LB Camden

LaSwap Sixth Form Centre

Noise Impact Assessment (For Planning)

Tel: +44 (0) 1202 654 600
Fax: +44 (0) 1202 654 601

Enterprise House
Old School Close
Ferndown
Bournemouth
Dorset
BH22 9UN

Audit Sheet

Revision	Description	Date	Issued by	Reviewed by
Draft	For Review	12/11/2013	TH	BD
1	For Issue	18/11/2013	TH	BD
2	Updated – For Planning	17/02/2014	TH	BD
3	Updated – Revised Proposals	17/10/2014	TH	BD

Contents

Figures

Appendices

1.0 Introduction

Hoare Lea Acoustics has been appointed by LB Camden to act as architectural acoustic design consultant in connection with the proposed LaSwap Sixth Form Centre development. The proposal comprises the development of a new sixth form centre on the existing tennis courts at Parliament Hill School within the London Borough of Camden.

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 all internal spaces are in accordance with the requirements of Building Bulletin 93 (BB 93).

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 in accordance with Building Bulletin 93 (BB 93).

2.0 Site Description

2.1 Existing Site

The proposed site is located in the grounds of the Parliament Hill School within the London Borough of Camden and is bound by Highgate Road to the north-east.

The proposal comprises the development of a new sixth form centre on the existing tennis courts to the front of the Parliament Hill School.

The surrounding buildings along Lissenden Gardens and Highgate Road are generally residential in nature; however there is an existing public house (The Bull and Last) immediately opposite the proposed site on Highgate Road. To the east is the existing Parliament Hill School, to the north is the William Ellis School and to the west is Hampstead Heath.

The proposed development site (indicative only) is identified in Figure 1 attached and the proposed ground floor plan is provided in Figure 2 attached.

2.2 Local Noise Conditions

The surrounding noise climate is formed predominantly by local road traffic noise from the immediate road network around the site, in particular Highgate Road to the east, but also from more distant roads including Gordon House Road (B518) to the south.

It should be noted that the London Overground is located approximately 350m to the south; as such the noise climate includes distant train movements. Similarly, 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 Building Bulletin 93

Building Bulletin 93 (5) (BB93) is the current Building Control requirement document for the acoustic design of schools. The document provides performance standards suitable to provide acoustic conditions in schools that facilitate clear communication of speech between teachers and students, and that do not interfere with study activities.

BB93 states that the sound insulation performance of the building envelope needs to be sufficient to reduce the external environmental noise in sensitive areas to the internal ambient noise levels in Table 1. The indoor ambient noise level includes noise contributions from external sources outside the school premises (including road, rail and air traffic) and building services.

Table 1 below provides the performance standards for teaching spaces as shown within BB93 when they are unoccupied and unfurnished.

It should be noted that BB93 provides performance standards for ancillary spaces, such as offices, staff rooms and toilets. These are intended for guidance purposes only and do not form any part of the Building Control requirements.

Type of Room		**Upper Limit for the Indoor Ambient Noise Level $L_{Aeq,30min}$** dB
General teaching areas, classrooms, seminar rooms, language laboratories		35[1]
Open-plan:		
Teaching Areas		40
Resource Areas		40
Ancillary Spaces:	*Offices, staff rooms*	*40*
	Corridors, stairwells	*45*
	Toilets	*50*

Table 1: Performance Standards for Indoor Ambient Noise Levels when Unoccupied and Unfurnished

Note [1]: For rooms having limits of 35 dB or less, the noise level should not regularly exceed 55 dB $L_{A01,30min}$.

Additionally BB93 states that:

"Noise levels in unoccupied playgrounds, playing fields and other outdoor areas should not exceed 55 dB $L_{Aeq,30min}$ and there should be at least one area suitable for outdoor teaching activities where noise levels are below 50 dB $L_{Aeq,30min}$."

Although it should be noted that this statement is provided for guidance purposes only and does not form part of any Statutory Requirements, it is none the less an aspirational target for external spaces.

3.4 Building Bulletin 101

Building Bulletin 101 (BB 101) (6) provides the regulatory framework in support of the Building Regulations for the adequate provision of ventilation in schools. BB 101 states that:

"When the Design Capability Supply Rate of 8 l/s per person is provided by natural ventilation, the design should achieve the BB 93 performance standards for the indoor ambient noise levels in Table 1.1 of BB 93 when they have been increased by 5 dB $L_{Aeq,30min}$."

As such, a 5 dB relaxation in the noise intrusion criteria is applicable for the supply rate of 8 l/s with natural ventilation.

3.5 Local Planning Policy

3.6 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.

3.6.1 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 2: 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.

3.6.2 Building Services - Noise

On the basis of Table 2 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 3 below outlines the criterion.

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

Table 3: Camden Council'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.

The survey comprised three different aspects:

- Automatic unattended noise measurements (commenced Tuesday 24th September through to Tuesday 1st October 2013);
- External attended octave band noise measurements (on Friday 20th September 2013); and
- External attended octave band noise measurements (on Tuesday 1st October 2013).

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

During the measurement periods, temperatures remained warm with some precipitation and winds varying in both direction and strength.

4.1 Unattended Noise Measurements

The unattended noise survey comprised seven days of automatic measurements by a single logger at existing roof level. The position of this noise monitor is shown as position L1 in Figure 1 attached. This measurement position was considered "free-field" at a height of approximately 1.5 metres above roof level.

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 Tuesday 24th September 2013 and Tuesday 1st October 2013.

A time history of the L_{Aeq}, L_{A90} and L_{Amax} from the unattended measurements recorded at position L1 is shown in Figure 3 attached.

Background noise levels measured at the unattended noise logger indicate that the lowest levels could drop to approximately $L_{A90,1hr}$ 43 dB during the daytime (0700 to 2300) and $L_{A90,5min}$ 31 dB during the night-time (2300 to 0700).

4.2 Attended Noise Measurements

Octave band measurements have been conducted at three positions at ground floor level. The position of these measurements at ground floor level is shown as positions S1, S2 and S5 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".

Table 4 below provides a summary of the overall results. Octave band measurements were conducted over several five and ten minute periods but given the nature of the surrounding noise climate are deemed to be representative of a thirty minute period. Full details of the hand-held octave band measurements at all positions during the daytime are shown in the tables within Appendix C attached.

Measurement Position	Maximum $L_{Aeq,30min}$ dB	Maximum $L_{A01,30min}$ dB	Minimum $L_{A90,30min}$ dB
S1	58	68	51
S2	58	66	49
S5	58	66	51

Table 4: Summary of Attended Noise Measurements

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 development, including residential areas. The nearest noise sensitive areas to the proposed site are therefore identified as the proposed development itself, Parliament Hill School (approximately 16m to the south west), William Ellis School (approximately 28m to the north west) and residential dwellings along Highgate Road (approximately 22m to the east) as indicated in Figure 4 attached.

6.0 Noise Emissions of Fixed Plant

Noise levels due to building services serving the proposed development are advised to meet the following noise level criteria shown below in Table 5 one metre from the nearest noise sensitive area as defined within Section 5.0 above (expressed as “free-field”). These are based on the background noise levels measured at position L1, which are deemed representative of the nearest noise sensitive receptor.

There is unlikely to be any significant building services plant operating overnight associated with the proposed school development, however night-time noise emission limits have been provided should building services plant need to remain operational overnight.

Period	Lowest Prevailing Background Noise Level $L_{A90,T}$ dB	Noise Emission Limit Calculation $L_{Ar,Tr}$ dB
Daytime (0700 to 2300)	43	38
Night-Time (2300 to 0700)	31	26

Table 5: 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 (expressed as “free-field”). As such, the combined operational noise levels of all plant are required to achieve the noise limits defined within Table 5.

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

Prior to installation, a detailed assessment of the noise emissions from all building services plant shall be undertaken to ensure compliance with the building services noise emission limit. The resultant sound pressure level one metre from the nearest noise sensitive receptor shall be calculated using the principles of ISO 9613-2 [(6)] and compared to the noise emission criterion.

All items of building services plant will be selected such that compliant noise emissions at the nearest noise sensitive receptor are provided. Attenuators and acoustic screening will also be provided, if necessary, to ensure compliance with these limits.

7.0 Noise Prediction Model

In order to predict the external noise levels present at each façade of the proposed development and to determine a suitable ventilation strategy, a noise map has been created using CADNA environmental noise prediction and mapping software. An initial baseline noise map was generated of the existing site using each of the measurements. This model was calibrated for the thirty minute equivalent noise level ($L_{Aeq,30min}$) in accordance with BB 93.

Subsequently, a noise map was generated of the site with the proposed development in-situ. Figure 5 attached displays the noise level map of the proposed development ($L_{Aeq,30min}$) at a height of 1.5m. A height of 1.5m was chosen as this is the preferred measurement height for environmental noise measurement and thus appropriate for noise prediction.

In addition, Figure 6 displays a three dimensional representation of the noise map prediction for each of the proposed development façades. It should be noted that the noise mapping exercise takes into consideration all noise reflections that may occur off the proposed development and adjacent buildings.

8.0 Building Envelope and Ventilation Strategy

The sound insulation properties of the building envelope and ventilation strategy 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 6 below provides an outline review of the proposed internal spaces with regards to the required sound insulation of each façade, as identified in Figure 7.

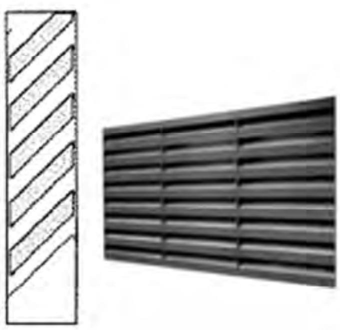
Floor	Façade	Internal Space	Noise Levels (dB)				
				All Ventilation		Natural Ventilation Only	
			Measured External $L_{Aeq,30min}$	BB93 Proposed Internal (Maximum) $L_{Aeq,30min}$	Minimum Level Difference D	BB 101 Proposed Internal (Maximum) $L_{Aeq,30min}$	Minimum Level Difference D
Ground	Highgate Road	Seminar Room	59	35	24	40	19
		Offices	59	40	19	45	14
		Toilets	59	50	9	55	4
	Other	Seminar Room	54	35	19	40	14
		Offices	54	40	14	45	9
		Staff Toilet	54	50	4	-	-
	South-West	Seminar Room	50	35	15	40	10
Roof Level	North Rooflights	Commons	55	40	15	45	10
	South Rooflight	Commons	50	40	10	45	5

Table 6: Natural Ventilation Feasibility

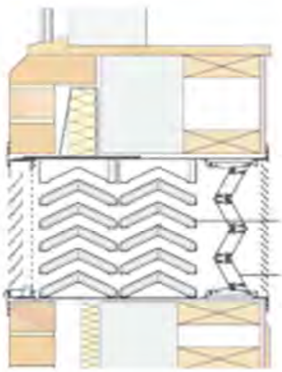
Simple natural ventilation through the use of opening windows will provide a level difference (D) in the order of 10 dB. It can be seen from Table 6 above that offices on other façades and toilets on all façades can adopt a natural ventilation strategy. Additionally, seminar rooms on the south west façade can adopt a natural ventilation strategy providing the relaxation criterion of BB 101 is applied.

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 spaces can be considered for passive acoustically attenuated ventilation.

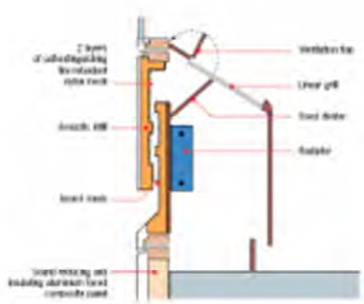
The acoustic treatment required to permit passive acoustically attenuated ventilation would be extensive and the following images describe three ways of how this may be achieved with a through-the-wall type system. The specifics of any such system will be determined during detailed design.



Option 1. Proprietary Acoustic Louvres (e.g. Passivent)



Option 2. Proprietary Through Wall Vents



Option 3. BB93 Bespoke System

Calculations have been undertaken to determine the sound insulation requirements of the building envelope to achieve BB93 internal noise levels ($L_{Aeq,30min}$ and $L_{A1,30min}$) with an assumption that all non-glazed façades achieve a sound reduction of $R_w + C_{tr}$ 41 dB. An example of an external wall capable of achieving this requirement is a cavity brickwork wall.

The calculations indicate that glazed elements are required to achieve a minimum of $R_w + C_{tr}$ 29 dB dB as a whole unit (seals, frames etc.). Such a performance is readily achieved by a standard thermal double glazing unit.

9.0 Summary and Conclusions

Hoare Lea Acoustics has conducted an environmental noise survey for the proposed LaSwap Sixth Form Centre development at the Parliament Hill School within the London Borough of Camden. Unattended noise monitoring throughout a typical seven day period and sample octave band measurements were conducted.

Background noise levels typical of the daytime 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, Parliament Hill School, William Ellis School and existing residential dwellings along Highgate Road.

During the daytime the combined building services plant noise emission contribution limit advised is 38 dB(A) and during the night-time the contribution limit advised is 26 dB(A). A further minus 5 dB correction may be applicable in accordance with the tonal correction defined in BS 4142. It is noted that there is unlikely to be any significant building services plant operating overnight associated with the proposed school development.

All items of building services plant will be selected such that noise emissions at the nearest noise sensitive receptor comply with the derived noise emission criterion. An assessment of the noise emissions from all externally located plant will be undertaken to ensure compliance with the building services noise emissions limits. Additional attenuators and acoustic screening shall be provided, if necessary, to ensure compliance with these limits.

An assessment of the building envelope and ventilation strategy is provided with a level difference (D).
The ventilation strategy should allow for attenuated mechanical ventilation or passive acoustically attenuated ventilation of some internal spaces as the level differences required are above those achievable by simple means of natural ventilation. However, natural ventilation can be provided to rooms on certain elevations of the development.

Noise intrusion calculations have also been undertaken to determine the sound insulation performance requirements of the façades in accordance with the indoor ambient noise levels defined within BB 93. The calculations indicate that the non-glazed element of all façades shall achieve a minimum of $R_w + C_{tr}$ 41 dB.

Similarly, the calculations indicate that glazed elements are required to achieve a minimum of $R_w + C_{tr}$ 29 dB as a whole unit (seals, frames etc.). Such a performance is readily achieved by a standard thermal double glazing unit.

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, 2000.

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

5. Skills, Department for Education and. Building Bulleting 93, Acoustic Design of Schools.

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

FIGURES

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

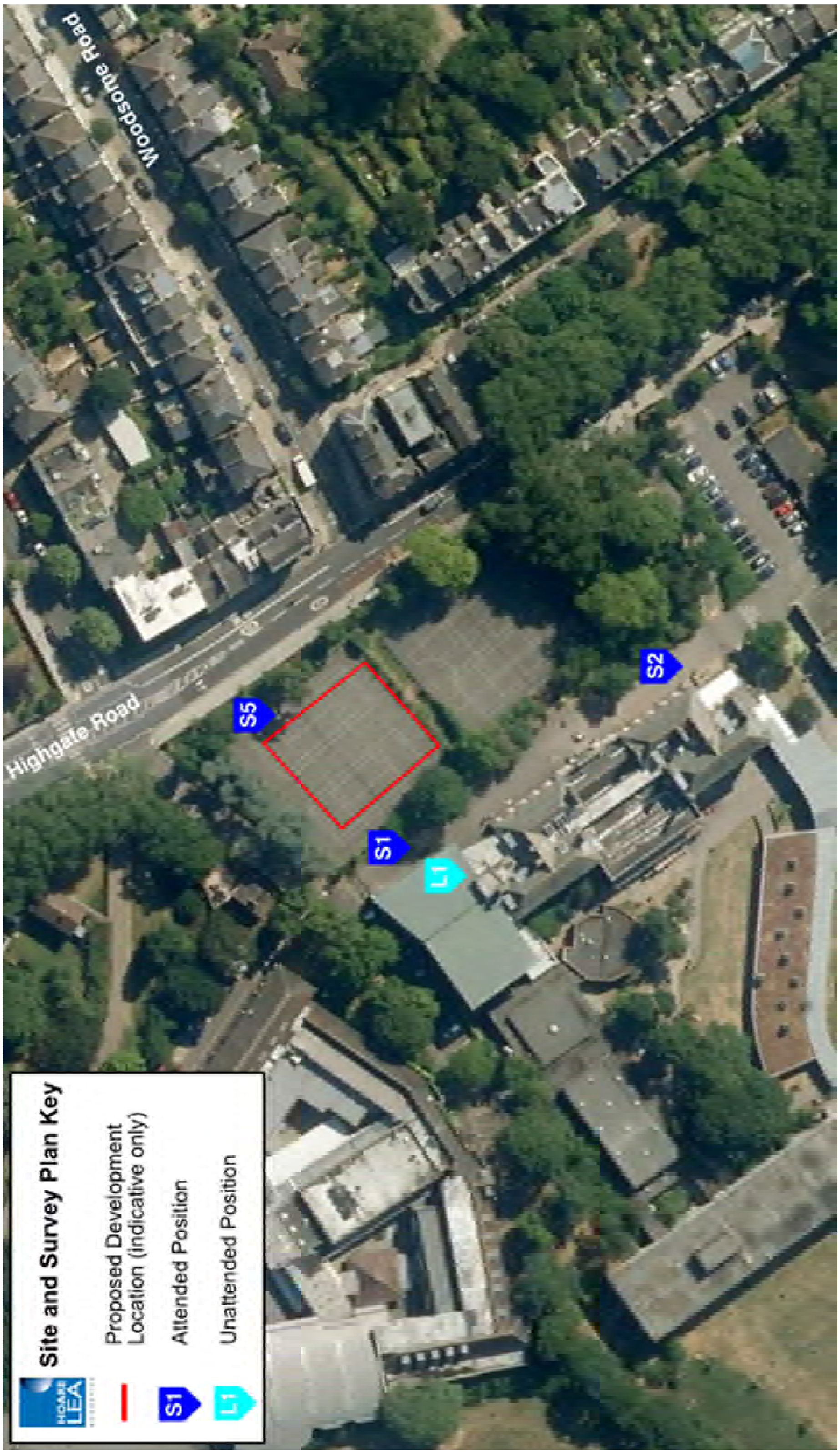


Figure 2: Proposed Ground Floor Plan

Figure 3: Time History of Unattended Measurements at Position L1

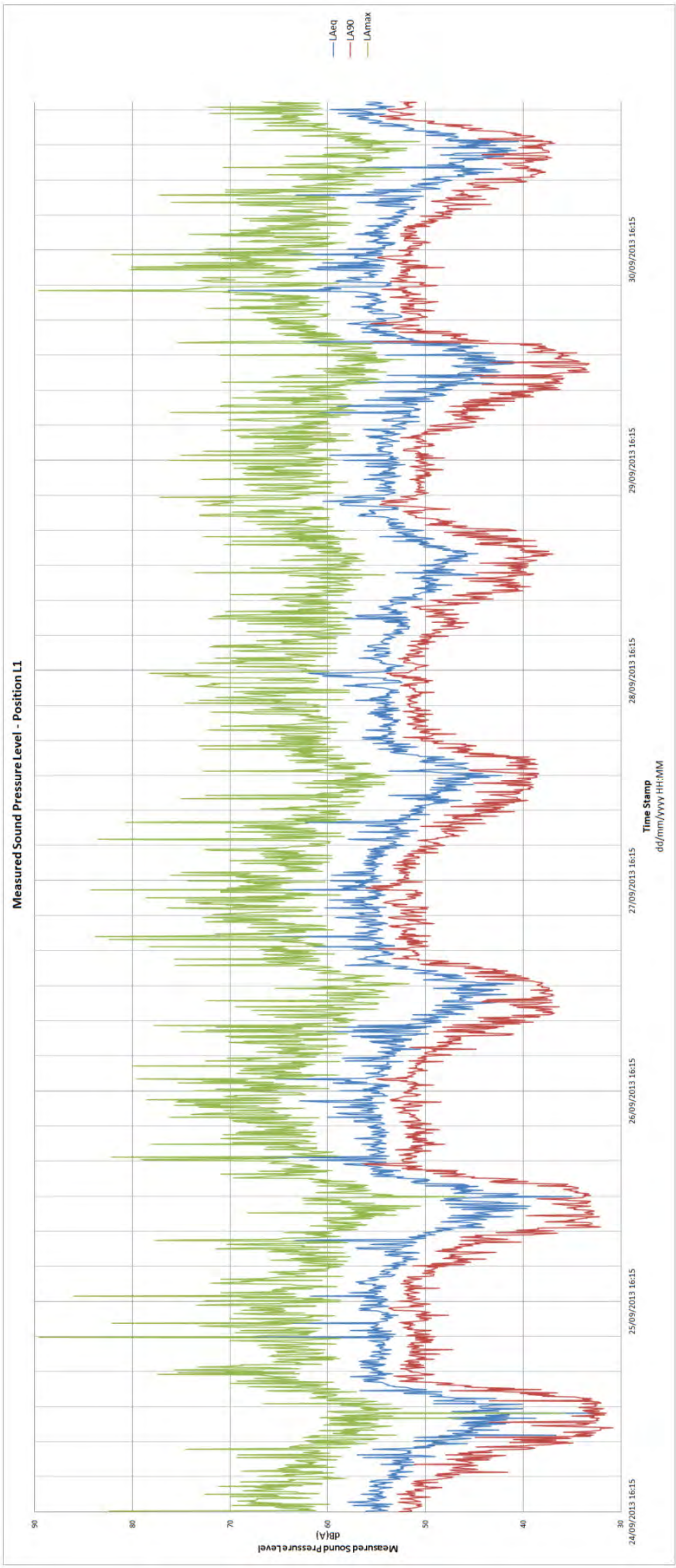


Figure 4: Nearest Noise Sensitive Receptor

Figure 5: Noise Map of Proposed Development during the Daytime ($L_{Aeq,30min}$) at 1.5m Above Ground Level

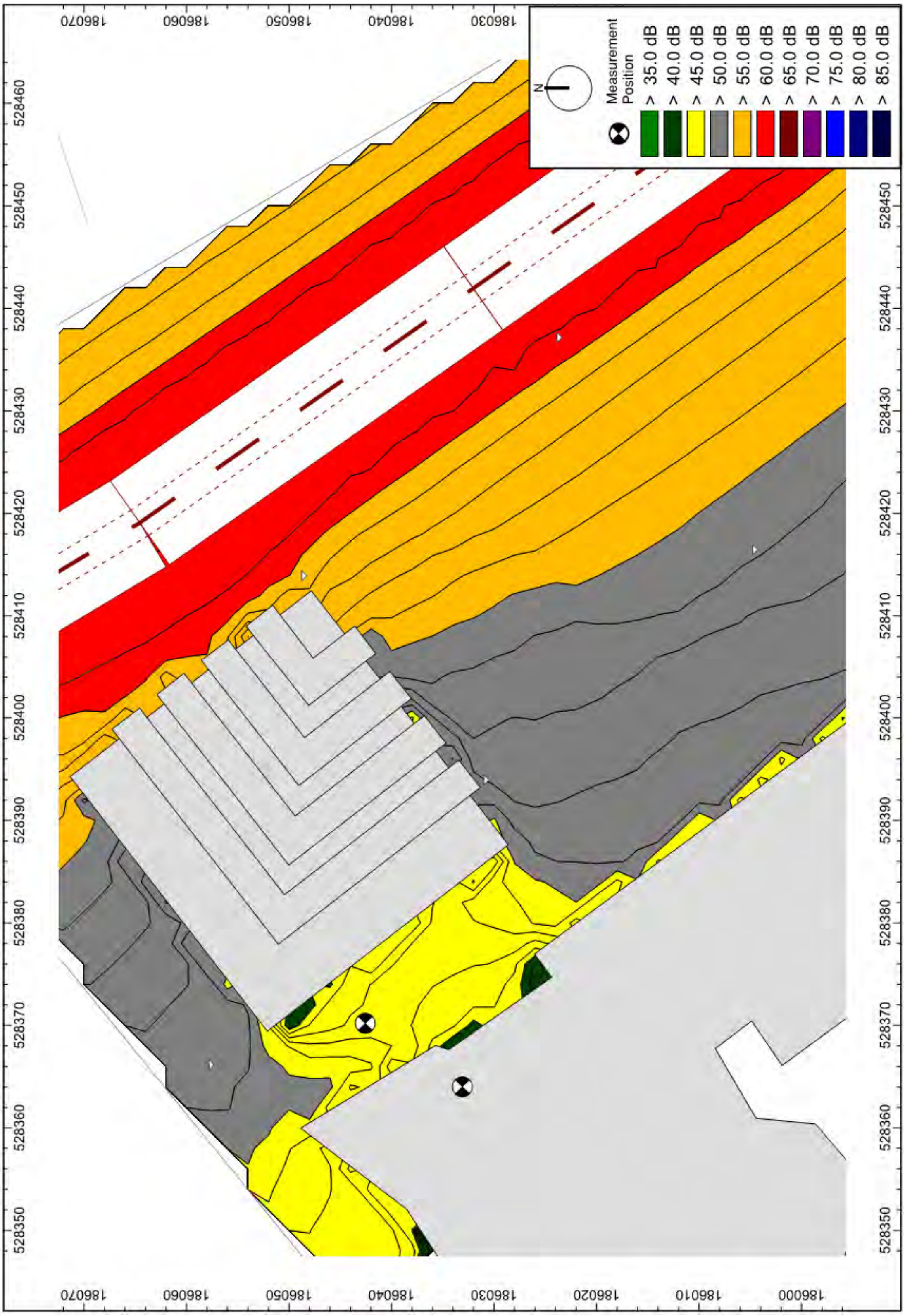
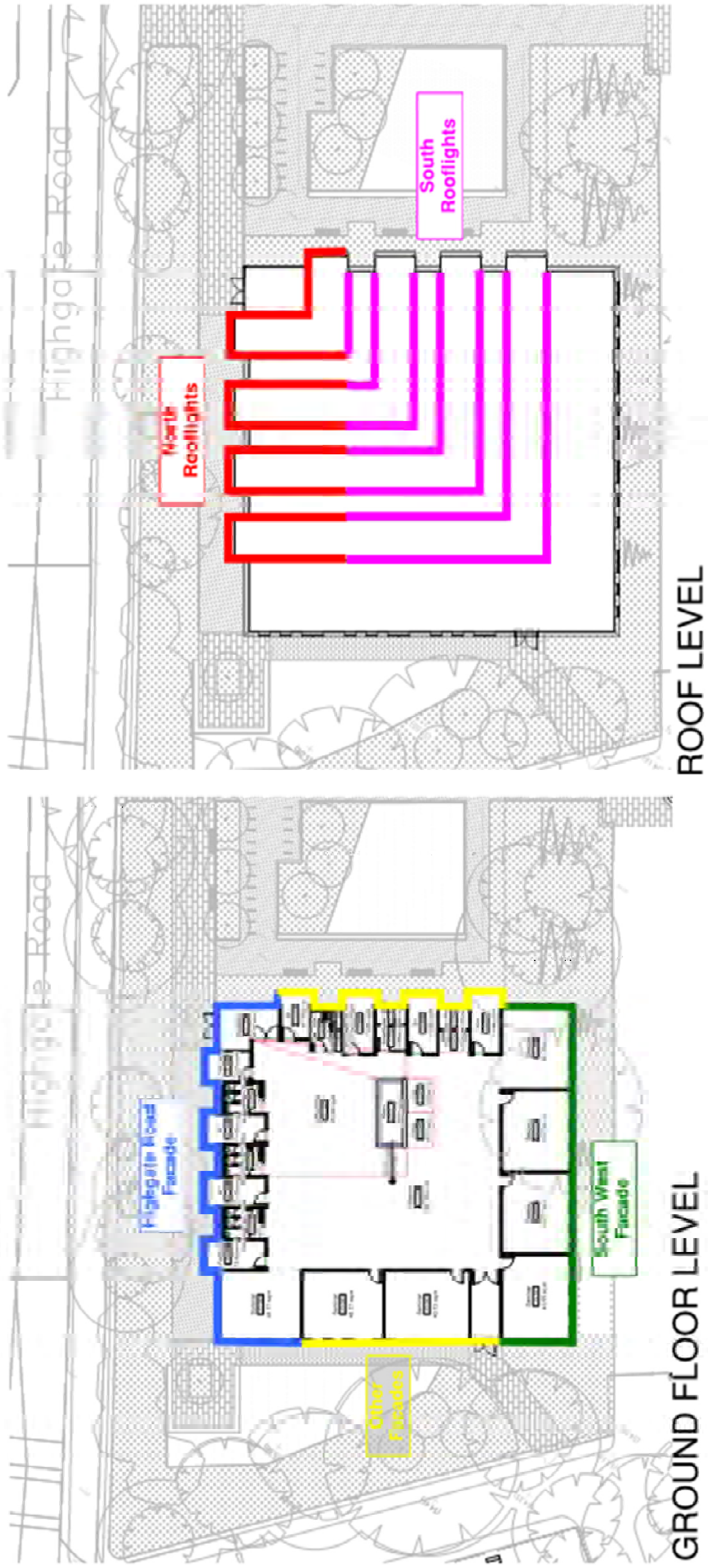


Figure 6: 3D Noise Map of Proposed Development

Figure 7: Façade Locations



APPENDICES

Appendix A: List of Measurement Equipment

Sound Level Meter (Position L1 - Unattended)

- Rion NL-31 Sound Level Meter (Serial Number 00841830)
- Rion NH-21 Pre-Amplifier (Serial Number 12962)
- Brüel and Kjær 4231 Sound Calibrator (Serial Number 2445715)
- Rion UC-53A Microphone (Serial Number 307209)

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

Sound

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

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 human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately 2 x 10^{-5} Pa (2 ten billionths of an atmosphere) and the highest is approximately 100 Pa.

It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound, where:

$$L_p = 10\ log\left(\frac{p^2}{{p_{ref}}^2}\right) = 10\ log\left(\frac{p}{p_{ref}}\right)^2 = 20\ log\left(\frac{p}{p_{ref}}\right)$$

Where: L_p *= sound pressure level (dB)*

p = sound pressure (Pa)

p_{ref} *= 2 x* 10^{-5} *– reference sound pressure (Pa)*

In accordance with the logarithmic scale, doubling the sound pressure level gives an increase of 6 dB.

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels.

In accordance with the logarithmic scale, 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 Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

Sound Pressure Level of Some Common Sources

An indication of the range of sound levels commonly found in the environment is given in the following Table.

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 (10m)	90
Lawn Mower (1m)	100
Diesel Truck (1m)	110
Amplified Music (1m)	120
Jet Plane (1m)	130

Frequency

The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.

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.

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 provided a fine resolution by dividing each octave band into three bands. For examples, third octave bands would be 160 Hz, 250 Hz and 315 Hz for the same 250 Hz octave band.

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 frequency than to low frequencies within the range. This is the basis of the A-weighting.

A-Weighting

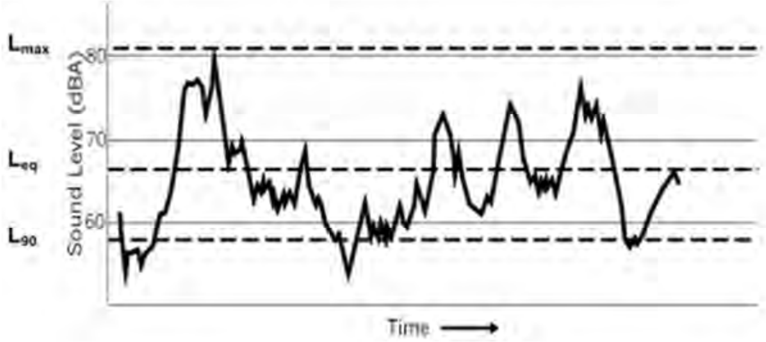
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

An A weighted value would be written as dB(A), or including A within the parameter term.

Noise Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as five minutes, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



$L_{eq,T}$

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 thought of as 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) and is commonly used to describe all types of environmental noise sources.

$L_{01,T}$

The $L_{01,T}$ is a parameter defined as the sound pressure level exceeded for 1% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter.

$L_{10,T}$

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 parameter and 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 parameter and is generally used to describe the prevailing background noise level.

$L_{max,T}$

The $L_{max,T}$ is a parameter defined as the maximum noise level measured during the specified period 'T'.

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.

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.

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.

Appendix C: Octave Band Levels at Measurement Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB								$L_{Aeq,T}$
			63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
S1	20/09/2013 10:16	02:30	70.6	59.0	54.5	56.1	51.8	51.0	45.9	41.9	58.0
	20/09/2013 10:24	05:00	64.9	56.8	55.5	54.4	52.9	49.8	46.9	39.6	57.7
S2	20/09/2013 10:02	10:00	67.8	57.8	54.8	50.4	47.7	45.9	42.0	35.8	54.0
	20/09/2013 10:30	05:00	67.8	60.2	57.6	56.1	51.7	49.9	44.4	35.7	57.9
S5	01/10/2013 09:32	05:00	70.1	65.5	57.6	51.5	51.4	48.6	43.3	38.8	57.1
	01/10/2013 09:37	05:00	71.6	64.0	57.3	52.8	52.6	49.6	44.7	39.8	57.6

Table 7: Ambient Levels Measured at all Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB								$L_{A90,T}$
			63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
S1	20/09/2013 10:16	02:30	60.9	54.6	48.3	45.9	45.1	42.2	35.0	26.0	50.8
	20/09/2013 10:24	05:00	59.5	50.9	45.6	45.1	45.1	41.2	34.9	25.1	51.0
S2	20/09/2013 10:02	10:00	60.2	51.7	46.2	42.7	42.9	40.5	33.5	23.5	48.9
	20/09/2013 10:30	05:00	59.6	52.7	47.7	44.9	44.8	42.3	33.4	22.5	50.1
S5	01/10/2013 09:32	05:00	62.2	56.1	50.7	46.1	46.5	42.2	34.1	25.1	51.4
	01/10/2013 09:37	05:00	61.8	55.8	49.1	44.6	44.0	40.5	35.1	27.8	49.2

Table 8: Background Levels Measured at all Positions

Position	Measurement Period	Duration	Sound Pressure Level per Octave Band Frequency in dB								$L_{A01,T}$
			63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB
S1	20/09/2013 10:16	02:30	79.4	66.0	62.2	65.1	61.8	63.1	59.4	56.8	68.3
	20/09/2013 10:24	05:00	72.3	64.1	66.3	64.2	64.2	60.7	56.0	49.8	66.5
S2	20/09/2013 10:02	10:00	76.7	65.8	66.3	61.5	53.1	51.4	50.3	47.5	61.6
	20/09/2013 10:30	05:00	77.1	70.8	67.6	67.0	60.0	60.8	57.4	48.6	66.1
S5	01/10/2013 09:32	05:00	79.3	76.1	65.9	58.0	56.6	56.8	54.2	51.7	64.9
	01/10/2013 09:37	05:00	82.3	74.3	67.8	60.9	58.9	57.7	54.3	50.9	65.7

Table 9: L_{A01} Levels Measured at all Positions