pressure is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm^{-2} or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure - *p*. The power is proportional to the square of the sound pressure.

The Sound Pressure Level

The lowest sound pressure possible to hear is approximately $2\ 10^{-5}$ Pa (2 ten billionths of an atmosphere)
.
It therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound

$L_p = 10 \log(p^2 / p_{ref}^2) = 10 \log(p / p_{ref})^2 = 20 \log (p / p_{ref})$ (1)
Where;
L_p = *sound pressure level (dB)*
p = *sound pressure (Pa)*
$p_{ref} = 2\ 10^{-5}$ *- reference sound pressure (Pa)*

Doubling the sound pressure level is an increase of 6 dB.

Sound Pressure Level of some Common Sources

Source	Sound Pressure Level *dB*
Threshold of hearing	0
Rustling leaves	20
Quiet whisper	30
Home	40
Quiet street	50
Conversation	60
Inside a car	70
Loud singing	80
Motorcycle (10 m)	90
Lawn mower (1m)	100
Diesel truck (1m)	110
Amplified music (1m)	120
Jet plane (1m)	130

Frequency

The frequency - cycles per second - of a sound is expressed in hertz - Hz.

Wavelength

The wavelength of sound is the distance between analogous points of two successive waves.

Octave and Third Octave Bands

An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

A musical octave is eight full tones, and 12 semi tones above or below another tone, with twice or half as many vibrations per second as the other tone. Where a semi tone is $2^{\wedge(1/12)}$ times the frequency of the semi tone below.

A-Weighting

The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB(A), or including A in the parameter term.

$L_{eq,T}$

The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. The $L_{eq,T}$ can be seen to be an "average" sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an 'A' weighted noise level in dB(A). It is commonly used to describe all types of environmental noise sources.

$L_{10,T}$

The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe road traffic noise.

$L_{90,T}$

The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe the prevailing background noise level or underlying noise level.

$L_{max,\,T}$

The $L_{max,\,T}$ is maximum noise level measured during the specified period 'T'.

Free Field

A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade

A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

Fast /Slow Time Weighting

Sound level meters can take averages using fast or slow response times.

D_{nT}

The difference in sound level between a pair of rooms, in a stated frequency band, corrected for the reverberation time. See BS EN ISO 140-4:1998.

$D_{nT,w}$

A single-number quantity which characterizes the airborne sound insulation between rooms. See BS EN ISO 717-1:1997

$D_{nT,w} + C_{tr}$

A single-number quantity which characterizes the airborne sound insulation between rooms using noise spectrum no. 2 as defined in BS EN ISO 717-1:1997. See BS EN ISO 717-1:199

C_{tr}

The correction to a sound insulation quantity (such as $D_{nT,w}$) to take account of a specific sound spectra

R_w

A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1:1997.

Sound reduction index (R_i)

A quantity, measured in a laboratory, which characterizes the sound insulating properties of a material or building element in a stated frequency band. See BS EN ISO 140-3:1995.

Specific Noise Level, $L_{Aeq,Tr}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Rating Level, $L_{Ar,Tr}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval that includes adjustments to account for characteristic features of the noise source.

Appendix C: Octave Band Levels at Measurement Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB										$L_{Aeq,T}$
			16Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
2	07/08/2013 12:50	05:00	72.9	81.2	82.7	76.1	74.7	69.8	68.9	65.9	59.6	52.5	73.7
	07/08/2013 12:55	05:00	73.1	79.1	81.5	76.0	73.2	70.0	69.5	65.7	58.8	50.8	73.7
	07/08/2013 13:00	05:00	72.8	80.0	80.6	75.2	72.8	69.3	68.8	65.1	57.9	49.8	73.0
	14/08/2013 11:50	05:00	72.8	81.0	78.4	77.8	72.2	69.6	68.9	65.2	58.9	52.8	73.3
	14/08/2013 11:55	05:00	73.8	79.0	77.8	77.2	72.0	70.2	69.3	65.8	59.5	53.9	73.6
3	07/08/2013 13:10	05:00	69.3	73.0	77.7	73.1	66.4	65.5	61.9	57.8	51.1	41.4	67.2
	07/08/2013 13:15	05:00	68.0	74.6	77.4	71.6	65.4	64.8	62.1	57.6	50.7	40.8	66.9
	07/08/2013 13:20	05:00	69.9	76.0	78.8	72.9	66.6	65.1	63.9	61.8	52.6	42.2	68.7
	14/08/2013 11:40	05:00	68.0	73.6	76.3	69.0	61.9	59.4	57.1	53.2	46.2	37.4	62.2
	14/08/2013 11:45	05:00	68.0	73.5	76.6	70.8	64.8	62.9	59.3	54.9	49.3	42.7	64.8
4	07/08/2013 13:35	05:00	62.8	69.8	72.4	64.1	58.6	58.1	53.7	50.0	46.2	39.2	59.6
	07/08/2013 13:40	05:00	64.3	72.5	72.7	63.4	58.1	57.3	54.0	49.7	44.0	37.5	59.3
	14/08/2013 11:20	05:00	63.8	68.8	70.9	64.6	56.5	56.3	53.8	50.4	44.8	37.7	58.9
	14/08/2013 11:25	05:00	62.7	71.5	71.3	63.5	57.3	56.6	53.6	50.0	43.4	35.5	58.8
	14/08/2013 11:30	05:00	65.4	76.3	75.1	68.4	63.4	63.1	61.2	57.4	51.0	44.4	65.6

Table 17: Ambient Levels Measured at all Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB										$L_{A90,T}$
			16Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
2	07/08/2013 12:50	05:00	66.7	73.5	74.6	70.0	67.5	64.5	63.7	60.1	53.0	42.8	68.4
	07/08/2013 12:55	05:00	65.8	73.5	74.4	69.2	66.6	64.2	63.1	59.4	52.1	42.3	67.8
	07/08/2013 13:00	05:00	65.8	74.5	74.1	69.5	66.9	64.6	64.1	60.3	52.6	42.2	68.6
	14/08/2013 11:50	05:00	65.9	74.9	71.8	67.9	66.0	62.2	60.4	57.7	51.0	43.2	65.9
	14/08/2013 11:55	05:00	66.9	73.8	71.3	68.8	66.8	63.0	61.0	58.2	51.8	42.8	66.2
3	07/08/2013 13:10	05:00	63.4	69.4	72.0	67.4	61.2	60.2	56.3	52.7	45.2	34.4	62.5
	07/08/2013 13:15	05:00	62.7	68.2	71.3	66.0	60.7	60.4	56.4	52.2	44.8	33.1	62.2
	07/08/2013 13:20	05:00	63.0	70.0	72.2	67.1	61.9	61.3	57.6	53.2	45.3	34.4	63.6
	14/08/2013 11:40	05:00	62.4	69.8	71.0	63.2	57.0	54.1	51.4	48.0	40.9	32.0	57.4
	14/08/2013 11:45	05:00	62.1	68.9	69.6	62.4	56.6	53.9	51.9	47.6	40.5	31.4	57.3
4	07/08/2013 13:35	05:00	57.7	65.9	67.5	60.0	54.4	53.8	49.6	44.7	36.3	25.9	55.8
	07/08/2013 13:40	05:00	57.3	64.2	67.6	59.4	54.0	53.2	49.8	44.7	36.3	26.5	55.5
	14/08/2013 11:20	05:00	56.9	64.4	66.8	60.0	53.3	52.7	49.5	45.8	38.4	27.9	55.5
	14/08/2013 11:25	05:00	57.3	65.8	66.2	60.4	53.8	52.5	48.8	44.1	36.2	25.1	54.8
	14/08/2013 11:30	05:00	58.2	65.7	66.9	60.5	54.0	53.8	51.0	46.2	39.7	29.9	56.6

Table 18: Background Levels Measured at all Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB										$L_{Amax,T}$
			16Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
2	07/08/2013 12:50	05:00	73.1	88.7	93.9	82.7	78.4	73.0	72.6	71.3	64.4	56.3	77.9
	07/08/2013 12:55	05:00	71.8	76.2	95.0	86.4	82.9	78.9	74.9	69.9	63.0	56.1	80.8
	07/08/2013 13:00	05:00	73.8	94.0	79.4	73.2	74.7	69.2	66.9	64.6	58.9	51.4	72.5
	14/08/2013 11:50	05:00	69.9	93.9	79.7	73.1	71.0	66.8	64.7	62.3	58.0	49.6	70.3
	14/08/2013 11:55	05:00	69.1	77.4	88.5	96.1	78.9	71.8	71.3	67.3	62.8	54.7	79.8
3	07/08/2013 13:10	05:00	71.5	73.9	90.3	77.2	74.4	74.0	69.8	66.2	60.5	51.0	75.3
	07/08/2013 13:15	05:00	71.9	78.6	92.1	77.1	70.8	69.3	63.6	60.4	54.5	46.0	71.5
	07/08/2013 13:20	05:00	85.3	78.2	80.0	70.6	69.5	64.4	64.3	58.2	49.5	39.9	68.0
	14/08/2013 11:40	05:00	83.6	74.9	81.9	69.6	64.2	58.9	57.6	53.5	49.5	43.3	63.1
	14/08/2013 11:45	05:00	67.1	84.8	94.3	82.2	71.6	69.3	66.9	62.9	59.0	57.3	73.2
4	07/08/2013 13:35	05:00	68.9	78.4	77.2	67.0	63.8	62.4	58.7	54.8	51.7	42.5	64.1
	07/08/2013 13:40	05:00	76.5	75.7	73.6	73.4	61.6	64.9	59.4	49.9	47.2	44.4	65.1
	14/08/2013 11:20	05:00	74.0	69.2	75.0	62.4	57.1	57.4	55.3	54.0	44.8	37.3	60.6
	14/08/2013 11:25	05:00	66.1	78.1	86.3	71.5	61.5	66.3	62.0	61.0	55.6	50.9	68.2
	14/08/2013 11:30	05:00	71.4	100.8	95.8	76.7	72.2	71.4	67.5	67.2	61.7	58.6	75.0

Table 19: Maximum Levels Measured at all Positions

Appendix D: Façade Noise Level Calculation Procedure

The calculation stages for each façade noise level are as follows:

- Apply a -3 dB "free-field" correction to the unattended façade measurements at position one.

  Daytime:

$$L_{Aeq,16hr(free-field)} = L_{Aeq,16hr(measured)} - 3$$

  Night-Time:

$$L_{Aeq,8hr(free-field)} = L_{Aeq,8hr(measured)} - 3$$
$$L_{Amax,T(free-field)} = L_{Amax,T(measured)} - 3$$

- Apply a -5 dB correction to the unattended façade measurements at position one to determine the resultant noise levels on the Cleveland Street façade:

  Daytime:

$$L_{Aeq,16hr(Cockspur\ Street)} = L_{Aeq,16hr(free-field)} - 5$$

  Night-Time:

$$L_{Aeq,8hr(ockspur\ Street)} = L_{Aeq,8hr(free-field)} - 5$$

Appendix E: Manufacturers Information – Dry Air Cooler Günter GFH 080.3D

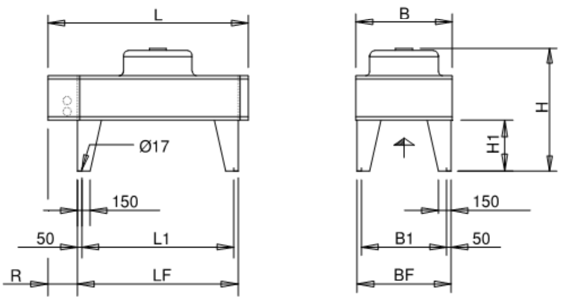
Date:	2014-01-15
Enquiry dated:	
Project:	
Quotation-no.:	
Item:	
Reference:	

Drycooler **GFH 080.3D/1-N(S)-F6/12P**

Capacity:	43.0 kW	**Medium:**	Ethylene glycol 30 Vol. %(1)
Surface reserve:	0.0 %	Inlet:	45.0 °C
Air flow:	17200 m³/h	Outlet:	40.0 °C
Air inlet:	35.0 °C	Pressure drop:	0.70 bar
Altitude:	0 m	Volume flow:	7.89 m³/h
Fans:	1 Piece(s) 3~400V 50-60Hz	Noise pressure level:	46 dB(A)(2)
Data per motor (nominal data):		at a distance of:	5.0 m
Speed:	770 min-1	Noise power level:	73 dB(A)
Capacity (mech./el.):	0.72 kW/0.88 kW	ErP:	Compliant(3)
Current:	1.40 A(4)		
Total el. power consumption:	0.88 kW	Energy efficiency class:	B
Casing:	Galv. Steel, RAL 7035	Tubes:	Copper(5)
Surface:	404.2 m²	Fins:	Aluminum(5)
Tube volume:	52.5 l	Connections per unit:	
Fin spacing:	2.40 mm	Inlet:	42.0 * 1.60 mm
Dry weight:	408 kg(6)	Outlet:	42.0 * 1.60 mm
Max. operating pressure:	16.0 bar	PED classification:	Art. 3, par. 3(7)

Dimensions:

L = 2947 mm
B =1541 mm
H =1430 mm
R = 497 mm
L1= 2205 mm
LF = 2305 mm
B1 =1405 mm
BF =1505 mm
H1= 600 mm



Attention: Drawing and dimensions not valid for all accessory options!

Important remarks / explanatory notes:

(1) Fluid group 2 according to pressure equipment directive 97/23/EG and directive 67/548/EWG
(2) by using the enveloping surface method acc. to EN 13487
(3) This unit is equipped with fans that meet the efficiency requirements of Directive 2009/125/EC (ErP Directive).
(4) The current consumption can differ in dependance of the air temperature and of the variations of system voltage according to the VDE guidance.
(5) The unit may not be suitable for very corrosive atmospheres (close to shores, in smoke rooms, etc.). For further information see program menu "?","Material recommendations brochure", or ask your sales partner.
(6) Dimensions and weights are not valid for all possible options! They may differ for units with accessories or special units (S-...).
(7) Piping (DN = 38.8 mm, TSmax = 100 °C, liquid). Final classification according to pressure equipment directive 97/23/EC during order processing.

Appendix F: Noise Emissions Calculation Procedure

All Items of Plant

The calculation stages for all in duct items of plant are as follows:

1. Apply a distance correction to the manufacturers L_w for the distance to the noise sensitive receptor (r) assuming hemispherical sound propagation:
$$Distance\ Correction = 20\ \log_{10} r + 8$$

2. Determine the barrier attenuation (D) provided by the plant room walls the method defined within ISO 9613-2.

3. Derive L_p at receiver location based on the manufacturers sound power level ($L_{w(man)}$) using following equation:
$$L_{p(receiver)} = L_{w(man)} - Distance\ Correction - D$$

Inverter Drives (if utilised)

1. Derive reduction from use of Inverter Drives
$$Inverter\ Drives = 50\ \log_{10} \frac{\%\ Reduction}{100}$$

2. Derive L_p at receiver location using following equation:

$$L_{p(receiver)} = L_w - Distance\ Correction - D + Inverter\ Drives$$

Appendix G: Resultant Sound Pressure Level at Fifth Floor Terrace Area

Dry Air Cooler

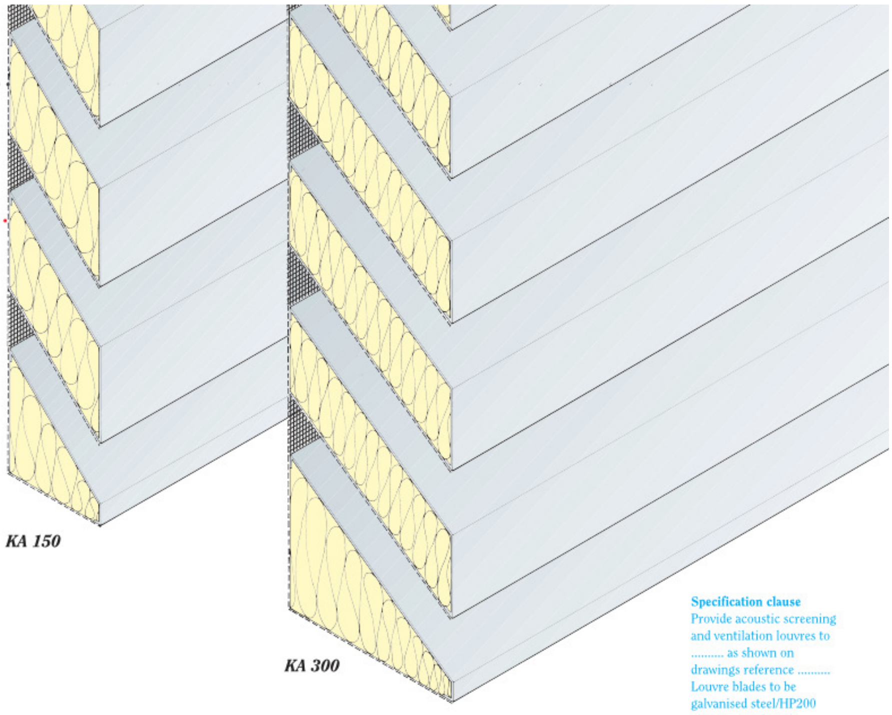
	Noise Level per Octave Band Frequency dB							dB(A)
	125	250	500	1000	2000	4000	8000	
A-Weighted L_w	50	59	64	69	67	62	55	73
L_w	66	68	67	69	66	61	56	73
Distance Correction (5.5m)	-23	-23	-23	-23	-23	-23	-23	-
$L_{p(receiver)}$	43	45	44	46	43	38	33	50

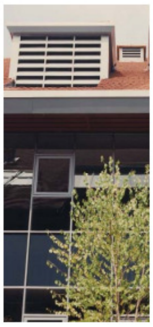
Appendix H: Resultant Sound Pressure Level at Sixth Floor Level (1m from Bedroom Window)

Dry Air Cooler

	Noise Level per Octave Band Frequency dB							dB(A)
	125	250	500	1000	2000	4000	8000	
A-Weighted L_w	50	59	64	69	67	62	55	73
L_w	66	68	67	69	66	61	56	73
Distance Correction (7.1m)	-25	-25	-25	-25	-25	-25	-25	-
Barrier Attenuation (Height 4m)	-7	-8	-10	-13	-15	-18	-20	-
$L_{p(receiver)}$	34	35	32	31	26	18	11	35

Appendix I: Manufacturers Information – Kingfisher Louvres



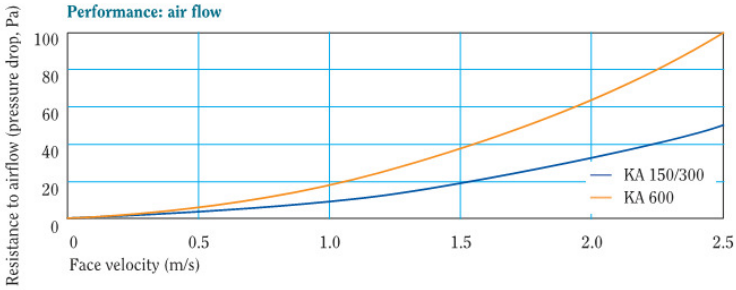


Performance: acoustic

Airborne sound insulation independently measured by Sound Research Laboratories to BS 2750: Part 5.

Louvre type	Depth	Airborne sound reduction index (dB) at octave band mid frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
KA 150	150mm	2	3	4	8	13	11	9	8
KA 300	270mm	4	7	10	12	15	16	13	12
KA 600	540mm	6	8	12	21	32	33	26	24

Performance: air flow



Specification clause

Provide acoustic screening and ventilation louvres to .... as shown on drawings reference .... Louvre blades to be galvanised steel/HP200 plastic coated steel/ stainless steel*. Other applied finish to galvanised steel: polyester powder coating to BS 6496/oven-baked spray coating*. Colour: .... Acoustic medium: non-toxic mineral wool, density 45kg/m³, packed at 10% compression to eliminate voids, and held in position within louvre blades by perforated galvanised steel sheet. Louvre type: KA 150/ KA 300/KA 600*. Accessories: HDPE/ aluminium* bird guard/ insect guard*. Louvres to be supplied by Kingfisher Louvre Systems Ltd, Plymouth Avenue, Brookhill Industrial Estate, Pinxton, Nottingham NG16 6NS. Tel: 01773 814102, Fax: 01773 814103, Email: info@kingfisherlouvres.com *Delete as applicable.

Appendix J: Resultant Sound Pressure Level at Fifth Floor Terrace Area with Acoustic Screen

Dry Air Cooler

	Noise Level per Octave Band Frequency dB							dB(A)
	125	250	500	1000	2000	4000	8000	
A-Weighted L_w	50	59	64	69	67	62	55	73
L_w	66	68	67	69	66	61	56	73
Distance Correction (5.5m)	-23	-23	-23	-23	-23	-23	-23	-
Barrier Attenuation (Height 2.5m)	-6	-7	-9	-11	-14	-16	-19	-
$L_{p(receiver)}$	37	38	35	35	29	22	14	38

Appendix K: Resultant Sound Pressure Level at Fifth Floor Terrace Area with Acoustic Louvre

Dry Air Cooler

	Noise Level per Octave Band Frequency dB							dB(A)
	125	250	500	1000	2000	4000	8000	
A-Weighted L_w	50	59	64	69	67	62	55	73
L_w	66	68	67	69	66	61	56	73
Distance Correction (5.5m)	-23	-23	-23	-23	-23	-23	-23	-
Acoustic Louvre	-7	-10	-12	-15	-16	-13	-12	-
$L_{p(receiver)}$	36	35	32	31	27	25	21	36