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Hoare Lea

Noise Assessment

Maizelands Limited & Arringford Limited

Lincoln House, London
Report for planning
2018-03-28 Revision 03

ACOUSTICS

Audit sheet

Rev.	Date	Description	Prepared	Verified
00	2017-02-10	P1	MF/BMD	AJP
01	2017-11-23	P2 – Updated plans	BMD	BJ
02	2017-11-27	P3 – Updated title	BMD	-
03	2018-03-28	P4 – Updated with comments	BMD	BJ

Contents

Executive summary

Plans have been prepared to refurbish and extend the commercial office property at Lincoln House, London.

Baseline noise measurements have been taken to establish existing ambient noise levels at the proposed development site. These measurements have identified that the site currently experiences relatively high levels of noise during both daytime and night-time, with the main source of noise affecting the site being road traffic from High Holborn.

Based on the measured noise levels, comments have been made on the sound insulation of the building envelope with regard to appropriate internal noise levels within the proposed development.

Measured levels have also been used to set noise emissions limits to later inform the design of mechanical or electrical plant.

In addition, comments have been made on the sound insulation of the internal separating floors.

Consideration has been given to national and the local policies of London Borough of Camden and compliance with BREEAM credits has been discussed.

1. Introduction

Hoare Lea Acoustics have been appointed by Maizelands Limited & Arringford Limited to provide acoustic design consultancy for the proposed redevelopment of Lincoln House, on High Holborn, London.

This initial report provides information on noise control requirements that will need to be addressed in further developing the design and is intended to accompany the planning application.

A glossary of acoustic terminology is given in Appendix A.

2. Planning Requirements and Acoustic Design Standards

The performance standards that will drive the design include Local Authority planning policy, BREEAM 2014 requirements and well established guidance documents including:

- London Borough of Camden local policy
- National Planning Policy Framework (NPPF)
- National Planning Policy Guidance (NPPG)
- British Council for Offices (BCO) Guide to Fit-out 2014
- British Standard 8233:2014 'Sound insulation and noise reduction in buildings – Code of practice'
- British Standard 4142:2014 'Methods for assessing industrial and commercial sound'
- BREEAM 2014

2.1 London Borough of Camden requirements

London Borough of Camden's (LBC) noise policy is set out within Appendix 3 of the Local Plan 2017. The document explains that noise is considered in terms of various 'effect levels' which align with the National Planning Policy Framework (NPPF) and National Planning Policy Guidance (NPPG) documents:

- NOEL – No observed effect level
- LOAEL – Lowest observed effect level
- SOAEL – Significant observed adverse effect level

Assessment is made relative to the following context descriptors:

- Green – where noise is considered to be acceptable
- Amber – where noise is observed to have an adverse effect level, but may be acceptable when assessed in the context of other merits of the development
- Red – where noise is observed to have significant adverse effect

For new noise generating development, assessment should be made with reference to the methodology set out within BS 4142:2014. The following thresholds are set:

- LOAEL (Green): Noise 'Rating level' to be 10 dB below the existing background. An additional criteria applies at night that no events exceed 57 dB L_{Amax}
- LOAEL to SOAEL (Amber): Noise 'Rating level' to be between 9 dB below and 5 dB above background, or noise events between 57 dB and 88 dB L_{Amax} at night
- SOAEL (Red): Noise 'Rating level' is greater than 5 dB above background, and/or events exceed 88 dB LAmax at night

2.2 British Council for Offices (BCO) requirements

BCO recommends that the sound level difference between separating office floors and walls should be at least $D_{nT,w}$ 45 dB at shell and core stage.

2.3 BREEAM requirements

It is understood BREEAM 'Excellent' is targeted for the scheme, where credits related to this report are Hea 05 and Pol 05.

2.3.1 Hea 05 requirements

The requirements for Hea 05 are split into a pre-requisite section and the awarding of up to three credits for achieving certain acoustic performance standards.

The first Hea 05 credit is awarded for achieving sound insulation performance in accordance with BS 8233:2014. This relates to standards of 'acoustic privacy' and is generally considered during the Cat B fit-out. With the exception of the new separating floor slabs, this is not included within this report.

The second Hea 05 credit pertains to internal noise levels throughout the development. In order to achieve the HEA 05 credit, BREEAM states that indoor ambient noise levels must comply with the "good practice" levels performance criteria set out in BS 8233. For Cat A only design, where it is not possible to define the exact nature of different spaces, Hea 05 Compliance Note 1 states that internal areas should be based on the most sensitive room type likely to be present, as a worst case.

The third credit under HEA 05 is awarded for achieving reverberation times compliant with Table 8 of BS 8233 in areas used for speech (not including meeting rooms). As the office is speculative in nature, the credit cannot be fully evaluated at this time but may be available as part of the Cat B fit-out.

2.3.2 Pol 05 requirements

Pol 05 pertains to noise pollution emitted from the development. Specific criteria require that the new development must not increase background noise levels at the façade of the nearest noise sensitive building, by more than +5 dB during the day (07:00-23:00) and +3 dB during the night (23:00 07:00). In this instance, the local authority criterion is the more stringent and will therefore be adopted.

2.4 British Standard 4142:2014 'Methods for assessing industrial and commercial sound'

Camden's Local Plan refers to BS 4142 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 assessment of impacts 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 impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact.
- A difference of around +5 dB indicates is likely to be an indication of an adverse impact.
- Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact.

3. Site and Surroundings

3.1 Existing site

The existing site is an eight storey mixed use building (plus basement and ground) providing a total floor area of 5,660sqm GEA. Office accommodation is located at the upper floors and there are two shop-type units at ground floor, currently occupied by a bank and a café.

The Site is bounded by High Holborn to the north, Northumberland House (303-306 High Holborn) – an 9 storey office building to the east, and 294-295 High Holborn to the west - which is currently a vacant site, with no buildings or structures, awaiting redevelopment.

Surrounding properties are primarily mixed in nature with retail units populating most ground level units, or office reception areas, and the upper levels in office use. Larger residential communities are predominantly located to the north in Bloomsbury or to the south in Covent Garden.

The private gardens of Lincoln's Inn are located immediately to the south of the Site and Lincoln's Inn Fields, to the south-west of the Site.

3.2 Proposed works

The works to be undertaken as part of the redevelopment include refurbishment, remodelling and extensions at rear, flank and roof level to provide 2,193sqm (GIA) additional floorspace and rooftop plant. Change of use of ground floor Use Classes from A1, A2 and B1a uses to provide 2 x A1 units (204sqm GIA) and remainder in B1a Use. Associated external alterations to the elevations. Provision of appropriate cycle parking, waste/recycling storage, additional services and associated ancillary works

4. Acoustic Survey Results

An acoustic measurement survey was undertaken at the development site to determine sounds levels at the proposed extension façade locations and to establish background noise levels for existing conditions surrounding the site. Full details of the survey are given in Appendix B.

A fixed-term monitor was located on the site in a position deemed representative of lowest background noise level conditions at nearby properties. The fixed monitor location was chosen at the lowest roof level to the south of the building as shown in Figure 1.

Attended measurements were also conducted, at the ground level location indicated in Figure 1. The measurement positions were chosen to capture the variation in noise climate across the extension façade.

Figure 1: Site location plan showing noise measurement locations

The surrounding noise environment is dominated by road traffic noise from High Holborn. The south of the building is screened from road traffic noise.

Average day ambient noise levels at the fixed monitor position are circa 56 dB $L_{Aeq,T}$ with road traffic noise from High Holborn being the dominant sound source. At ground floor level, sound levels are between 55-56 dB $L_{Aeq,T}$ to the south of the site. Levels at this position were influenced by nearby existing plant units and surrounding road traffic noise.

Maximum noise events during the day time were governed by vehicle movements (including buses) on the surrounding roads and aircraft events and range between 71-80 dB L_{Amax}. It was also noted there was some influence from nearby construction noise. At ground level, these are in the lower region of 62-66dB L_{Amax} due to additional screening from the road.

Fixed-term monitor results show that between day time lowest background noise levels drop by 1-5 dB at the measurement position with lowest measured background results of 45 dB L_{A90} (daytime) and 44 dB L_{A90} (night time).

5. External Envelope Design

This section confirms the internal noise levels to be achieved for various room types and outlines acoustic design considerations for the building envelope.

The existing building at Lincoln House will be refurbished and extended to the rear with no amendment to the existing front facades. The following will therefore apply to the new build extension sections only.

5.1 Target internal noise levels

External noise will need to be reduced sufficiently to achieve suitable internal ambient noise levels in line with BREEAM 2014 Hea 05 requirements to achieve the second credit. The required internal noise level depends on the main function of a space and is set accordingly in line with relevant standards and guidance.

Table 1 provides internal noise level criteria to be achieved as part of the scheme for specific areas and includes noise contribution from both external noise intrusion and from building services. Maximum permissible noise levels from the operation of mechanical services as expressed in terms of Noise Rating ($L_{eq,1min}$) are given in section 6.1.1.

Type of space	Internal noise levels, dB $L_{Aeq,T}$
Speculative office/open plan office	45 – 50
Single occupancy office	35 – 40
Meeting room / Executive office	35
Corridor / Reception / Atria	45 – 55
Toilets	50 - 55

Table 1: Internal noise level criteria to be achieved for typical room types. Criteria referenced from BS 8233:2014 as per BREEAM Hea 05 second credit requirements.

The above criteria are also in line with British Council for Offices (BCO) standards.

5.2 Façade sound insulation performance

The requirements for sound insulation of the building envelope are not onerous. To allow maximum flexibility with regards to any future Cat B fit-out, calculations have been undertaken on the basis of achieving internal noise levels of 35 dB $L_{Aeq,T}$, which is in line with BS 8233:2014 criteria for meeting rooms and single occupancy offices.

It is expected that noise could be reduced to the most onerous targets by using a relatively conventional external wall to achieve an overall façade performance of 38-40 dB R_w. The above sound reduction performances are expected to be achieved with a masonry type construction and relatively standard thermal double glazing.

5.3 Level 9 rooftop slab

It is understood that the Level 9 roof slab between the plant area and offices below will comprise a concrete construction of 400mm. The floor build up and suspended ceiling is expected to be sufficient acoustically to attenuate noise break-in via the floor structure itself from plant equipment including roof mounted Air Handling Units (AHUs).

A further review of noise intrusion levels from plant level slab is to be undertaken during later stages. A suspended ceiling is proposed to the underside of the roof slab and may be utilised for additional sound reduction performance where required to attenuate roof plant noise.

5.4 Ventilation Strategy

It is understood that supply and extract ventilation is provided to the office floorplates of the existing building via a combination of the main Air Handling Units (AHU) and openable windows. The AHU's are either to be located in the basement or on the roof. These will then be ducted to the downflow units in either a single or double risers depending on a split tenancy requirement.

Whilst mechanical ventilation and comfort cooling will be required to comply with the Client brief, the low energy design attributes of naturally ventilated buildings should be considered in the proposed baseline design.

Generally, openable windows allow users flexibility of use during the 7 or 8 months where outdoor air is a natural source of ventilation and temperature control, when outside noise levels permit. It can also increase occupant satisfaction by providing connectivity to the outside.

In addition to openable windows are central AHUs located at roof level and distributed down the building via central risers.

The reduction in noise level, from outside to inside, achieved through an open window is typically between 10 - 15 dB. Noise levels to the rear of the development, screened from High Holborn, are circa 56 dB $L_{Aeq,T}$. With openable windows, this would result in internal levels in the region of 41 – 46 dB $L_{Aeq,T}$. As you can see from Table 1, these internal levels would be suitable for an open plan or speculative office but would be above the recommended range for cellular offices and meeting rooms. As such, where windows are screened from High Holborn, openable windows may be an acceptable means of ventilation depending on the proposed use of the internal space.

Where windows overlook High Holborn, openable windows will not be an acceptable means of ventilation, due to the high levels of noise due to road traffic.

Noise from ventilation systems will need to be attenuated to maintain the required internal noise levels. Guidance on noise from M&E systems is provided in section 6.0.

5.5 Flanking sound insulation

It is important that mullions at potential fit-out partition lines provide sufficient sound insulation to maintain the performance of an internal wall. Where there are junctions with separating floors, transoms may also require treatment.

For BCO compliance, horizontal cladding mullions at potential fit-out partitions should be capable of achieving a flanking sound reduction performance of 45dB $D_{nf,w}$. This should be upgradable to 53dB $D_{nf,w}$ during the Cat B fit out.

Options to address the flanking at potential partition junctions could include:

- Over-cladding the mullions/transoms
- Infilling the mullions with acoustic pads

This detail should be developed further at a later design stage.

6. Internal Architectural Acoustics

6.1 Sound insulation of separating floor slab

6.1.1 Between offices

It is understood that the separating floor slabs between offices in the existing building comprise a concrete construction of 300mm. It is also understood that the floor slabs for the extension are still being developed, but a concrete construction of 300mm has also been assumed for these areas.

This floor build up and a suspended ceiling is expected to be sufficient to achieve the BCO requirement sound insulation performance of $D_{nT,w}$ 45 dB which is also considered by BREEAM.

6.1.2 Between office and retail

The separating floor slabs between office areas and the ground floor retail units is also understood to comprise a concrete construction of 300mm. This will provide a high level of sound reduction and should achieve a sufficient acoustic performance between these two areas.

7. Building Services Noise and Vibration Control

This section covers two aspects of building services, the effects of building services on the development itself and on the local environment.

It is proposed that plant is to be located at a roof level external plant space and at basement level.

Current proposals for roof level plant include the following equipment:

- 2 Air Handling Units;
- 2 Rooftop chillers
- Toilet extract fans;
- Future tenant's cooling plant

Additional mechanical plant proposed at basement level includes a generator and life safety plant, boilers, storage vessels, Low Temperature Hot Water and Boosted Cool Water pumps and cold water storage tanks.

Equipment specifics are likely to change during further design development and are only included here for indicative information on potential noise emission considerations.

7.1 Internal noise levels from building services

7.1.1 Criteria

The BCO guide states that building services noise should be controlled to meet the noise ratings (NR) shown in when measured under Cat A condition. While the design is for the Cat A fit out, and therefore there are no cellular offices, the criterion is provided in Table 2 for guidance.

Room Type	Maximum building services noise
Cellular Office	NR35
Speculative Office	NR38
Executive Office	NR35
Open plan office	NR38-40
Corridor / Reception	NR40
Toilets	NR40

Table 2: BCO Guide 2014 building services noise criteria

When converted to dB(A) values (by adding 6 dB to the NR values above), the levels in the above table correlate well with the levels stated in BS 8233, either falling at the lower or mid-level of the applicable ranges shown in Table 1.

Note that noise emissions in sensitive areas from plant located within the building and not directly in or serving those areas shall be controlled to NR15. This is based on the principle that whilst people will generally acknowledge and accept some level of noise from services equipment which they are gaining benefit, they will not generally wish to hear noise from neighbouring plant rooms. This criterion forces the need for such unwanted sources of noise to be reduced to well below the normal design standards for the space. To achieve the target consideration needs to be given to both the equipment specifications and the separating structure

7.1.2 Vibration from building services plant

Adequate vibration isolation will be provided to all systems such that there is no perceptible vibration from building services plant throughout the development. BCO criteria state that vibration should not exceed a peak acceleration of $0.01ms^{-2}$ with a W_b weighting. According to BS 6472-1:2008 Clause 3.3, this is in line with the threshold of perception for 25% of the population (i.e. 75% would not perceive vibration).

7.2 External noise emissions from building services noise

7.2.1 Location of nearby noise sensitive properties

Limits on noise emissions to atmosphere from the operation of mechanical services will apply at the nearest noise sensitive receptors.

While there are no existing residential properties in the vicinity of Lincoln House, it is understood that a proposed residential development on the land directly to the west of the site has been granted planning permission. As such this development is considered to be the nearest residential property to the scheme.

Other nearby existing noise sensitive properties have been identified at the following distances from the proposed redevelopment.

- The adjacent commercial property on High Holborn, identified as Northumberland House, a minimum of 5 metres from rear windows of the top floor. These are to be treated as noise sensitive properties.
- The adjacent commercial property at Stone Buildings, a minimum of 20 metres from the north façade windows. These are to be treated as noise sensitive properties.

7.2.2 Noise emission limits

Limits on noise emissions to atmosphere from the operation of mechanical services will be driven by two requirements:

- LBC's planning requirements
- BREEAM Pol 05 requirements

7.2.3 Planning authority requirements

Recommended noise emission limits for new plant associated with the development are presented in Table 3. These limits have been derived based on the guidance provided by LBC's Local Plan and BS 4142: 2014.

The proposed noise limits are 5 dB below the minimum measured background noise level and as such would be considered a 'LOAEL to SOAEL' within the context of LBC's planning policy. The limits have been recommended with the intention that noise from new plant will not be noticeable by the neighbours and so avoid the risk of noise nuisance.

Period	Minimum measured background noise level, $L_{A90,15min}$ (dB)	Plant noise rating level, $L_{Ar,Tr}$ (dB)
Daytime (07:00 – 23:00)	45	40
Night time (23:00 – 07:00)	44	39

Table 3: Plant emission limits

The limits shall apply at the façade of the nearest existing noise sensitive buildings. As per LBC's requirement, if plant noise is expected to create a perceptible hum, hiss or tone, the above noise limits will be subject to an appropriate character penalty.

7.2.4 BREEAM Pol 05

As noise sensitive areas have been identified in proximity of the development site, noise limits for fixed plant should be set in order to satisfy Pol 05 criterion. Any noise associated with the new development must not increase background noise levels at the façade of the nearest noise sensitive building, by more than +5 dB during the day (07:00-23:00) and +3 dB during the night (23:00 07:00).

Limits imposed by the local authority are more onerous than what is required under BREEAM Pol 05 and therefore where these are achieved the Pol 05 criterion will be satisfied.

7.3 External plant noise mitigation

Detailed advice for plant noise control will be provided once plant noise data is known. Provision is currently made within the current design proposals for louvered screening measures to external plant at roof level.

It is reasonable to expect that the above criteria could be readily achieved provided the following basic noise control measures are observed;

1. Low noise equipment (e.g. Air Handling Units, DX cooling condensers) will be selected where practically possible.
2. AHU's to incorporate ducted splitter attenuators to fresh air intakes and exhaust ducts.
3. AHU enclosures to be sound insulated to limit fan noise breakout from casing.
4. Acoustic louvres to the ground level external plant area.
5. All equipment to be vibration isolated.

7.4 Future provision for emergency plant

Any M&E plant for emergency use shall be designed (for testing purposes only) to achieve 10 dB above the lowest measured background noise level. This is specified on the basis that plant will be tested during the day and infrequently only for short periods of time. The rating level for emergency plant at sensitive properties is shown in Table 4.

Period	Measured background noise level dB (L_{A90})	Emergency plant noise rating level at façade of nearest noise sensitive property ($L_{Ar,T}$)
Day	45dB	55dB

Table 4: Emergency plant noise emission limit

8. Construction Noise and Vibration Impact

It is understood that as part of the scheme the existing property at Lincoln House is to be extended. It will be necessary to consider the impact of these works on neighbouring properties.

Any neighbour has a common law right to seek redress in the courts for unacceptable levels of noise and vibration that are affecting their premises. Under The Control of Pollution Act 1974 (CoPA) and the Environmental Protection Act 1990 (EPA), the local authority can both control noise and vibration emission levels from construction activities using national legislation and act to prevent or to secure abatement of noise or vibration where it is deemed to be a statutory nuisance.

Construction noise and vibration is temporary and cannot be assessed in the same way as more permanent operational effects. BS 5228-1 indicates a number of factors that are likely to affect the acceptability of construction noise including site location, existing ambient noise levels, duration of site operations, hours of work, attitude of the site operator and noise characteristics of the work being undertaken.

Further review and assessment of the scope of construction activity will be required to ultimately feed into a construction management plan. This should aim to control and mitigate the negative impacts of noise and vibration from any construction activities or ground works to within acceptable bounds.

9. Summary and Conclusions

This report has covered acoustic advice for:

- Sound insulation of the building envelope
- Sound insulation of internal separating floors
- Compliance with BREEAM credits and Planning Authority Criteria
- Plant noise limits to atmosphere and allowance for noise mitigations

It is expected that through the specification of suitable sound control measures it will be possible to meet the requirements of the London Borough of Camden in terms of noise emissions from building services equipment and to provide adequate internal noise conditions for a commercial office environment via the sound insulation of the building envelope.

Appendix A – Glossary of acoustical terms used

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.

Octave and Third Octave Bands
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-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).

L_{Amax}
The highest A-weighted noise level recorded during a measurement period.

$L_{eq,}$
The $L_{eq,}$ 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_{90}
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.

Noise rating (NR) curves
To measure the noise rating of a given environment, the sound pressure level is measured in octave or one-third octave bands. The number of the highest curve touched by the measured levels then gives the noise rating. For general broadband noise, the NR rating is typically 5 dB to 7 dB less than the sound pressure level as measured in dB(A).

Rating Level
The specific noise level of the source plus any adjustment for characteristic features of the noise.

Reverberation Time, T
The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60 dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

Sound Reduction Index, 'R'
The difference measured between the amount of energy flowing towards the wall in the source room and the total amount of energy entering the receiving room (usual range 100 Hz - 3150 Hz). R varies with frequency and is measured in a laboratory in one-third octave bands.

Standardised Level Difference, D_{nT}
This is a measure of the level difference, corresponding to a reference value of the reverberation time in the receiving room. A correction term of ten times the common logarithm (to base 10) of the ratio of the actual reverberation time to the reference reverberation time is added to the level difference, D. For residential dwellings the reference reverberation time is 0.5s. The D_{nT} is measured in decibels. It is used as an airborne noise measurement parameter in sound insulation tests.

Standardised Impact Sound Pressure Level, L'_{nT}
This is a measure of the average noise level in a receiving room generated by use of a standard impact source on a separating floor reduced by a correction term corresponding to a reference value of the reverberation time. A correction of ten times the common logarithm (to base 10) of the ratio of the actual reverberation time to the reference reverberation time is subtracted from the received average noise level. For residential dwellings the reference reverberation time is 0.5s. The L'_{nT} is measured in decibels. It is used as an impact noise measurement parameter in sound insulation tests.

Impact Single Number Quantity Weighting
This is a weighting procedure defined in BS EN ISO 717, Part 2 for converting third octave band L'_{nT} values to a single number quantity denoted in $L'_{nT,w}$. It is a decibel value.

Airborne Single Number Quantity Weighting
This is a weighting procedure defined in BS EN ISO 717, Part 1 for converting third octave band R, R', D and D_{nT} values to a single number quantity denoted as R_w, R'_w, D_w or $D_{nT,w}$. It is a decibel value.

Spectrum Adaptation Term C_{tr}
This is a correction factor calculated from the measured R_w, R'_w,, $D_{nT,w}$ and the corresponding third octave band R, R' and D_{nT} values. It uses a set of weighting levels in third octave bands derived from a road traffic noise spectrum. It is applied to airborne test results and is measured in dB.

Appendix B – Acoustic Survey Details

Noise measurements were conducted on site in order to establish prevailing external noise levels between Friday 30th September and Tuesday 4th September 2016. Fixed measurements were undertaken in a position deemed representative of surrounding properties background noise levels. Manual measurements were taken at a ground level location.

Equipment used for both the fixed and manual measurements is summarised in Table 5. Weather conditions during the manual measurements were observed to be majority dry during the fixed noise monitoring. All instruments were calibrated before and after measurements and no significant drift was observed.

Monitor	Type	Manufacturer	Model	Serial No.	Calibration Expiry
Fixed	SLM	Rion	NL-52	00832187	24/11/2017
	Pre-amplifier	Rion	NH-25	32215	24/11/2017
	Microphone	Rion	UC-59	05405	24/11/2017
Manual	Sound Level Meter	Rion	NA-28	01260200	07/09/2017
	Pre-amplifier	Rion	NH-23	60103	07/09/2017
	Microphone	Rion	UC-59	280	07/09/2017
Calibrator		Rion	NC-74	34172704	04/07/2017

Table 5: Fixed and manual measurement equipment information

No.	Date	Start Time	Elapsed Time (MM:SS)	$L_{Aeq,T}$ dB	L_{A90} dB	L_{Amax} dB
1	04/10/16	10:30	05:00	55	53.4	66.3
2	04/10/16	10:35	05:00	54.5	52.6	63.8
3	04/10/16	10:40	05:00	56.2	54.3	64.3
4	04/10/16	10:46	05:00	54.6	52.5	61.6
5	04/10/16	10:51	05:00	54.7	52.8	63.8
6	04/10/16	10:56	05:00	54.5	53.2	65.2

Table 6: Manual noise measurement results at positions indicated in Figure 1

Time history results from the fixed monitor position are shown in Figure 2 overleaf.

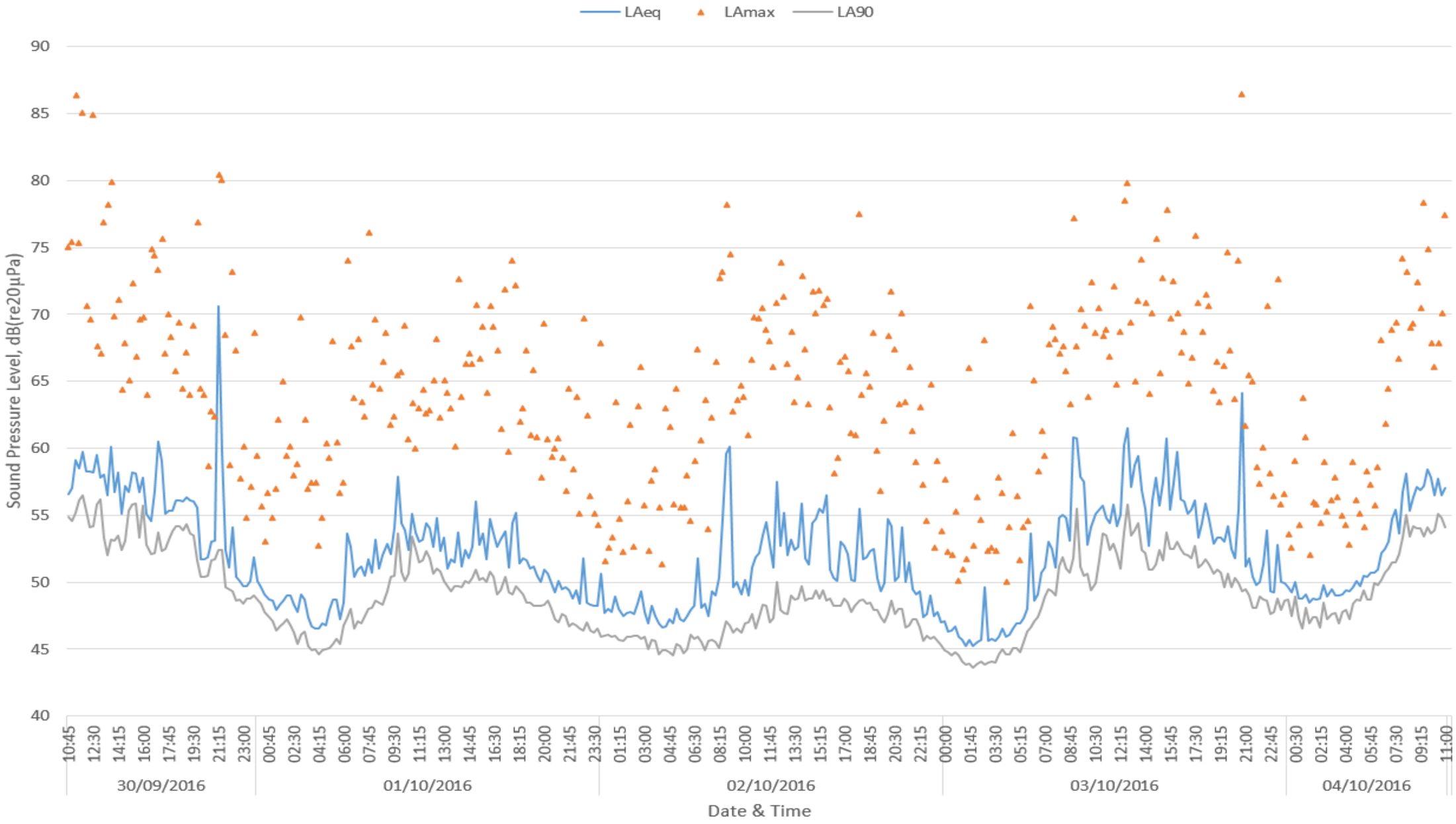

Figure 2 Results of the fixed noise monitoring measurements

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