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REPORT AS10743.180920.NIA

MOUNTVIEW LODGE,
9 SWISS TERRACE, LONDON NW6 4RR

NOISE IMPACT ASSESSMENT

Prepared: 29 October 2018

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List of Attachments

1.0 INTRODUCTION

It is proposed to develop Mountview Lodge at 9 Swiss Terrace, London NW6 4RR (the Site) to provide new sixth, seventh and eighth floors to provide eight new residential units.

Clarke Saunders Associates has been commissioned by Quod on behalf of Graham Shapiro to undertake an assessment of the current environmental noise impact on the site. This is in response to comments received by the London Borough of Camden (LBC) in their Pre-Application Advice (ref: 2018/2635/PRE) which, due to the Site's close proximity to Finchley Road (A41), suggests that a Noise Impact Assessment should be conducted in line with requirements set out in the LBC Local Plan.

This assessment also considers the requirement for any outline mitigation measures as appropriate for the proposed residential development.

2.0 SITE DESCRIPTION

The Site is currently occupied by a five floor residential development, located on Swiss Terrace and accessed from Belsize Road to the west. It is bounded by Finchley Road (A41), a busy thoroughfare, some 25 m to the east with primarily residential areas to the north, south and west. The Site's northern aspect is screened from Finchley Road by a high rise residential development to the north east.

3.0 CRITERIA & REQUIREMENTS

3.1 Camden Local Plan 2017 – Policy A4

Policy A4 'Noise and vibration' of LBCs Local Plan requires that developments have regard to 'Noise Thresholds', which evaluate noise impact in terms of various 'effect levels' described in the National Planning Policy Framework and Planning Practice Guidance.

A table of noise levels applicable to noise sensitive residential developments proposed in areas of existing noise is copied directly from Policy A4 below in Figure 3.1.

It should be noted that LBC's Local Plan also aligns, in many respects, to the amenity guidelines outlined within BS8233:2014 BS 8233: 2014 *Guidance on sound insulation and noise reduction for buildings* [BS8233: 2014] and World Health Organisation *Guidelines for Community Noise* (1999) [WHO 1999], which are included below for reference.

Dominant Noise Source	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Anonymous noise such as general environmental noise, road traffic and rail traffic ~	Noise at 1 metre from noise sensitive façade/free field	Day	<50dB$L_{Aeq,16hr*}$	50dB to 72dB$L_{Aeq,6hr*}$	>72dB$L_{Aeq,16hr*}$
		Night	<45dB$L_{Aeq,8hr3}$ <40 dB$L_{Aeq,8hr**}$	45dB to 62dB$L_{Aeq,8hr*}$ >40dB$L_{night**}$	>62dB$L_{Aeq,8hrs*}$
	Inside a bedroom	Day	<35dB$L_{Aeq,16hr}$	35dB to 45dB$L_{Aeq,16hr}$	>45dB$L_{Aeq,16hr}$
		Night	<30dB$L_{Aeq,8hr}$ 42dB$L_{Amax,fast}$	30dB to 40dB$L_{Aeq,16hr}$ 40dB to 73dB$L_{Amax,fast}$	>40dB$L_{Aeq, 8hr}$ >73dB$L_{Amax,fast}$
	Outdoor living space (free field)	Day	<50dB$L_{Aeq,16hr}$	50dB to 55dB$L_{Aeq,6hr}$	>55dB$L_{Aeq,16hr}$
Non-anonymous noise	See guidance note on non-anonymous noise				

Figure 3.1: LBC Local Plan Appendix 3 Noise Levels

3.2 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was first published in March 2012, updated in July 2018, and revoked all previous planning policy statements and guidance notes.

The document sets out the Government's planning policies and how these are expected to be applied. Paragraph 180 refers to noise impact:

180. Planning policies and decisions should ensure that new development is appropriate for its location taking into account the likely effects of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

With regards to mitigation, reference is made to the Noise Policy Statement for England (DEFRA, 2010). The Policy aims are defined as,

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

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

Clarification of the terms *adverse* and *significant adverse* are given as follows,

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

In order to enable assessment of impacts in line with these requirements, reference should be made to other currently available guidance.

London Borough of Camden's Environmental Health department has advised by telephone that an evaluation of the external noise should be undertaken to achieve the internal noise levels stated in the Camden Local Plan 2017.

3.3 BS8233:2014 *Guidance on sound insulation and noise reduction for buildings*

The guidance in this document indicates acceptable noise levels for various activities within residential dwellings.

The relevant section of this standard is shown in the following table:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,\ 16\ hour}$	-
Dining	Dining Room	40 dB $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$

Table 3.1 - Excerpt from BS8233: 2014 **[dB ref. 20µPa]**

For external areas the standard states the following:

> *For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments.*
>
> *However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*

3.4 WHO Guidelines for Community Noise (1999)

The guidance in this document details suitable noise levels for various activities within residential and commercial buildings.

The relevant sections of this document are shown in Table 3.2.

Criterion	Environment	Design range $L_{Aeq,T}$ dB
Maintain speech intelligibility and avoid moderate annoyance, daytime and evening	Living Rooms	35
Prevent sleep disturbance, night time	Bedrooms	30

Table 3.2 - Excerpt from WHO **[dB ref. 20µPa]**

This guidance also states:

> *For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times a night (Vallet & Vernet 1991)".*

For outdoor living areas, it is stated that:

> *To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.*

4.0 SURVEY PROCEDURE & EQUIPMENT

A survey of the existing background noise levels was undertaken at the location shown in site plan AS10743/SP1, (named 'measurement position LT1'). Automated measurements of consecutive 5-minute L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were taken between 12:00 hours on Friday 14th September and 12:00 hours on Tuesday 18th September 2018.

The following equipment was used during the course of the survey:

- Svantek Class 1 sound level meter type SV958;
- Rion Class 1 sound level calibrator type NC-74.

The calibration of the sound level meter was verified before and after use. No significant calibration drift was detected. All equipment has current laboratory calibration and certification is available upon request.

Weather conditions during the survey were ideal for the measurement of noise, it being fine and dry, with just a light wind from variable directions (<5 ms-1) prevailing.

Measurements were made following procedures in BS7445:1991 (ISO1996-2:1987) *Description and measurement of environmental noise Part 2-Acquisition of data pertinent to land use*.

Please refer to Appendix A for details of the acoustic terminology used throughout this report and Figure AS10743/SP1 for monitoring locations.

5.0 RESULTS & DATA ANALYSIS

Figures AS10743/TH1-TH4 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at measurement position LT1.

The site is affected, primarily, by road traffic noise from Finchley Road and, additionally, by noise from surrounding plant items.

The average free-field noise levels for the '*Daytime'* and '*Night-time*' periods are shown in Table 5.1.

Measurement Location	Period	Noise Level		
		$L_{Aeq,T}$	Typical L_{Amax}	Typical L_{A90}
LT1	Daytime (07:00-23:00hrs)	64 dB	82 dB	60 dB
	Night-time (23:00-07:00hrs)	61 dB	79 dB	54 dB

Table 5.1 - Daytime and night-time noise levels at long term monitoring position [dB ref. 20µPa]

Measurements have been corrected from façade incident to free field measurements.

The apartments proposed on level eight are set back from the building edge. As such, measurements were simultaneously taken at the proposed façade location LT2 to quantify any loss reduction in sound level due to screening by the building edge.

The recorded losses are tabulated as Table 5.2 below.

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Screening Loss (dB)	4	5	5	5	4	5	8	9

Table 5.2 Screening loss at level eight façade

6.0 OUTLINE EXTERNAL BUILDING FABRIC

The following design review is based on the Woods Hardwick architectural drawings for the proposed construction available at the time of writing, targeting the internal noise levels set out in Section 3.

6.1 Non-Glazed Façade Element

It has been assumed that all non-glazed elements, i.e. masonry walls/facings and the roof systems, will provide the following minimum sound insulation performances, when tested in accordance with ISO 10140-2:2010.

Frequency (Hz)	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
Masonry	41	43	48	50	55	55

Table 6.1 - Assumed minimum sound reduction indices of solid constructions

6.2 Required Glazing Performance

The minimum sound insulation specifications for the glazed elements of the building façade facing Finchley Road are given in the table below. These have been calculated using the monitoring data.

Development Level	Glazing Type	Single Figure Weighted Sound Reduction Figure (dB)	Ventilator Performance (dB)
L6 - 7	Type A – For Bedrooms	R_w 40	$D_{n,e,w}$ 49
	Type B – For Living Spaces (other than bedroom)	R_w 34	$D_{n,e,w}$ 41
L8	Type C – For Bedrooms	R_w 40	$D_{n,e,w}$ 49
	Type D – For Living Spaces (other than bedroom)	R_w 32	$D_{n,e,w}$ 41

Table 6.2 - Minimum required sound reduction indices for glazing and ventilators

External noise levels at the eastern and southern façades are such that allowance must be made to ensure that windows can remain closed to maintain appropriate internal noise levels. An alternative means of background ventilation will therefore be required. If passive ventilation (wall or trickle vents) are used, the performance shown in Table 6.2 will be required. The figures stated are for a single vent per room. If multiple vents are required, then the performance requirement shown in

Table 6.2 will increase by a value equal to + 10log(N), with N being the total number of vents serving the room.

There is no reason why windows could not be opened as a matter of personal preference or for purge ventilation, since no such internal noise criteria are specified for this scenario.

The façade to the north of the building is screened by the surrounding buildings from road traffic noise. It is expected that standard, thermally sealed double glazing should provide adequate sound reduction to achieve suitable internal levels.

Appendix B identifies where the performance requirements shown in Table 6.2 apply.

It is important that the quoted minimum sound reduction specifications are met by the panels and windows, including frames, seals, etc. Glass performance alone is not an acceptable means of demonstrating compliance with the specification for window performance.

Internal noise level criteria must be met with any proposed trickle vents installed and open. If this cannot be achieved then alternative means of ventilation may be required.

7.0 ASSESSMENT

7.1 Internal Areas

For levels six and seven, it is anticipated that, for example, thermal double glazing of the order of 9-12-12 units for glazing Type A and 6-12-8 for glazing Type B would provide sufficient attenuation for satisfactory internal noise levels to be achieved.

Due to the footprint of level eight being set back from the building edge, a certain degree of screening is afforded and it is anticipated that example thermal double glazing of the order of 6-12-8.8 units for glazing Type A and 6-12-6 for glazing Type B would provide sufficient attenuation for satisfactory internal noise levels to be achieved at this level.

These glazing configurations are indicative and intended only for demonstration of feasibility at the planning stage. Calculations of the necessary attenuation required should be undertaken once the façade design and internal room layouts have been finalised.

With the above recommendations implemented, the noise levels within the residential dwellings are expected to achieve the guidance levels set within BS8233:2014 and WHO 1999 and to lie within the NOAL to LOAEL range as defined within the Camden Local Plan 2017.

7.2 Areas of External Amenity

There are balconies proposed to the north (rear) and south (front) of the eighth floor apartments. Due to the north aspect of the building being screened from road traffic noise by the surrounding buildings, it is expected that noise levels in these external amenity areas would be < $L_{Aeq,16hour}$ 50 dB and would therefore fall into the LOAEL category as defined in the LBC Local Plan.

Without any mitigation or screening, noise levels at the southern balcony of level eight would fall into the SOAEL category (> $L_{Aeq,16hour}$ 55 dB), as defined in the LBC Local Plan.

However, for seated receptors in the most exposed balcony positions, it is anticipated that the adoption of balcony screens, of minimum height of 1.2 metres and minimum superficial density 10 kg/m^2, would be sufficient to control noise to between the LOAEL to SOAEL (Amber) category as per the LBC Local Plan. Screening should be continuous and imperforate around the perimeter of the balcony. Gaps, (for instance at the junction of the screen and balcony), should be sealed.

It should be noted that the LOAEL to SOAEL (Amber) category within the LBC Local Plan correlates to the external amenity guidelines outlined within BS8233:2014 and WHO (1999). The National Noise Incidence Survey (2000) found that 55 ± 3% of the population of England and Wales live in dwellings exposed to day-time noise levels above the WHO/ BS8233:2014 level of 55dB $L_{Aeq,day}$. A review of the health effects of noise for the Department of the Environment, Transport and the Regions (DETR) found that there is no evidence that anything other than a small minority of the population exposed to levels above the WHO/ BS8233:2014 guidelines values finds them to be particularly onerous in the context of their daily lives.

Furthermore, BS 8233:2014 notes that in noisy areas, such as city centre or urban areas in proximity to strategic transport networks, a compromise between elevated noise levels and other factors, such as the convenience of living in such locations or making efficient use of land resources to ensure that development needs can be met should be considered.

This site is not unique in its proximity to main, busy roads in London. There are several examples of developments which have their outdoor living areas located alongside the A41 in the surrounding area.

With this suggested mitigation in place, noise levels can be considered to fall between the LOAEL and SOAEL levels, generally being below the level that is expected to cause significant annoyance and are compliant with the current guidance figures for areas of external amenity, as provided in WHO 1999 and BS8233:2014.

8.0 CONCLUSIONS

Measurements have been made of the prevailing noise climate at the proposed site for residential development at Mountview Lodge, 9 Swiss Terrace, London NW6 4RR.

The measured levels have been assessed against the Camden Local Plan (2017) and currently available standards and guidance documents including World Health Organisation *Guidelines for Community Noise* (1999) and BS8233:2014 *Guidance on sound Insulation and noise reduction for buildings*, to consider whether the site is suitable for its proposed residential use.

The survey has allowed the minimum sound reduction requirements of the external building fabric to be established as a performance specification.

However, it is important that the successful contractor demonstrates in a UKAS accredited or an equal and approved laboratory that the minimum sound reduction requirements can be achieved by their proposed window systems.

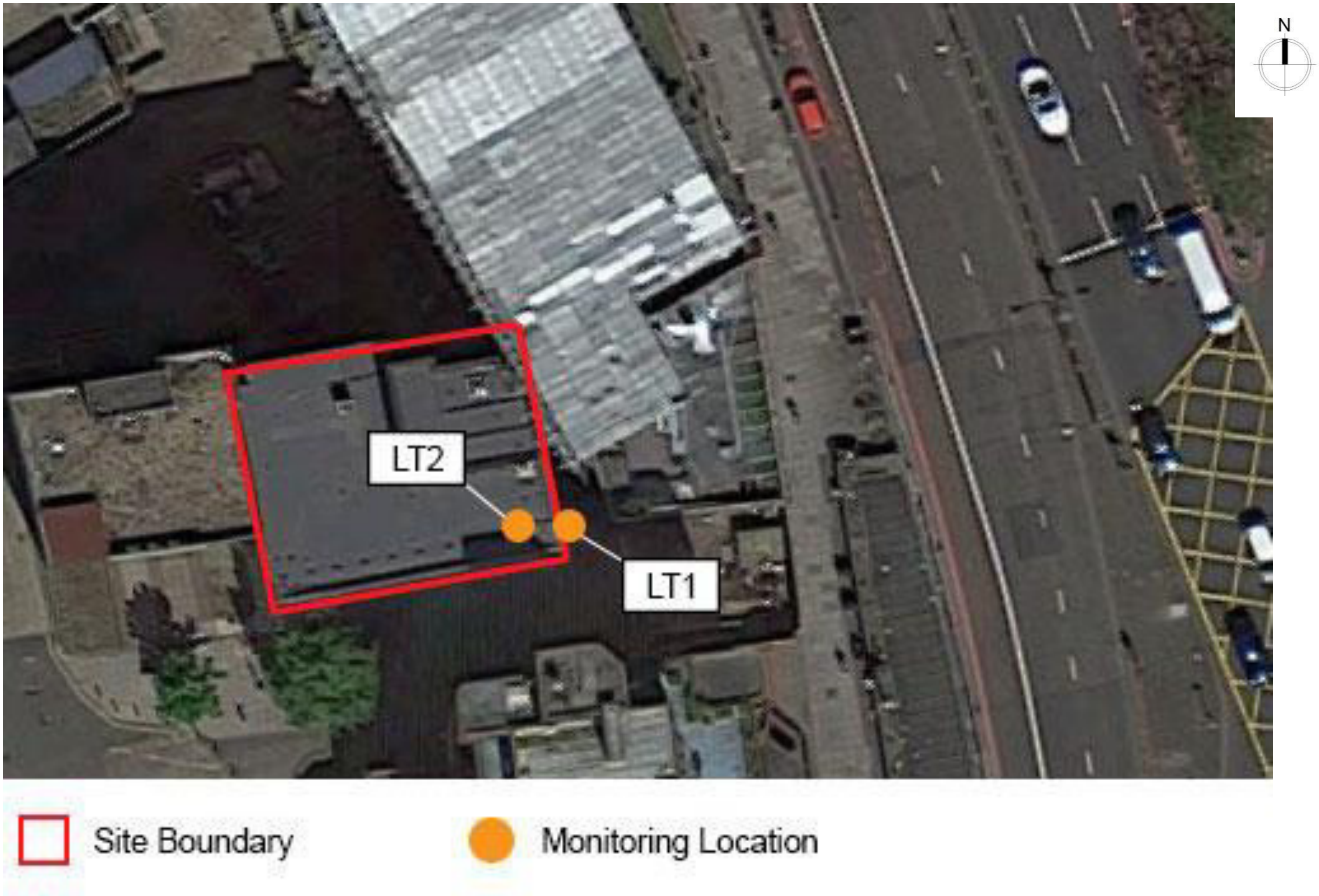
Mitigation measures including acoustically specified double-glazing, have been recommended. The acoustic performance of the external building fabric would be fully determined as the design progresses.

Due to the screened outlook to the north of the development, it is expected that high quality, thermally sealed double glazing units would be sufficient for rooms on the northern façade of the building.

Rooms on the southern façade with a direct line of sight to the A41 will require alternative means of ventilation due to high external noise levels although acoustic trickle vents would be suitable in this location.

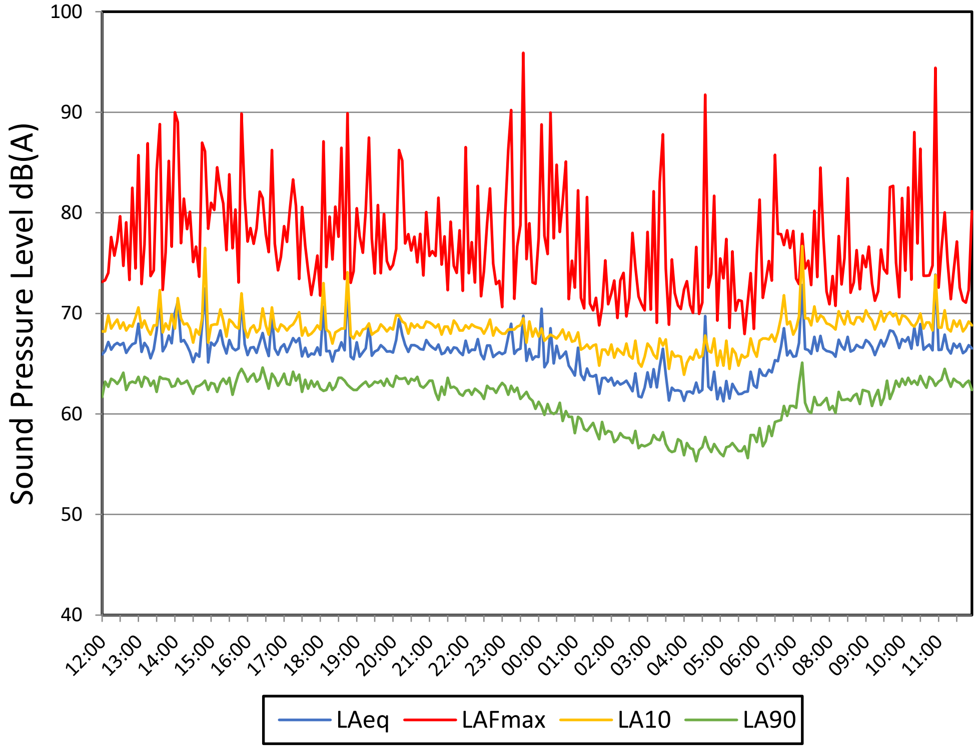
Ben Dymock MIOA

CLARKE SAUNDERS ASSOCIATES


N
LT2
LT1
Site Boundary
Monitoring Location

9 Swiss Terrace, London NW6 4RR

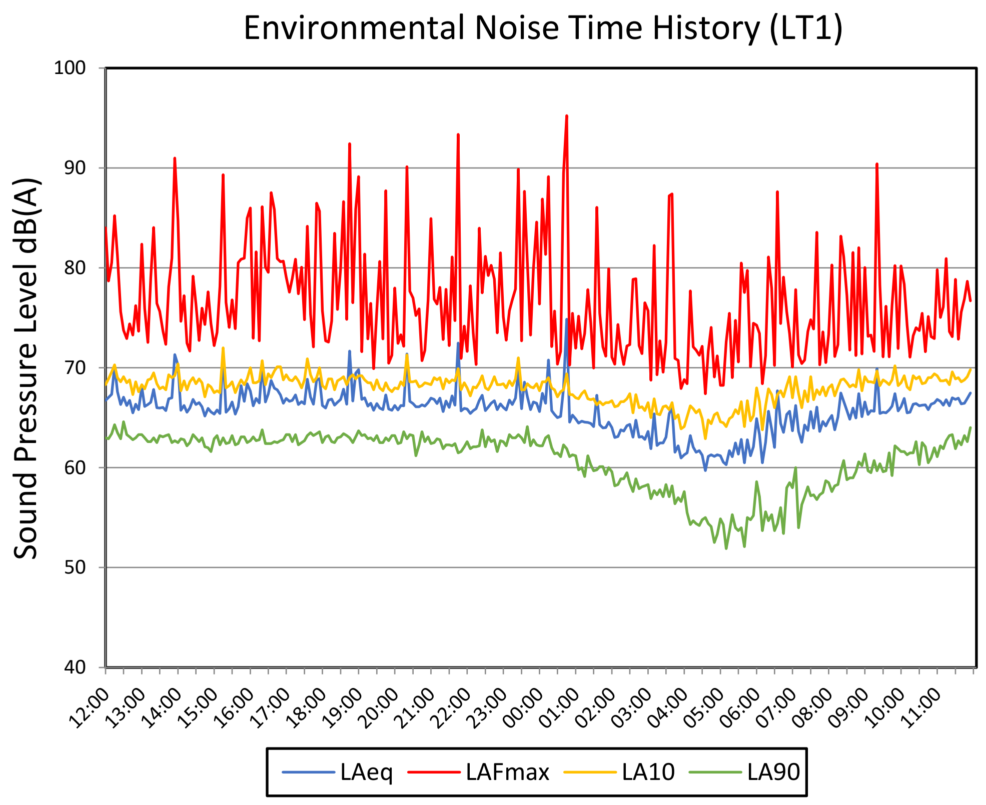
Environmental Noise Time History (LT1)



Friday 14 September to Saturday 15 September 2018

Figure AS10743/TH1

9 Swiss Terrace, London NW6 4RR

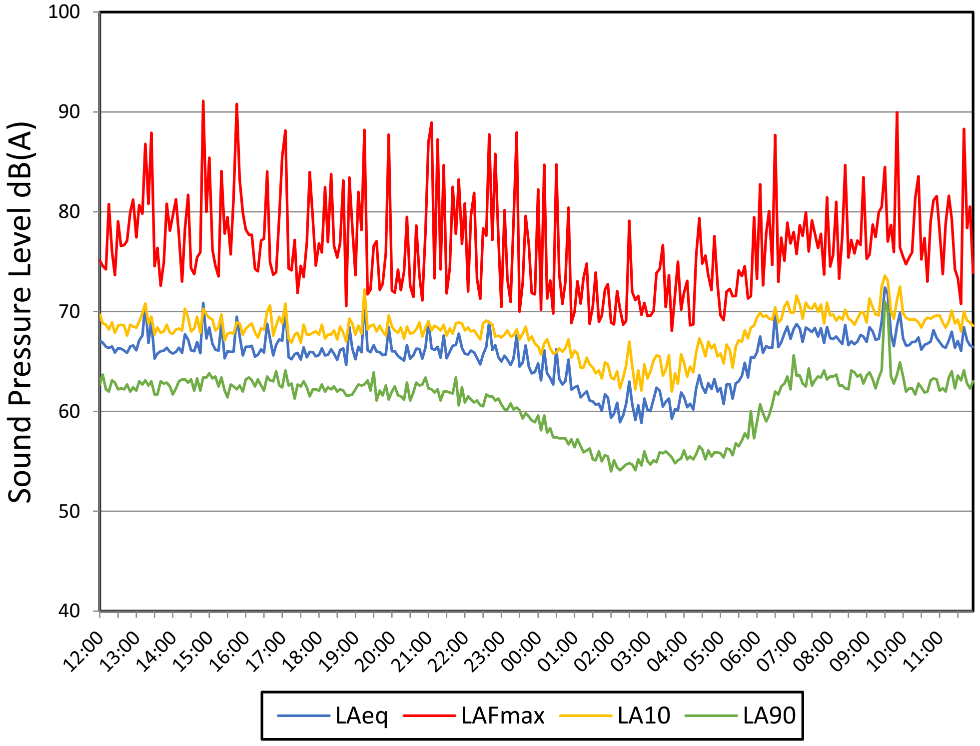


Saturday 15 September to Sunday 16 September 2018

Figure AS10743/TH2

9 Swiss Terrace, London NW6 4RR

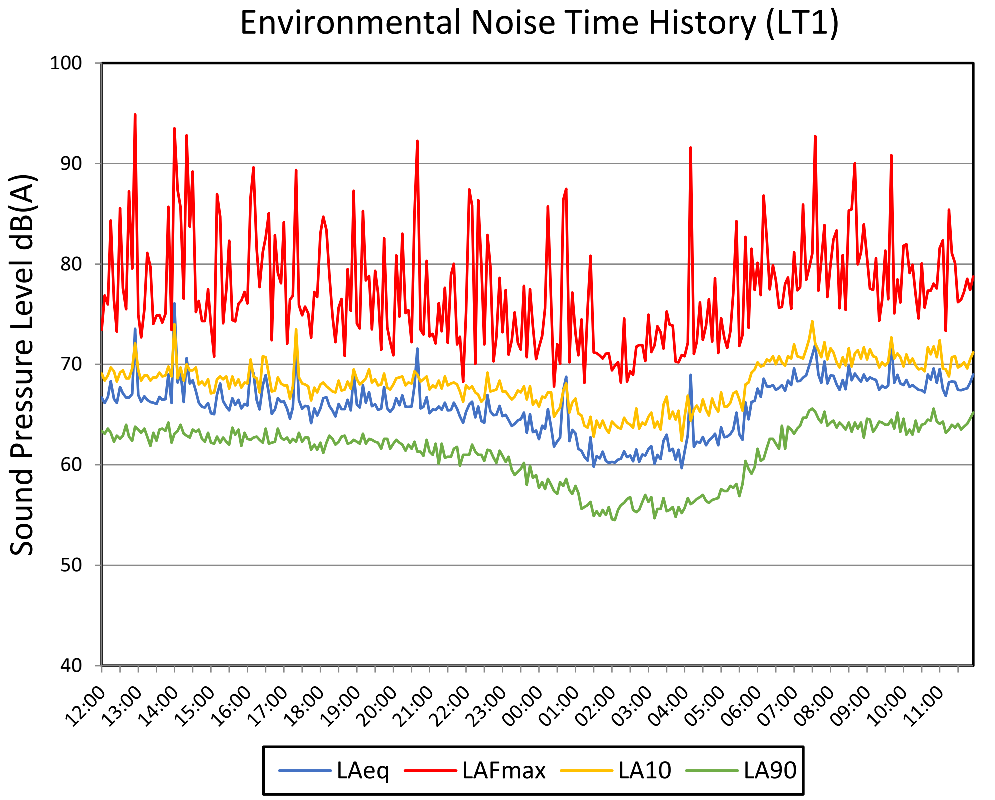
Environmental Noise Time History (LT1)



Sunday 16 September to Monday 17 September 2018

Figure AS10743/TH3

9 Swiss Terrace, London NW6 4RR



Monday 17 September to Tuesday 18 September 2018

Figure AS10743/TH4

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND SOUND

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.
L_{eq} :	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.
$D_{n,e}$	Normalised sound insulation of small building elements of fixed dimensions, such as vents, measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010.
R_w D_w $D_{nT,w}$ $D_{n,e,w}$ $D_{n,f,w}$	Value of parameter, determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1 to provide a single-figure value.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

INTERPRETATION

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.


Proposed New
Roof Level
Proposed New
Eighth Floor
Proposed New
Seventh Floor
Proposed New
Sixth Floor
PROPOSED
FRONT ELEVATION 1:100@A1
Notes
1. Contractors must check all dimensions on site. Only figured dimensions are to be worked from. Discrepancies must be reported to the Architect or Engineer before proceeding. © This drawing is copyright
2. Reproduced from OS Sitemap ® by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright 2008. All rights reserved. Licence number 100007126.
Materials Schedule
Roof Finish
1 - New Metal Cladding - Finish - Zinc
2 - New Polyester Powder Coated Coping - Finish - Bronze
3 - New Glass Balustrade
Wall Finish
4 - New Render - Colour - To Match Existing
5 - New Windows and Curtain Walling to 6th & 7th Floor - Colour - Bronze, To Match Existing
6 - New Windows and Doors - Polyester Powder Coated Frame
7 - New boiler flues
8 - New lightweight cladding - Zinc Rain Screen
Other
9 - Fall Protection
Building Rear Elevation
Centre Heights Side Elevation
9
SWISS
TERRACE
Belsize Road Side Elevation
Building Front Elevation
Type A
Type B
Type C
Type D