SIDCUP LIBRARY

HADLOW ROAD, LONDON, DA14 4AQ

ACOUSTIC REPORT

Report to

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 50 years of continuous practice.

Architects: Design and project management services which cover all stages of design, from feasibility and planning through to construction on site and completion.

Acoustic Consultants: Expertise in planning and noise, the control of noise and vibration and the sound insulation and acoustic treatment of buildings.

Construction Technology Consultants: Expertise in building cladding, technical appraisals and defect investigation and provision of construction expert witness services.

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1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have been appointed to provide acoustic consultancy services to a proposed residential development at Sidcup Library, Hadlow Road, London, DA14 4AQ.

This report is intended to support an application to the London Borough of Bexley (LBB) for approval to convert the existing public library building at Hadlow Road into a residential development containing 32 apartments.

The report contains a description of the site and proposed development (Section 2.0), acoustic design criteria informed by local planning policy and national good practice guidance (Section 3.0), a summary of the environmental noise and vibration survey carried out at the site by BAP in July 2021 (Section 4.0) and initial acoustic design advice based on the survey results and the current architectural and M&E design for the project (Sections 5.0 – 8.0).

This report is necessarily technical. A glossary of acoustic terminology is included in Appendix 1. Information on the environmental noise and vibration survey, including equipment serial numbers and weather history, is included in Appendix 2. The current architectural design drawings are included in Appendix 3.

This report has been prepared specifically in response to instructions received from BexleyCo Homes and is not intended for any other purpose. Survey work carried out in connection with this commission is limited in extent to the scope of those instructions.

2.0 SITE INFORMATION

The site contains the Sidcup Library building located at the junction of Hadlow Road and Sidcup High Street (A211). The surrounding land usage is a combination of residential and commercial, with semidetached residential houses along Hadlow Road and St John’s Road to the North and East, and commercial usage along Sidcup High Street to the South and East.

There is a commercial building comprising a ground floor Waitrose supermarket with a Travelodge hotel above, adjacent to the Southern boundary of the site. The rear façade of this commercial property is at approximately 40 metres to the Eastern façade of the existing library building.

There is an electrical substation at approximately 30 metres to the Eastern façade of the existing library building.

A marked up aerial photograph of the site is shown in Figure 1.

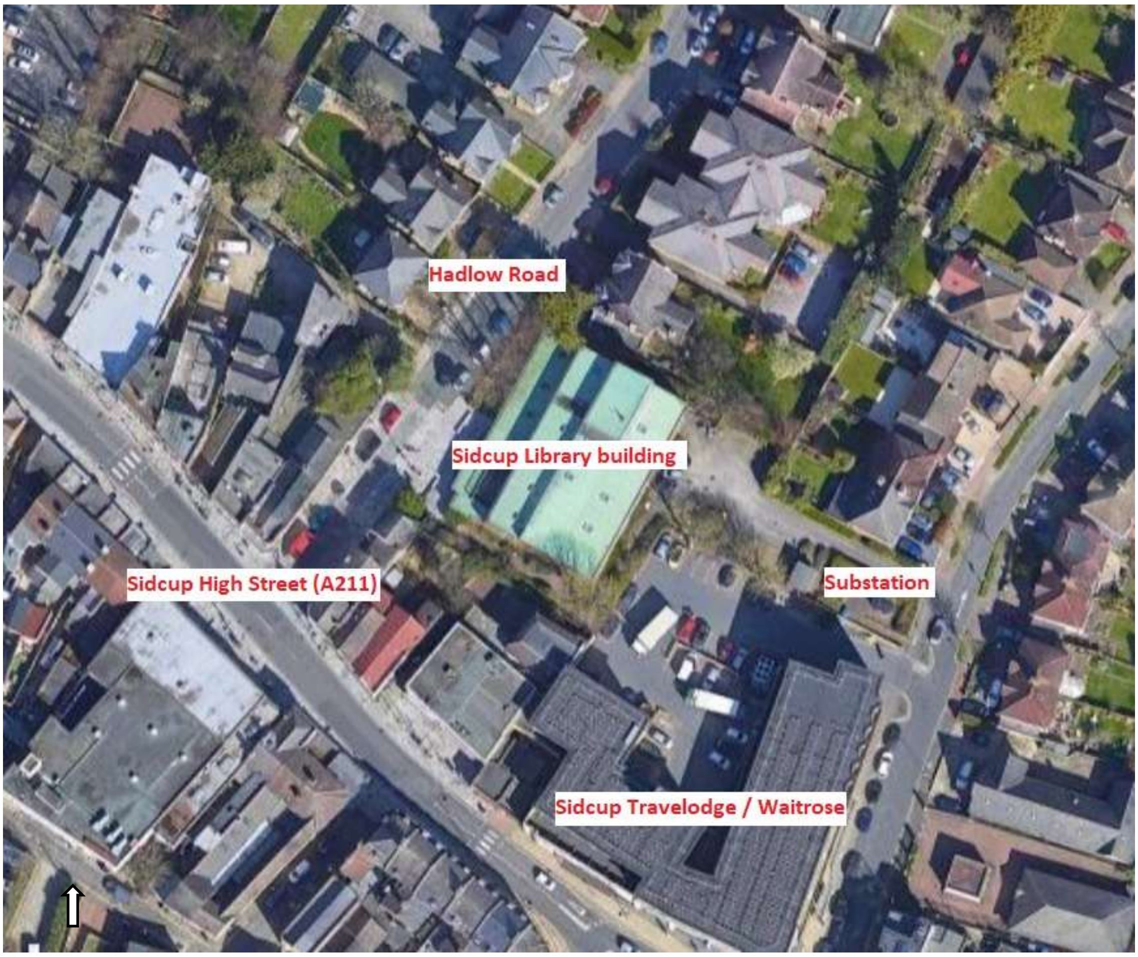


Figure 1: Aerial photograph of the existing site

The site boundary of the proposed development is shown in Figure 2.

Figure 2: Site boundary drawing (from Stitch Studio red-line drawing)

BAP understand that the proposed development will comprise a four-storey building of residential apartments. There is associated external landscaping along with 16 parking spaces created to the rear of the site (Eastern boundary). There are internal cycle and bin stores on the ground floor. The building is to be served by air source heat pumps (ASHPs) which are located externally in a compound on the North-eastern site boundary. The current architectural design drawings in plan layout and section view, provided by Stitch Studio Ltd., are included in Appendix 2 of this report.

3.0 ACOUSTIC DESIGN CRITERIA

3.1 London Borough of Bexley

BAP have reviewed the LBB Local Development Framework, Supplementary Planning Document: 'Sustainable Design and Construction Guide' (adopted 2006) to establish the anticipated acoustic design criteria for the project.

Appendix A (page 55) of that document presents a table of information relating to *"Objective 3 – Reducing negative impact of development on the local environment"*. Under the key principle of *"Mitigate noise impact"*, the following guidance is given:

"

1. *Demonstrate that adverse impacts of noise have been minimised, using measures at source or between source and receptor (including choice and location of plant or method, layout, screening and sound absorption) in preference to sound insulation at the receptor, wherever practicable.*
2. *For residential development, achieve BS 8233:1999 (Table 5) 'good' standards for external to internal noise and improve on Building Regulations (2003) Part E for internal sound transmission standards by 5 dB (see BRE Ecohomes)".*

In the absence of any specific numerical requirements with regard to plant noise emissions, BAP expect that the Local Authority's acoustic criteria is anticipated to be in line with the national planning guidance and BS4142:2014. BS8233:1999 has been withdrawn and replaced with BS8233:2014. This report has been prepared based on the current version of BS8233.

3.2 National Planning Policy Framework: 2021

The relevant planning policy under the 2021 NPPF for new development with regards to noise is provided below.

"174. Planning policies and decisions should contribute to and enhance the natural and local environment by: …

…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; …"

"185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative 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:

a) *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*[65]*;…"*

[65] *See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food & Rural Affairs, 2010).*

3.3 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) provides the framework for noise management decisions to be made that ensure noise levels do not place an unacceptable burden on society.

The stated aims of the Noise Policy Statement for England are to:

- *Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;*
- *Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development; and*
- *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*

In respect of achieving the first aim above, the NPSE defines the Significant Observed Adverse Effect Level (SOAEL) as "*This is the level above which significant adverse effects on health and quality of life occur*". No objective guidance has been provided to enable policy makers, noise practitioners and decision makers to understand what this threshold level is.

3.4 Planning practice guidance (Noise) – PPG(N)

Central government guidance on how planning can manage potential noise impacts in new development is provided on the online Planning Practice Guidance (Noise) (PPG(N)) website, last updated July 2019 National - Planning Practice Guidance Noise PPG(N)

It provides guidance on how to determine the noise impact, advising that local planning authorities should take account of the acoustic environment and in so doing consider:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

It states that in line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure is, or would be, above or below the "significant observed adverse effect level" and the "lowest observed adverse effect level for a given situation. These boundary levels are described in the guidance as follows:-

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected.
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Guidance is provided on how to recognise when noise could be a concern. It explains that when noise is not noticeable, there is by definition no effect. As the noise exposure increases, it can slightly affect the acoustic character of an area but not to the extent there is a perceived change in quality of life. At this noise exposure level, no specific noise mitigation measures are required. As the exposure increases further, the lowest observed adverse effect level boundary is crossed. The noise starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

The guidance advises that above the significant observed adverse effect level boundary, the planning process should be used to avoid this effect occurring, by use of appropriate mitigation such as by altering the design and layout. Such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused.

At the highest extreme, noise exposure would cause extensive and sustained changes in behaviour without an ability to mitigate the effect of noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be prevented from occurring.

Guidance on an interpretation of these boundaries is given in Table 1, based on the likely average response.

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 1 - Planning practice guidance (Noise)

3.5 British Standard 8233:2014 "Guidance on sound insulation and noise reduction for buildings"

British Standard 8233 provides the acoustic design criteria for new residential buildings in the UK. This Standard was updated in 2014. It is considered appropriate that acoustic design criteria for this project should be adopted from the updated 2014 Standard.

For internal ambient noise levels in dwellings, British Standard 8233: 2014 states that in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values given in Table 2:

Activity	Location	07:00 – 23:00 dB $L_{Aeq, 16 hour}$	23:00 – 07:00 dB $L_{Aeq, 8 hour}$
Resting	Living room	35	-
Dining	Dining room/area	40	-
Sleeping	Bedroom	35	30

Table 2: Criteria for internal sound levels in residential spaces (from Table 4 of BS 8233: 2014)

These design level criteria are consistent with those found in the 1999 version of BS 8233 (Table 5).

BS 8233: 2014 also advises that "*regular individual noise events (for example, scheduled aircraft or passing (trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values*".

BAP recommend that a guideline of 45 dB $L_{AF,max}$ should be used to assess regular noise events within bedrooms at night. This is consistent with the criteria associated with Table 5 of the 1999 version of BS 8233 and is based on guidance from the World Health Organisation (WHO) on sleep disturbance caused by noise maxima.

BS 8233:2014 also includes the following guidance with respect to gardens and amenity spaces:

"*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.*"

3.6 BS 4142: 2014

British Standard 4142: 2014 contains guidance on assessing and rating the impact of industrial and commercial sound.

Section 1.3 of BS 4142 discusses the scope of the standard and states the following;

"1.3 The determination of noise amounting to a nuisance is beyond the scope of this British Standard.

Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems.

The standard is not intended to be applied to the rating and assessment of sound from:

a) recreational activities, including all forms of motorsport;

b) music and other entertainment;

c) shooting grounds;

d) construction and demolition;

e) domestic animals;

f) people;

g) public address systems for speech; and

h) other sources falling within the scopes of other standards or guidance.

The standard is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels."

Clause 11 of BS 4142 regarding the assessment of impact states the following:

"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9) and consider the following.

NOTE 1 More than one assessment might be appropriate.

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

With regards to context the standard advises the following,

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used *to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*

NOTE 3 Consideration ought to be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

- *I. facade insulation treatment;*
- *II. ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
- *III. acoustic screening."*

The context of this site is such that prevailing high levels of traffic noise (and local authority acoustic performance standards) will require the proposed dwellings to have a high level of façade insulation treatment and ventilation to secure good internal acoustic conditions.

3.7 Sound insulation between residential receptors (Internal separating walls and floors)

The sound insulation performance requirements for construction projects in England are detailed in Approved Document Part E (2003) of The Building Regulations 2010 (ADE:2003).

Table 3 presents the sound insulation performance criteria for purpose-built dwelling-houses and flats under Requirement E1 of ADE:2003.

Building element	Airborne sound insulation $\geq D_{nT,w} + C_{tr}$ dB	Impact sound insulation $\leq L'_{nT,w}$ dB
Separating walls	45	-
Separating floors	45	62

Table 3: ADE:2003 performance requirements (from Table 0.1a)

It can be seen from the LBB requirements in 3.1 that the sound insulation performance of separating partitions must be 5 dB above the Building Regulations. On that basis, the resultant sound insulation criteria for this project are presented in Table 4 below. Note that impact sound insulation values are inversed (i.e., the lower the number, the greater the performance).

Building element	Airborne sound insulation $\geq D_{nT,w} + C_{tr}$ dB	Impact sound insulation $\leq L'_{nT,w}$ dB
Separating walls	50	-
Separating floors	50	57

Table 4: London Borough of Bexley performance requirements (+5dB above ADE:2003)

It is common for housing associations to request higher acoustic performance standards similar to the above planning requirements.

3.8 Sound insulation of internal walls and floors

For internal floors and specified partitions within a new residential property, Approved Document E requires a minimum performance standard of 40 dB R_w. This is demonstrated by selecting partition types, tested in a laboratory by the manufacturer, which meet or exceed this performance standard.

3.9 Sound insulation of entrance doors to apartments

The minimum recommended performance standard set out in Approved Document E is that the entrance door to the apartments should have good perimeter sealing (including threshold seals where practical) and a minimum mass of 25 kg/m^2, or a minimum laboratory tested performance of 29 dB R_w.

3.10 Reverberation control

Approved Document E includes a mandatory requirement for the control of reverberation in common internal parts of buildings that give direct access to the apartments, i.e., the communal corridors. Sound absorption is not required for common internal parts of buildings which do not provide direct access to apartments.

Regulation E3, states that *"The common internal part of a building that contains a flat or a room for residential purposes shall be designed and constructed in such a way as to limit reverberation around those common parts to a reasonable level."*

Two methods are described to satisfy Regulation E3 Method A and Method B.

"Method A: Cover a specified area with an absorber of an appropriate class that has been rated according to BS EN ISO 11654.

Method B: Determine the minimum amount of absorptive material using a calculation procedure in octave bands. Method B is intended only for corridors, hallways and entrance halls as it is not well suited to stairwells."

To comply with Method A the ceiling of halls or corridors which give direct access to flats should have a sound absorption class of Class C or higher (when rated in accordance with BS EN ISO 11654). Method A is the simplest method to demonstrate compliance.

3.11 Control of internal M&E plant equipment noise

There are no mandatory standards for the control of M&E noise inside a building. Noise from continuously running plant (MVHR) must be controlled to an acceptable level to avoid the risk of annoyance and/or residents switching their MVHR units off.

Recommended internal building services noise levels for residential spaces are taken from by CIBSE *Guide A: 2015 Environmental Design*, Approved Document F: 2010 of the Building Regulations, are given in Table 5.

Space	**CIBSE Guide A: 2015**		**Approved Document F**
	NR	**dB(A)**	**dB(A)**
Bedrooms	25	30	30(2)
Living rooms	30	35	30(2)
Kitchens	40-45(1)	45-50(1)	35(2)
Bathrooms	-	-	35(2)

Table 5: Limiting background building services noise levels inside residential spaces

Note 1: Intermittent extract.

Note 2: Noise from a continuously running mechanical ventilation system on its minimum low rate should not normally exceed these levels, and should preferably be lower in order to minimise the impact of the ventilation system.

Recent evidence[1] on the acceptability of noise from MVHR systems suggests a lower limit (26 dBA) for bedrooms should be used. BAP recommended maximum permissible noise limits from building services for the residential spaces in the development are given in Table 6. Compliance with these standards will usually require room side attenuation for the MVHR system.

[1] Acoustic Ventilation and Overheating – Residential Design Guide (ANC & IOA 2020).

Space	Systems serving or located in space	
	NR	dB(A)
Bedrooms – minimum low rate	20	26
Living rooms - minimum low rate	25	30
Kitchens/bathrooms – minimum low rate	30	35

Table 6: Recommended maximum permissible background noise levels generated by building services installations

3.12 British Standard 6472-1:2008

The relevant standard for the assessment of vibration levels impacting on residential amenity is British Standard BS6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting*.

The standard advises that "*In homes adverse comment about building vibrations is likely when the vibration levels to which the occupants are exposed are only slightly above thresholds of perception.*"

"*Perception thresholds for continuous whole-body vibration vary widely among individuals. Approximately half the people in a typical population, when standing or seated, can perceive a vertical weighted peak acceleration of 0.015m/s^2. The weighting used is W_b. A quarter of people would perceive a vibration of 0.01m/s^2 peak, but the least sensitive quarter would only be able to detect a vibration of 0.02m/s^2 peak or more. Perception thresholds are slightly higher for vibration duration of less than about 1s.*"

These weighted peak acceleration thresholds can be used to objectively assess whether complaints about vibration are justified.

The Standard uses the weighting curves from BS 6841:1987 "*Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock*" to define the threshold of perception. These 1/3 octave values can also be used to objectively assess vibration levels.

Vibration can also increase perception via induced parallel effects include rattling. The standard advises that "*Effects such as the rattle of windows, furniture, fittings or ornaments might be due to vibration or acoustic excitation, but their occurrence might emphasize the presence of vibration and should be measured if appropriate and reported*"

The standard provides the following guidance on the response of floors to footfall or "dynamic excitation"

"Floors with natural frequencies lower than about 7-10 Hz are sometimes known as "low frequency" floors. These are susceptible to a resonant build-up of vibration due to periodic human excitation such as walking, running, jumping etc. In such cases, the amplitude of vibration depends on the magnitude of the excitation and the mass and damping of the floor engaged. More massive floors with greater damping exhibit lower vibration response for the same excitation."

As well as guidance on perceptibility, BS 6472 also provides Vibration Dose Values which assess the level of vibration over a 16-hour day or 8-hour night. The VDV assessment criteria is presented below.

Place and time	**Low probability of adverse comment (m.s$^{-1.75}$ [1])**	**Adverse comment possible (m.s$^{-1.75}$)**	**Adverse comment probable (m.s$^{-1.75}$ [2])**
Residential buildings (16h day)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings (8h night)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 7: BS 6472-1:2008 VDV criteria

4.0 ENVIRONMENTAL NOISE AND VIBRATION SURVEY

4.1 Survey Methodology

An environmental noise and vibration survey was carried out at the project site between Wednesday 21st and Monday 26th July 2021.

The purpose of the survey was to establish the prevailing noise environment across the site, to inform the design of the building envelope for suitable internal levels and to establish limiting background noise levels for the assessment of noise impact to neighbouring sensitive receptors.

Three noise monitoring positions were taken around the site during the survey. These monitoring locations are indicated (1 – 3) on the aerial photograph in Figure 3.

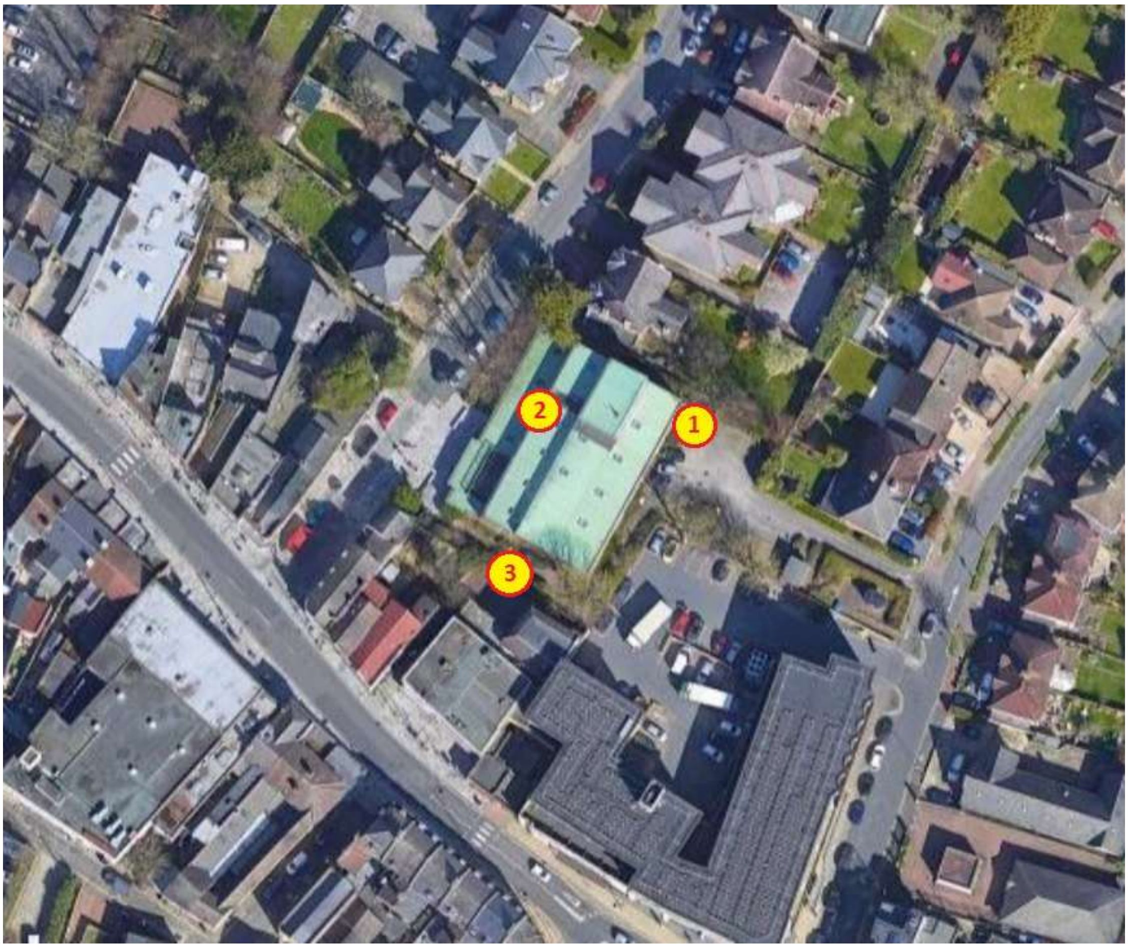


Figure 3: Noise monitoring locations

The noise monitoring equipment used during the survey was field calibrated before and after, with no significant drift in calibration observed.

Weather conditions throughout the survey period were warm to mild, with no precipitation and wind speeds under 5 m/s. These conditions are considered suitable for obtaining representative measurement results.

Full details of the monitoring equipment used during the environmental noise survey, including serial numbers and calibration histories, can be found in Appendix 2 of this report.

During the noise survey it was observed that:

- The dominant source of noise incident on the site was road traffic noise along Sidcup High Street (A211) and at the junction with Hadlow Road. This included regular bus and HGV passes.
- The attended noise measurements at the front (public entrance) side of the library building were also influenced by pedestrian noise.
- High-flying commercial jet passes overhead were regular but not observed to influence the average noise level.
- Noise from the electrical substation was inaudible both at close distance to the source (5 metres) and at the monitoring positions.
- No vibration was perceptible from the electrical substation.

4.1.1 Unattended long-term noise monitoring

A noise monitor was installed at Monitoring Position (MP) 1 to carry out long-term, unattended measurements. The noise monitor at this position was fixed to the metal access gate of the refuse store at the rear of the existing library building, being the only secure location available for the equipment. The monitoring position is shown in Figure 4.

Figure 4: Long-term, unattended monitoring at MP1

The noise monitor at MP1 was set up to log broadband and 1/3 octave sound pressure level data at 15-minute intervals between 16:45 on 21st July and 14:30 on 26th July.

The noise level data from this monitoring location have been used to establish the continuous average noise levels incident on the site.

4.1.2 Short term attended noise monitoring

The long-term survey was supplemented by a series of short-term attended measurements at Monitoring Positions (MP) 2 and 3 taken on Wednesday 21st July.

MP2 is located along a public access path that runs past the Southern boundary and façade of the existing library site. The position is screened from road traffic noise by two-storey buildings at 17 to 21 Sidcup High Street. The monitoring position is pictured in Figure 5.

Figure 5: Short-term, attended monitoring at MP2

Noise level measurements at MP2 were taken between 13:40 and 14:25 using a sound level meter fixed on a tripod at 1.5m above ground level. The noise monitor was set up to log broadband and 1/3 octave sound pressure level data at 15-minute intervals.

At MP3, noise monitoring was carried out using a sound level meter with the microphone extended at 1 metre from the first-floor window of the existing library building (West-facing façade – Southernmost window). The monitoring position is picture in Figure 6.

Figure 6: Short-term, attended monitoring at MP3

Noise level measurements at MP3 were taken between 15:00 and 15:30. The noise monitor was set up to log broadband and 1/3 octave sound pressure level data at 15-minute intervals.

4.1.3 Vibration monitoring

Vibration monitoring was carried out inside the library building between 21st and 26th July. The purpose of this monitoring was to establish the impact, if any, or vibration levels incident on the site. The primary source of any potential vibration incident on the site is the electrical substation at 30 metres to the East (indicated in Figure 1). No vibration from the substation was perceptible on site.

Vibration monitoring was carried out with the accelerometer located on a hard tile surface in the rear access corridor to the existing library building, which is a staff access route to both the ground floor library and the Council archives space on the first floor. Vibration data has been analysed for Thursday 22nd July only – as the library is closed on that day and so the measurements are not influenced by footfall within the building.

4.2 Survey results

The noise and vibration survey results are presented in full in Appendix 3 of this report. A summary of the survey data is presented here, relevant to the acoustic design strategy for the project. Raw survey data can be made available on request.

4.2.1 Average noise levels

Continuous average noise levels (dB $L_{Aeq,T}$) have been established using data from the long-term unattended noise monitor at position MP1. These are presented in Table 8.

The noise level data has been processed as a logarithmic average of all 15-minute measurements taken in Day (0700 – 2300) and Night (2300 – 0700) periods throughout the survey duration. The Day and Night time average levels for each survey date between 21st and 26th July are then arithmetically averaged to determine the overall design level.

Position	Day time average noise level (dB $L_{Aeq,16h}$)	Night-time average noise level (dB $L_{Aeq,8h}$)
MP1	50	44

Table 8: Continuous average noise level data (Eastern façade)

The western façade of the building is expected to be exposed to higher noise levels than those incident on the eastern façade (MP1), due to its unobstructed line of sight to Hadlow Rd. Noise survey data on the western façade of the building are only available as spot measurements of limited duration (MP3), as there was not a secure location to leave a noise monitor measuring unattended. Based on those short-term measurements, in comparison with the unattended measurements at MP1, it anticipated that the continuous average noise levels (dB $L_{Aeq,T}$) on the western façade of the building are as follows:

Position	Day time average noise level (dB $L_{Aeq,16h}$)	Night-time average noise level (dB $L_{Aeq,8h}$)
MP3	55	49

Table 9: Continuous average noise level data (Western façade) – Estimated

These are the noise levels which are used as the basis of design for the building envelope (with regard to achieving suitable internal noise levels). The relevant 1/1 octave band data (processed by the same method) is presented in Table 11.

4.2.2 Maximum noise levels

The night-time noise level maxima incident on the site are created by the movement of heavy vehicles (bus and HGV) along the A211. It was not possible to install a noise monitor in a secure location representative of the Northern and Western façades of the existing building that are closest to this noise source. It is reasonable to assume that noise level maxima generated by bus and HGV movement during the day will be the same as those at night. The determination of representative noise maxima has therefore been assessed using the short-term, attended monitoring data from MP2 and MP3.

The maximum noise level data (dB L_{AFMax}) from these monitoring positions has been processed at 1-second resolution data is presented in graphical format for each monitoring position in Figure 7. Histogram analysis has also been used to inform the processing of a suitable design level for noise maxima.

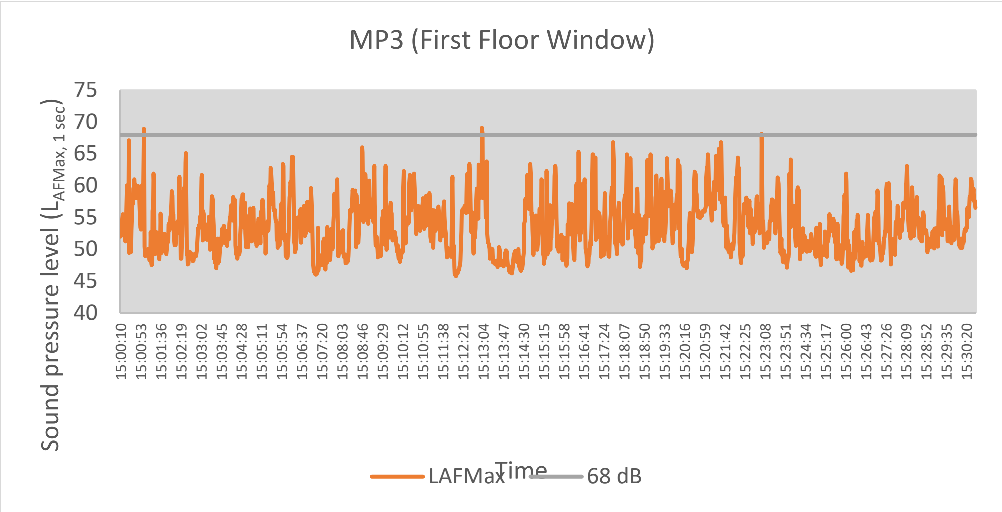


Figure 7: Maximum noise level data (1 second resolution)

Based on the data presented in Figure 7 above, a maximum noise level of 68 dB $L_{AFMax,\ 1s}$ is considered to be a representative noise level for assessing the acoustic design of the proposed development, with regard to the control of maximum noise levels inside bedrooms at night.

4.2.3 Background noise levels at night

The background noise levels (dB $L_{AF90,\ 15\ min}$) during the night-time period (2300 – 0700) measured at MP1, are presented in Table 10 below. These are processed by taking the arithmetic average of each 15-minute measurement.

Date	Night-time average noise level (dB $L_{Aeq,\ 8\ h}$)
21/07/21	36
22/07/21	35
23/07/21	38
24/07/21	33
25/07/21	32
Typical	35

Table 10: Night-time background noise data (Façade)

4.2.4 Vibration data summary

The measured vibration levels are plotted against the weighting curves from BS 6841:1987 which define the threshold of perception on the vertical (z-axis) and horizontal (x and y axis). As can be seen in Figure 8, vibration levels are below the thresholds of perceptibility and no mitigation measures are necessary.

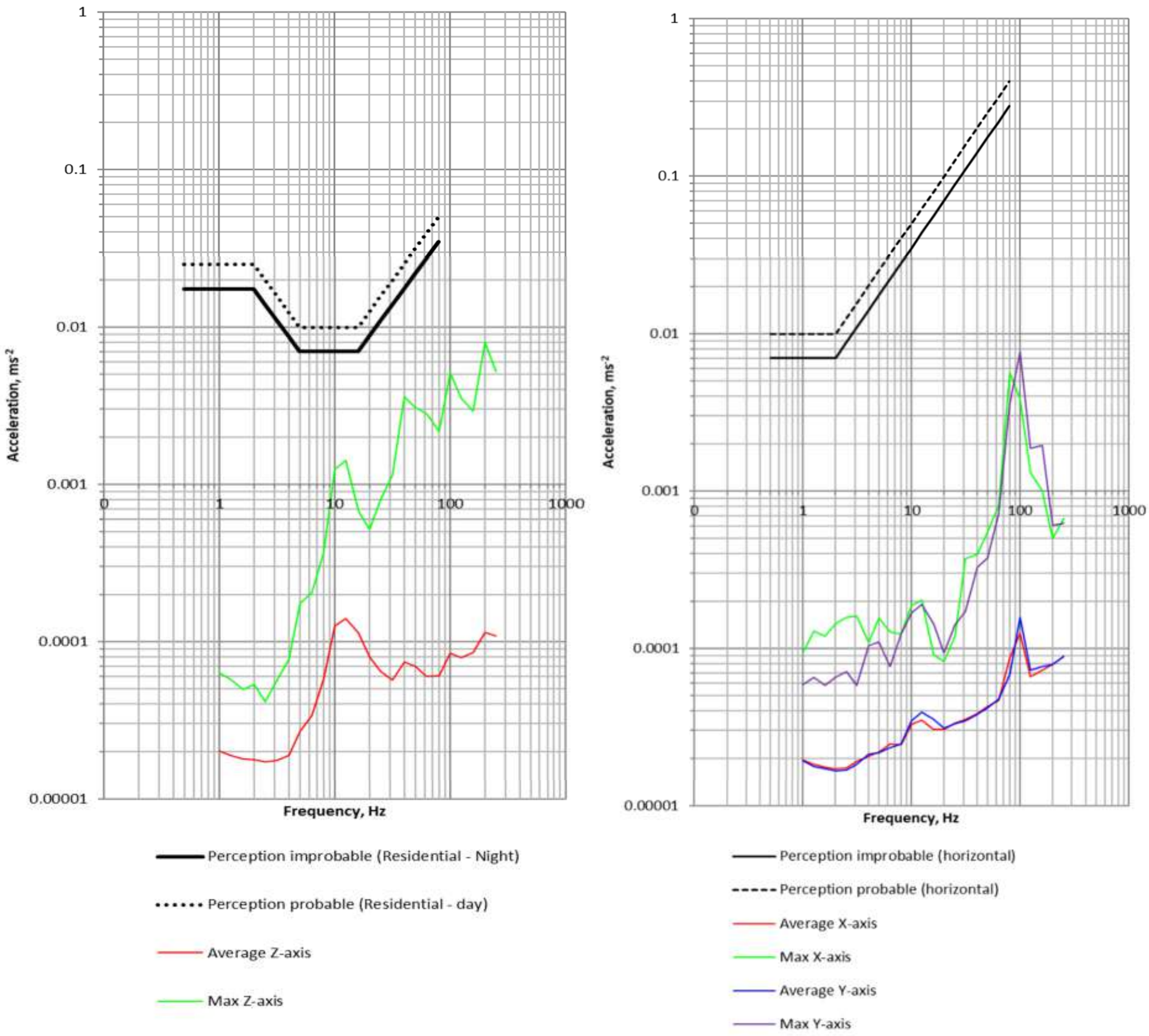


Figure 8: Vibration data summary and assessment

5.0 BUILDING ENVELOPE

5.1 Design assumptions

Based on the survey results detailed in Section 4.0, BAP have adopted design levels for the relevant paraments as presented in Table 11. 1/1 octave band level data are presented alongside broadband (dBA) levels as they relate to the following acoustic design assessment.

Time	Parameter	Sound pressure level at 1/1 octave band (dB)						dBA
		125	250	500	1000	2000	4000	
(Western façade) Day (0700 – 2300)	$L_{Aeq, 16 h}$	58	53	51	50	48	44	55
(Western façade) Night (2300 – 0700)	$L_{Aeq, 8h}$	49	45	43	43	43	40	49
(Eastern façade) Day (0700 – 2300)	$L_{Aeq, 16 h}$	53	48	46	45	43	39	50
(Eastern façade) Night (2300 – 0700)	$L_{Aeq, 8h}$	45	40	38	38	38	35	44
Night (2300 – 0700)*	$L_{AFMax, 1s}$	66	63	61	60	64	61	68

Table 11: Summary of design noise levels

The area of glazing in any room, along with the room size and acoustic conditions, affects the degree of reduction in noise transmission from outside to inside. BAP have carried out an assessment based on architectural drawings provided by Stitch Studio Ltd. The following assumptions have been used for the assessment of the building envelope's sound insulation requirements:

- Room and window sizes based on Stitch Studio drawings: *20217 Series 0100 (Plan) and 0200 (Elevation)*.
- Predictions are made using the general method set out in BS EN 12354-3:2017.

- The building envelope construction is assumed to perform at 52 R_w / 48 $R_w + C_{tr}$. This is based on BAP library data for a standard brick-block cavity wall.
- It has been assumed that the on-site performance will be comparable with manufacturers' claimed performance.
- The predictions assume good quality workmanship, for example that windows, doors and opening lights are well sealed. Poor workmanship may result in predicted internal noise levels being exceeded.
- BAP understand that the ventilation strategy for the development is continuous mechanical supply and extract with heat recovery (MVHR) (i.e., Approved Document F System 4), therefore background/trickle will not feature in the design.
- The acoustic strategy is based on achieving noise standards inside noise sensitive rooms with windows closed and adequate (MVHR) ventilation provided as per recommendations in BS8233:2014. With windows open noise levels will exceed recommended BS8233:2014 desirable standards however the external environmental noise levels are modest and internal noise levels will not be excessive for the future occupants.

5.2 Recommended performance standards

This section provides window sound insulation performance requirements for the living rooms and bedrooms, which with careful detailing are expected to provide the necessary performance requirements to meet the relevant criteria.

The glazing requirements are applicable to the window system, including frames and any mullions and panels. When selecting windows, acoustic performance must be verified by test data from an independent testing facility (UKAS or international equivalent). Laboratory test data should be carried out under the BS EN ISO 10140 series and rated in accordance with BS EN ISO 717-1:2020. Laboratory tests carried out in accordance with the recently withdrawn earlier versions of these standards are also likely to be acceptable but should be submitted to the project acoustic consultant for approval.

The window sound insulation requirements are dependent on the ventilation strategy for the development. If the strategy changes away from a MVHR or system 4 the below specifications will need to be re-assessed.

Table 12 provides a summary of the minimum sound insulation requirements for façade elements. The specified sound reduction indices, R_w and $R_w + C_{tr}$ should be met as a minimum in each case.

Façade	**Room type**	**Window**	
		R_w (dB)	**$R_w + C_{tr}$ (dB)**
All (System 4 – MVHR)	Bedroom	31	27
	Living room	31	27

Table 12: Minimum glazing sound insulation requirements

The requirements in Table 9 are not onerous and representative of a standard 4-12-4mm double glazing specification.

5.3 Outdoor amenity space

The proposed development includes a communal amenity space at the Eastern side of the site.

The location at which noise was measured during the attended survey is representative of the amenity space indicated at the Eastern side of the site. The measured façade level at this side of the site (MP1) during the day was 50 dB $L_{Aeq, 18h}$, which is equal to the target level guidance for outdoor amenity spaces in BS 8233:2014. It is possible that the proposed building itself will reduce the noise level in the amenity space further to screening effects.

6.0 INTERNAL SOUND INSULATION

In this section, advice on general sound insulation requirements for the project is provided with reference to the performance criteria. Details of the proposed separating wall and floor constructions throughout the project are not available at the time of writing. The recommendations below should be regarded as indicative notionally suitable construction options for achieving the airborne and impact sound insulation requirements. There are many options available capable of achieving the required project performance standards.

6.1 Separating walls

The construction of separating walls between residences should achieve an airborne sound insulation performance of ≥50 dB $D_{nT,w}+C_{tr}$.

It is understood that the preferred constructional option would be for loadbearing walls. Indicative notionally suitable construction options for achieving the airborne and impact sound insulation requirements are presented below, although there are many other options available.

The separating wall construction examples below include a cavity masonry wall and a dry lining construction option.

Cavity Masonry Wall Indicative construction option:

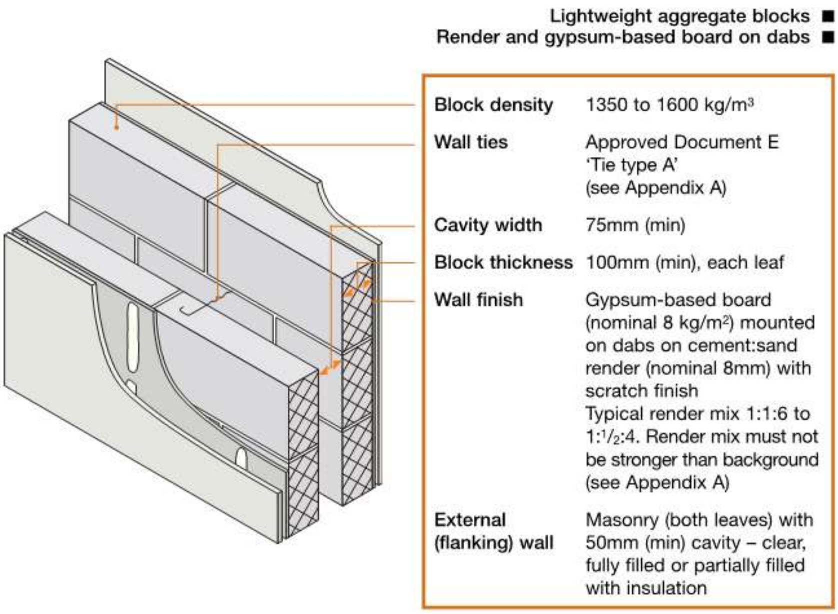


Figure 9: Cavity masonry wall construction example

Note:

It should be noted that the separating floor between the flats must not be continuous, for this construction to work. A cavity wall construction will not work acoustically with a continuous structural floor. An indicative detail is shown in Figure 10 below:

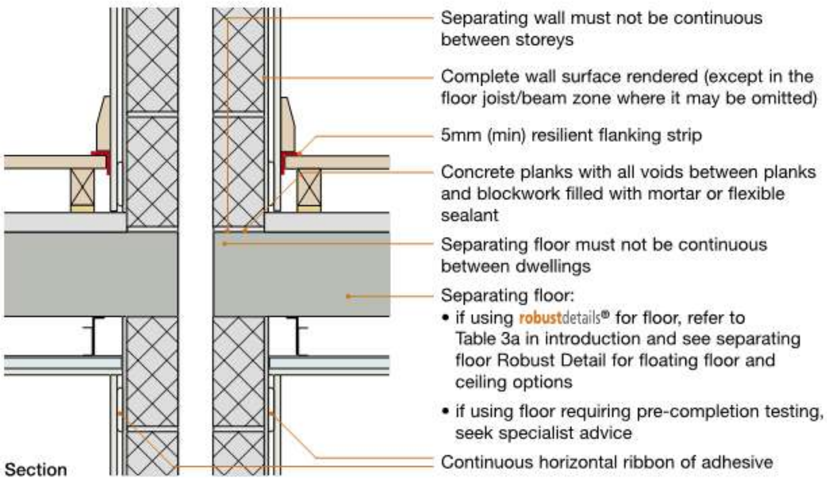


Figure 10: Indicative separating wall to separating floor junction detailing for cavity masonry wall construction

Drylining Indicative construction option:

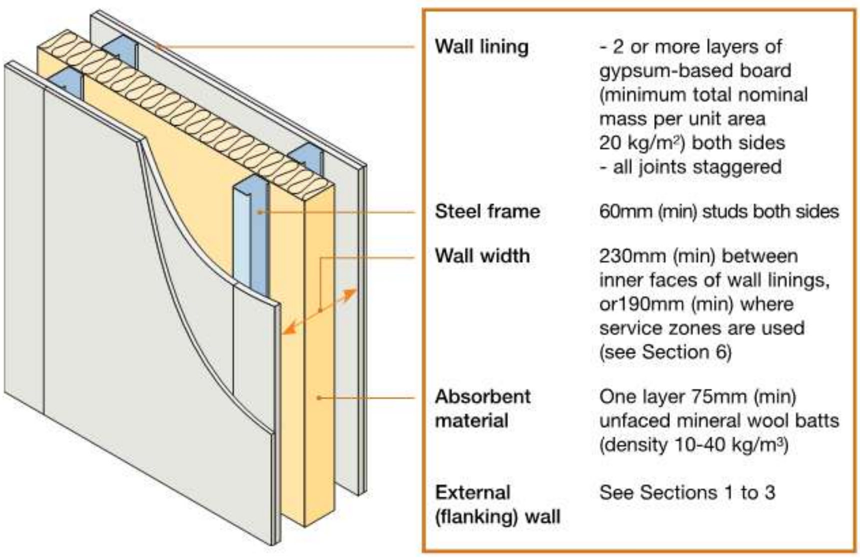


Figure 11: Steel frame drylining party wall construction example

Note:

This construction it does not require the floor between the flats to be split (compared to the cavity masonry wall option). However, the slab must be at least 175mm with a density of 2400kg/m^3

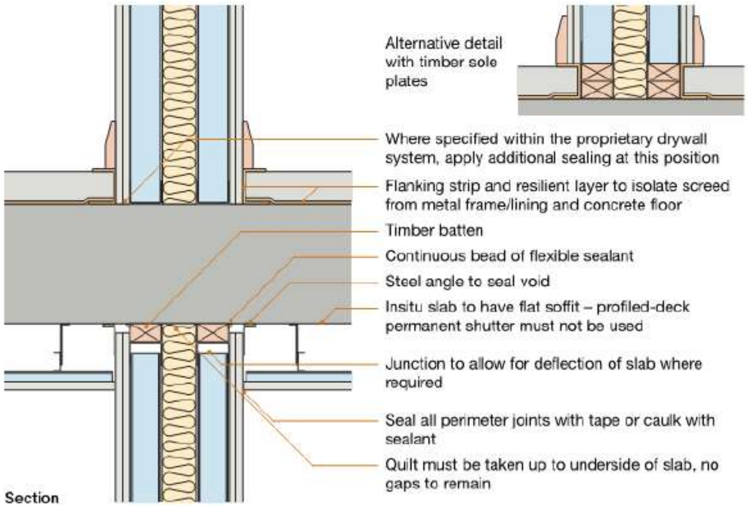


Figure 12: Indicative separating wall to separating floor junction detailing for steel frame drylining party wall construction wall construction

All walls should run from the floor structure to soffit/underside of the roof decking.

6.2 Acoustic detailing

Whichever wall construction is used it is imperative that to achieve the required acoustic performance in-situ, the walls must be built in strict accordance with the dry lining or block manufacturer’s recommended details including all penetration and junction details.

6.3 Separating floors

The construction of separating floors between residences should achieve an airborne sound insulation performance of 50 dB $D_{nT,w}+C_{tr}$ and an impact sound insulation performance of 57 dB $L'_{nT,w}$.

Indicative notionally suitable construction options for achieving the airborne and impact sound insulation requirements are presented below, depending on the selection of the proposed party wall construction.

Precast concrete floor example (to be used with a cavity masonry wall construction)

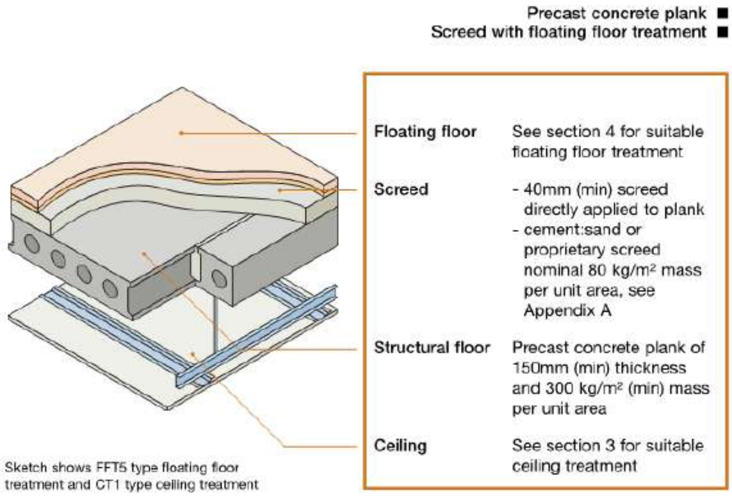


Figure 13: Precast concrete floor construction example

In-situ concrete floor example (to be used with a drylining wall construction)

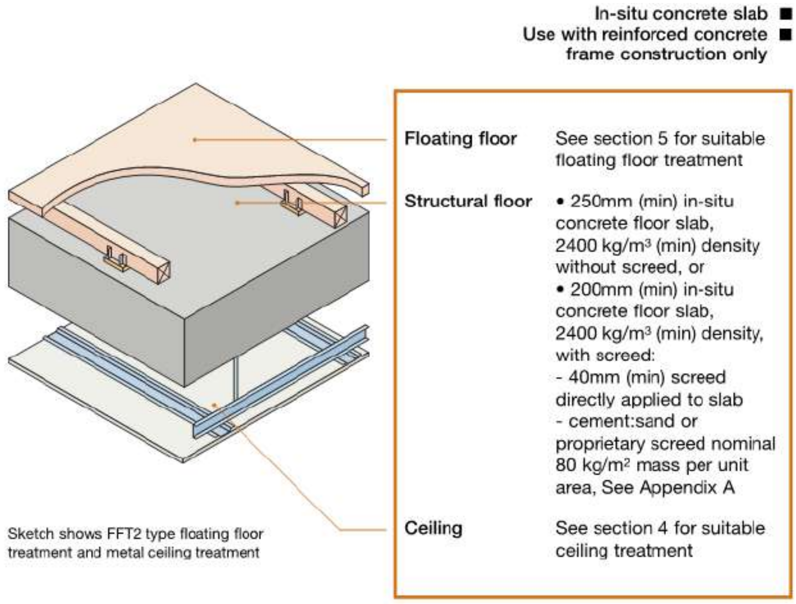


Figure 14: In-situ concrete floor example

6.4 Internal partitions

Internal partitions (i.e., within each residential apartment) need to achieve a laboratory rated sound insulation performance of minimum 40 dB R_w.

An example of a 75-80mm wide construction from the British Gypsum White Book capable of achieving this performance is:

One layer of 12.5mm Gyproc Wallboard board each side of 48mm Gypframe "C" Studs at 600mm centres. 25mm Isover Acoustic Partition Roll (APR 1200) in the cavity.

There are many options available. Confirmation is required that there are no betterment standards in relation to internal partitions from BexleyCo.

6.5 Junction details

There is potential for flanking noise transmission across separating walls, floors and lightweight roofs at junction interfaces. To achieve the above performance requirements for internal walls and floors, appropriate junction detailing is paramount to ensure that the acoustic integrity of the separating walls and floors is not compromised. Beams and columns bridging acoustically rated separating constructions will also need attention. General guidance in control of sound flanking is provided below although analysis and advice on details is beyond this stage's scope.

The following general guidance should be noted:

6.5.1 Junction of a Separating Wall with a Separating Floor

The separating walls should be brought down to the structural floor and extended up to the underside of the structural soffit, where appropriate head deflection detailing would need to be developed. Any gaps between the top and bottom edges of the partitions should be minimised and well-sealed with non-setting mastic.

It will be necessary to ensure that an appropriate perimeter flanking strip is installed at the junctions of a floating floor system with the separating/external walls to ensure that the floating floor does not have a rigid contact with surrounding structure and its resilience is not unduly compromised.

It is important to note that any gaps at the junction of the ceiling and the walls should be minimised as far as is possible and any unavoidable gaps should be well filled with non-setting mastic.

Ensure any services between the floating floor and the structural floor do not bridge the resilient layer.

6.5.2 Junction of an External Wall with a Separating Floor or Wall

There are likely to be a number of junction details with the external walls. Where a separating wall or floor structure abuts the inner leaf of the external walls there is the potential for flanking transmission, which may act to reduce the acoustic performance of the installed separating wall/floor system. The important principles to be followed in these areas are as follows:

- The inner layers of the external walls should not be continuous across the separating walls and separating floors.
- The void within the external wall system at the line of the separating wall or separating floor should be closed with a flexible mineral wool closer.

6.5.3 Junction of a Separating Wall with a Corridor Wall

Where separating walls form a “T”-connection at the corridors, the inner leaf of the plasterboard lining, which forms the head of the “T”, should not to cross the line of the leg of the “T”. Plasterboard linings of the flanking wall should be double boarded.

6.5.4 Joints in wall linings

Stagger joints in wall linings to avoid air paths;

6.5.5 Integration of structural elements - Cladding around columns in separating walls;

The integration of columns into infill separating walls is the most common situation where structural elements need to be considered.

Any columns that are on the line of the separating wall must be integrated so they do not act as a bridge through the wall for sound transmission. It is important to ensure that the gypsum lining is not fixed directly to the columns, and to provide some resilience between the column and the separating wall structure.

6.6 Pipe/services penetrations in apartments

No pipe/services penetration details have been available at the time of writing. The details should follow the design principles outlined below.

- Pipes and ducts that penetrate a floor separating habitable rooms in different flats should be enclosed for their full height in each flat. The enclosure should be constructed of a material having a mass per unit area of at least 15kg/m^2. Either line the enclosure, or wrap the duct or pipe within the enclosure, with 25mm unfaced mineral wool. Penetrations through a separating floor by ducts or pipes should have fire protection to satisfy Building Regulations Part B. Fire stopping should be flexible and also prevent rigid connection between the pipe and the floor.
- There must be no rigid connection between the pipework and the internal lining of separating walls, floors or ceilings.
- Any pipework supporting elements must not be connected back to internal linings. Brackets should be supported on standalone unistrut/steel frame systems or fixed directly to masonry (where possible) instead.
- No additional lining is required for pipework if running behind a construction (wall or floor) which provides a mass per unit area of at least 16 kg/m^2, i.e. a minimum of 2x12.5mm wallboard or better
- No acoustic brackets are required if SVPs are made of plastic and fixed back to concrete. In case of cast iron pipes, it is recommended that acoustic brackets are used where possible.
- Flexible fire stopping should be acoustically rated. There should be no rigid connection between the slab and pipe work.

6.7 Sockets

Any sockets or light switches in the party walls should be avoided based on ADE guidance. Where this is unavoidable, they should either be boxed in using the plasterboard manufacturer's recommended detail or proprietary putty pads should be used such as Hilti CP617 or equivalent. These putty pads must meet the performance requirements of Robust Details.

6.8 Doorsets

Front doorsets to the residences should have good perimeter sealing (including threshold seals where practical) and a minimum mass of 25 kg/m^2 or a minimum laboratory tested performance of 29 dB R_w.

6.9 Reverberation control

Approved Document E includes a mandatory requirement for the control of reverberation in common internal parts of buildings that give direct access to the apartments, i.e., the communal corridors. Sound absorption is not required for common internal parts of buildings which do not provide direct access to apartments.

The requirement E3, states that *"The common internal part of a building that contains a flat or a room for residential purposes shall be designed and constructed in such a way as to limit reverberation around those common parts to a reasonable level."*

Two methods are described to satisfy Regulation E3 Method A and Method B.

"Method A: Cover a specified area with an absorber of an appropriate class that has been rated according to BS EN ISO 11654.

Method B: Determine the minimum amount of absorptive material using a calculation procedure in octave bands. Method B is intended only for corridors, hallways and entrance halls as it is not well suited to stairwells."

Method A can be achieved by covering the ceiling of halls or corridors which give direct access to flats with a product with a sound absorption class of Class C or higher (when rated in accordance to BS EN ISO 11654). An example of a Class C sound absorber would British Gypsum's Gyptone Quattro 41 boards with a plenum depth of 187 mm.

7.0 ENVIRONMENTAL NOISE IMPACT

Any externally installed items of fixed mechanical plant associated with the proposed development must be designed to meet acceptable noise levels at nearest sensitive receptors.

Subject to confirmation, it is expected that the Local Authority's requirement with regard to fixed-plant noise emissions, would be in line with the requirements BS4142:2014 with the predicted noise level from all plant items to be not higher than the existing typical background noise level at the locations of the nearest noise sensitive receivers.

The typical background noise level measured during the BAP survey was 35 dB $L_{AF90,\ 15\ min}$ (see Table 7).

The current M&E design for the project indicates that 6 No double Air Source Heat Pumps (ASHPs) manufactured by Mitsubishi (model CAHV 500) will be located in a compound to the Northeastern side of the proposed development. The compound is shown on an excerpt from the project ground floor layout drawing in Figure 15 below (the drawing is included in full in Appendix 2).

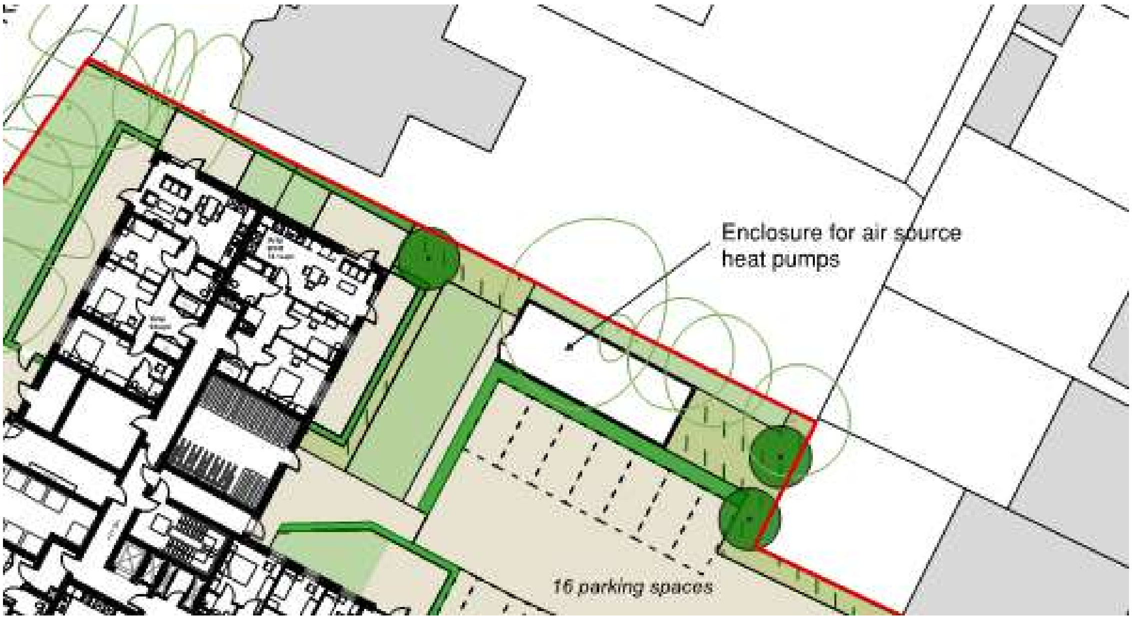


Figure 15: ASHP enclosure layout

The nearest off-site noise-sensitive location to the ASHP enclosure will be the residential property at 2 Hadlow Road, which is also shown in black and white outline in Figure 8 (top left) and in Figure 9. This property is approximately 15 metres away from the indicated position of the ASHP enclosure and has a rear-facing first floor window at approximately five metres height, which is assumed to be a bedroom.

The nearest on-site noise sensitive location is located to a similar distance away from the plant enclosure and it is considered to be the 4th floor window on the eastern façade of the development itself overlooking the plant.

Figure 16: ASHP installation in relation to NSR

Noise level data for each ASHP model provided by the manufacturer indicates a broadband sound pressure level of 59 dBA at one metre. No penalty has been applied for tonal noise.

With this source noise level, BAP have carried out a prediction assuming six sources located within the enclosure and operating in unison, using a correction for hemispherical propagation from a point source to a receptor at 15 metres away and at 5 metres in height.

The resultant level, without any mitigation measures, is predicted to be 44 dB $L_{Aeq, T}$ (Free field) which is 9 dB above the typical background level at night. Therefore, mitigation measures may be required for achieving the acoustic criteria.

Based on the current plant selection additional noise control will be required to control noise levels for the nearest on and off-site receptors. It is understood from the mechanical engineers that any acoustic mitigation measures should allow the air to come into the enclosure from the sidewalls and be discharged vertically to minimise air recirculation within the enclosure.

On that basis, the following mitigation options could be applicable:

Option 1:

Install the air source heat pumps within a fully louvred enclosure, including the top. The acoustic louvres forming the enclosure should have the following minimum sound reduction requirements:

	1/1 Octave Frequency Bands - Hz							
Acoustic louvred/attenuator enclosure minimum sound reduction requirements - R	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
	6	12	15	21	24	27	25	20

Table 13: Acoustic enclosure minimum sound reduction requirements

The detailed design of a proprietary acoustic enclosure would need to be carried out by a specialist industrial noise control supplier to achieve both the acoustic and air-flow performance standards.

Option 2:

Fit an attenuator on the discharge of each heat pump and install the heat pumps within an enclosure which has an open top but fully louvred walls. The acoustic louvres forming the enclosure walls should have the following minimum sound reduction requirements:

	1/1 Octave Frequency Bands - Hz							
Acoustic louvres/attenuator minimum sound reduction requirements - R	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
	6	12	15	21	24	27	25	20

Table 14: Acoustic louvres minimum sound reduction requirements

	1/1 Octave Frequency Bands - Hz							
Top discharge attenuator minimum insertion loss requirements	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
	6	12	15	21	24	27	25	20

Table 15: Top discharge attenuator minimum insertion loss requirements

As above the detailed design of a proprietary acoustic enclosure would need to be carried out by a specialist industrial noise control supplier to achieve both the acoustic and air-flow performance standards.

Option 3:

Select a quieter unit.

Note: The finally selected louvres must comply with the mechanical engineer's airflow and pressure drop requirements which it is understood to be a total 37 m^3/s (37,000 l/s) a max pressure drop of 30 pascals.

8.0 SUMMARY

Bickerdike Allen Partners LLP (BAP) have carried out an acoustic survey and assessment in support of the proposed residential development at Sidcup Library, Hadlow Road, London.

This acoustic design report sets out the aco ustic performance standards required for the development, the results and analysis of the survey data and the implications that data has on the architectural and M&E design.

Recommendations have been given on the specification of the building envelope (Section 5.0) and outline advice provided on internal sound insulation design. The potential noise impact of externally located ASHPs has been assessed with recommendations made for a suitable noise mitigation strategy.

Please note that it is mandatory to undertake pre-completion sound insulation testing in order to demonstrate compliance with Approved Document E requirements and get Building Control approval. Pre-completion sound insulation testing should be undertaken within 10% of units within the development, conducting one "set" of tests for every ten flats/houses, as required by Approved Document E. For flats, a "set" comprises two airborne wall, two airborne floor tests and two impact floor tests (i.e. six tests). The number of tests is subject to confirmation by Building control but based on the number of residential units (i.e. 32) we suggest an allowance be made for approximately 4 no sets of tests.

Commissioning testing for internal ambient noise is optional.

Tom Deering	**Theo Niaounakis**	**David Trew**
for Bickerdike Allen Partners LLP	**for Bickerdike Allen Partners LLP**	**Partner**

APPENDIX 1
GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic, and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

Statistical Term	Description
$L_{Aeq, T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level (LAeq, T). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.
L_{A90}	The level exceeded for 90% of the time is normally used to describe background noise.
$L_{Amax,T}$	The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)

Sound Transmission in Rooms

Sound energy is reflected from the room surfaces and this gives rise to reverberation. At short distances from a sound source, the sound level will fall off at a rate of 6 dB per doubling of distance, as it would in the open air – this is known as the direct field. Beyond a certain distance, the effect of reverberation takes over and the level ceases to fall off significantly with distance from the source. This is known as the reverberant field. For receiver positions in this part of the room, sound levels can be reduced by applying sound absorbing finishes to the surfaces of the room. A 3 dB reduction can normally be obtained by doubling the absorption present, which corresponds to halving the reverberation time (see below).

Sound Insulation - Airborne

Voices, hi-fi systems, television and radio sound and musical instruments are all sources of airborne sound. They excite the air around them and the vibration in the air is transmitted to surrounding surfaces, such as walls, ceilings and floors. This sets these constructions into vibration and this vibration is radiated in neighbouring rooms as sound. Energy is lost in the transmission path and this is referred to as transmission loss or, more generally, sound insulation. The most simple measure of sound insulation is the sound level difference, D, which is the arithmetic difference between the sound level, in dB, in the source room and the sound level in the receiving room.

Other measures of sound insulation include the sound reduction index, R, which is a measure of the acoustical performance of a partition, obtained in a laboratory, and the standardised level difference, D_{nT}, which is used mainly in the sound insulation of domestic separating walls and separating floors. The relevant test procedures are laid down in BS EN ISO 140. A single figure “weighted” result can be obtained from one-third octave band test results by using a curve-fitting procedure laid down in BS EN ISO 717. The subscript “w” is added to the relevant descriptor (eg $D_{nT,w}$).

The sound reduction index, R, is used in the specification of components, such as partitions, doors and windows. It is important to bear in mind that the performance of components in the field is usually lower than can be obtained in a laboratory. The transmission of sound via other components common to both rooms (“flanking transmission”) can reduce the apparent sound reduction index (R’) significantly.

Sound Insulation - Impact

In the case of impact sound, the building construction is caused to vibrate as a result of a physical impact. Footsteps on floors are the most obvious example. The vibration is radiated as sound in neighbouring rooms. Impact insulation is measured using a standard tapping machine, which drops weights cyclically onto a floor. The sound pressure level is measured in the receiving room below and the result is known as the impact level, Li for laboratory tests and L’i for field tests.

APPENDIX 2
ENVIRONMENTAL NOISE AND VIBRATION SURVEY DETAILS

A2.1 EQUIPMENT DETAILS

The following table provides serial numbers and calibration histories of the equipment used during the environmental noise and vibration survey at Sidcup Library on 21st to 26th July 2021.

BAP Reference	Measurement position	Description	Serial Number	Calibration Date	Certificate number	Calibration Due
Nor 140-1	MP3	Norsonic Type 140 Investigator	1403409	11/06/2021	U38140	10/06/2023
		Norsonic Type 1209 Preamplifier	14359	11/06/2021	U38140	10/06/2023
		GRAS-40AF Microphone	207309	11/06/2021	U38140	10/06/2023
Nor 140-2	MP2	Norsonic Type 1251 Calibrator	32200	18/11/2020	U36343	17/11/2021
		Norsonic Type 140 Investigator	1405622	16/10/2019	U33112	15/10/2021
		Norsonic Type 1209 Preamplifier	12722	16/10/2019	U33112	15/10/2021
DUO-1	MP1	DUO Smart Noise Monitor	12068	08/09/2021	UCRT21/2085	07/09/2023
		DUO Preamplifier	11108	08/09/2021	UCRT21/2085	07/09/2023
		GRAS-40CD Microphone	224324	08/09/2021	UCRT21/2085	07/09/2023
ORION3	Internal	01dB Orion	10126	29/05/2019	68162	N/A
Nor 140-1	MP2,3	Norsonic Type 1251 Calibrator	32200	18/11/2020	U36343	17/11/2021
DUO-1	MP1	Bruel & Kjær Type 4231 Calibrator	1883753	31/03/2021	UCRT21/1449	30/03/2022

Table A2.1: Survey equipment details

A2.2 WEATHER HISTORY

In the following pages, weather history data for the survey period is provided from *wunderground.com* (PWS ID: ISIDCU5).

The weather history shows no precipitation save for brief, light showers (0.01 – 0.2 in) on the 24^{th} and 25^{th} of July. Wind speed throughout the survey period was under 5 metres per second. These conditions are suitable for carrying out environmental noise surveys in accordance with the guidance found in BS 4142:2014+A1:2019.

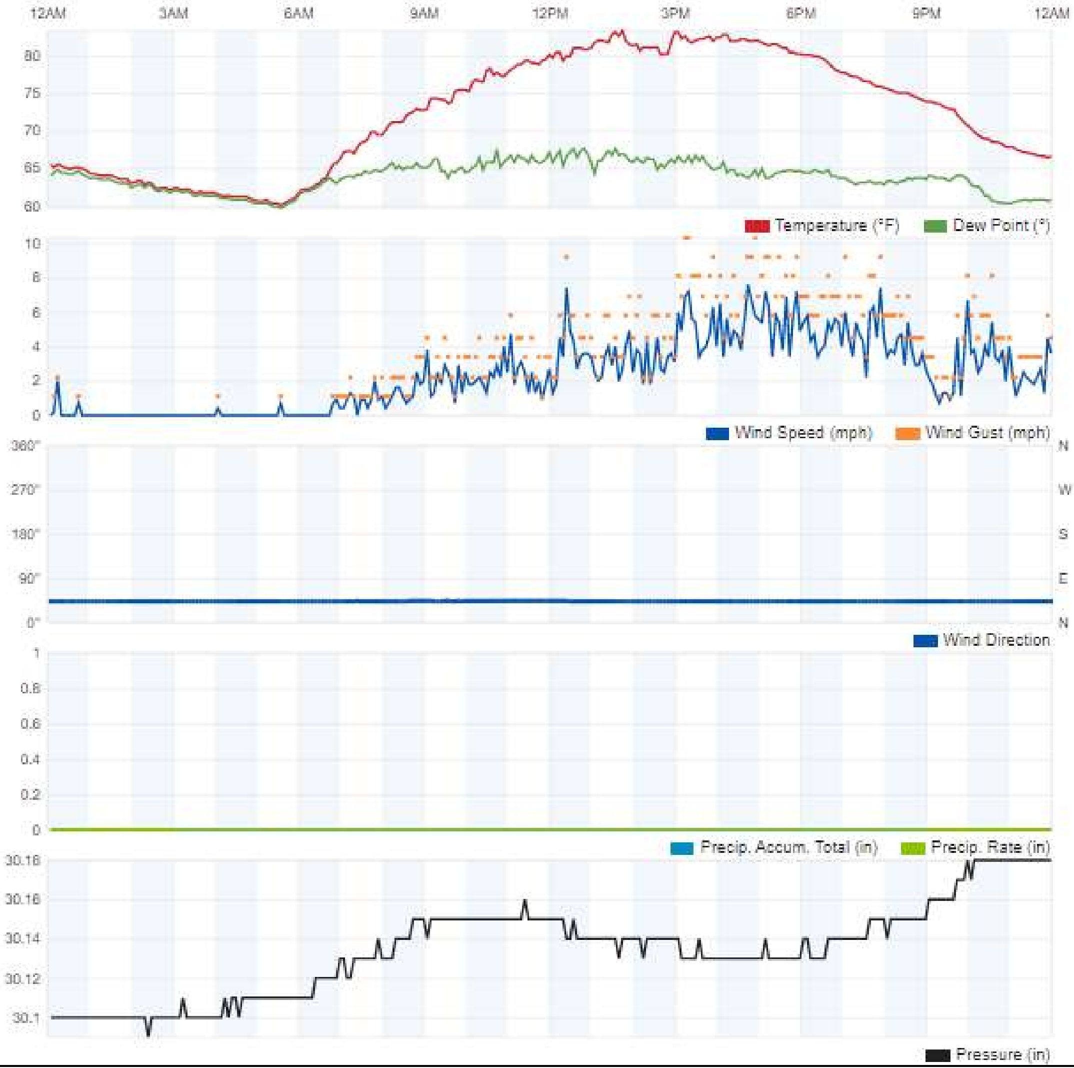
July 21, 2021

	High	Low	Average
Temperature	83.3 °F	60.1 °F	72.2 °F
Dew Point	67.6 °F	59.7 °F	63.3 °F
Humidity	99 %	51 %	76 %
Precipitation	0.00 in	--	--

	High	Low	Average
Wind Speed	7.6 mph	0.0 mph	1.1 mph
Wind Gust	10.3 mph	--	1.7 mph
Wind Direction	--	--	NE
Pressure	30.18 in	30.09 in	--

Graph Table

July 21, 2021



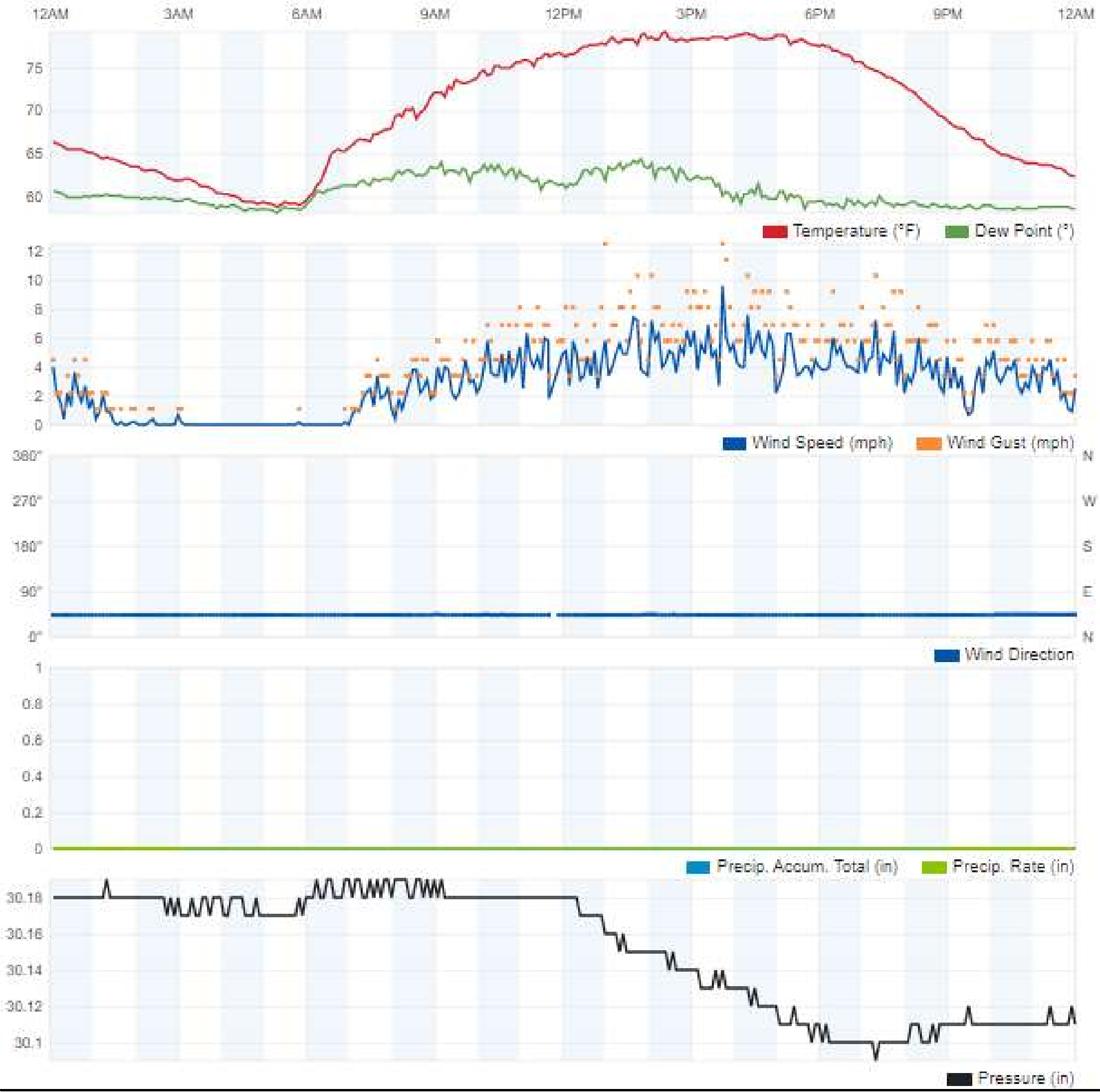
July 22, 2021

	High	Low	Average
Temperature	79.2 °F	58.8 °F	69.9 °F
Dew Point	64.4 °F	57.4 °F	60.0 °F
Humidity	98 %	49 %	73 %
Precipitation	0.00 in	--	--

	High	Low	Average
Wind Speed	9.6 mph	0.0 mph	1.4 mph
Wind Gust	12.5 mph	--	2.2 mph
Wind Direction	--	--	NE
Pressure	30.19 in	30.08 in	--

Graph | Table

July 22, 2021



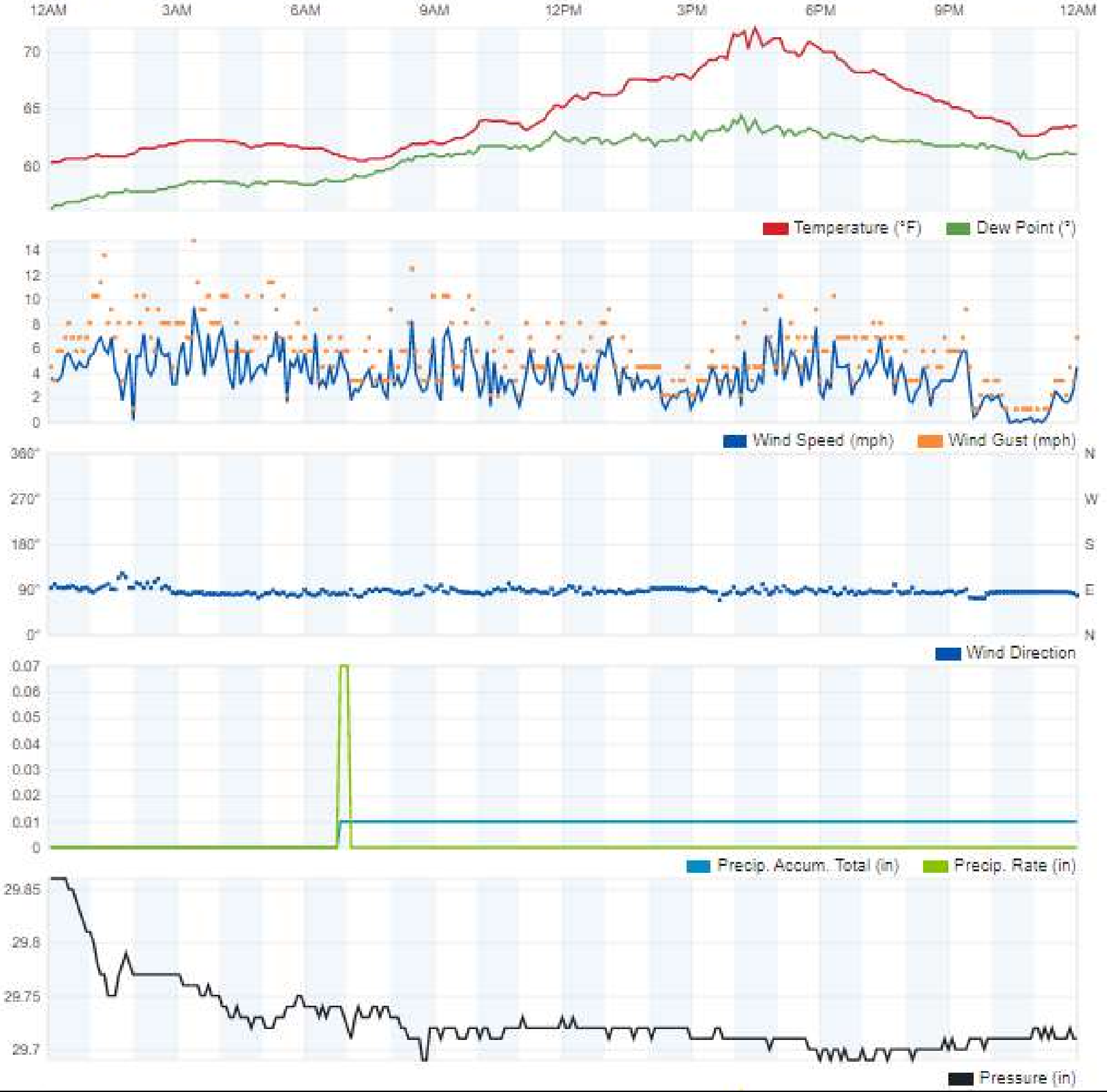
July 24, 2021

	High	Low	Average
Temperature	72.1 °F	60.3 °F	64.4 °F
Dew Point	64.4 °F	56.1 °F	60.5 °F
Humidity	96 %	73 %	87 %
Precipitation	0.01 in	--	--

	High	Low	Average
Wind Speed	9.4 mph	0.0 mph	1.8 mph
Wind Gust	14.8 mph	--	2.9 mph
Wind Direction	--	--	East
Pressure	29.86 in	29.68 in	--

Graph Table

July 24, 2021



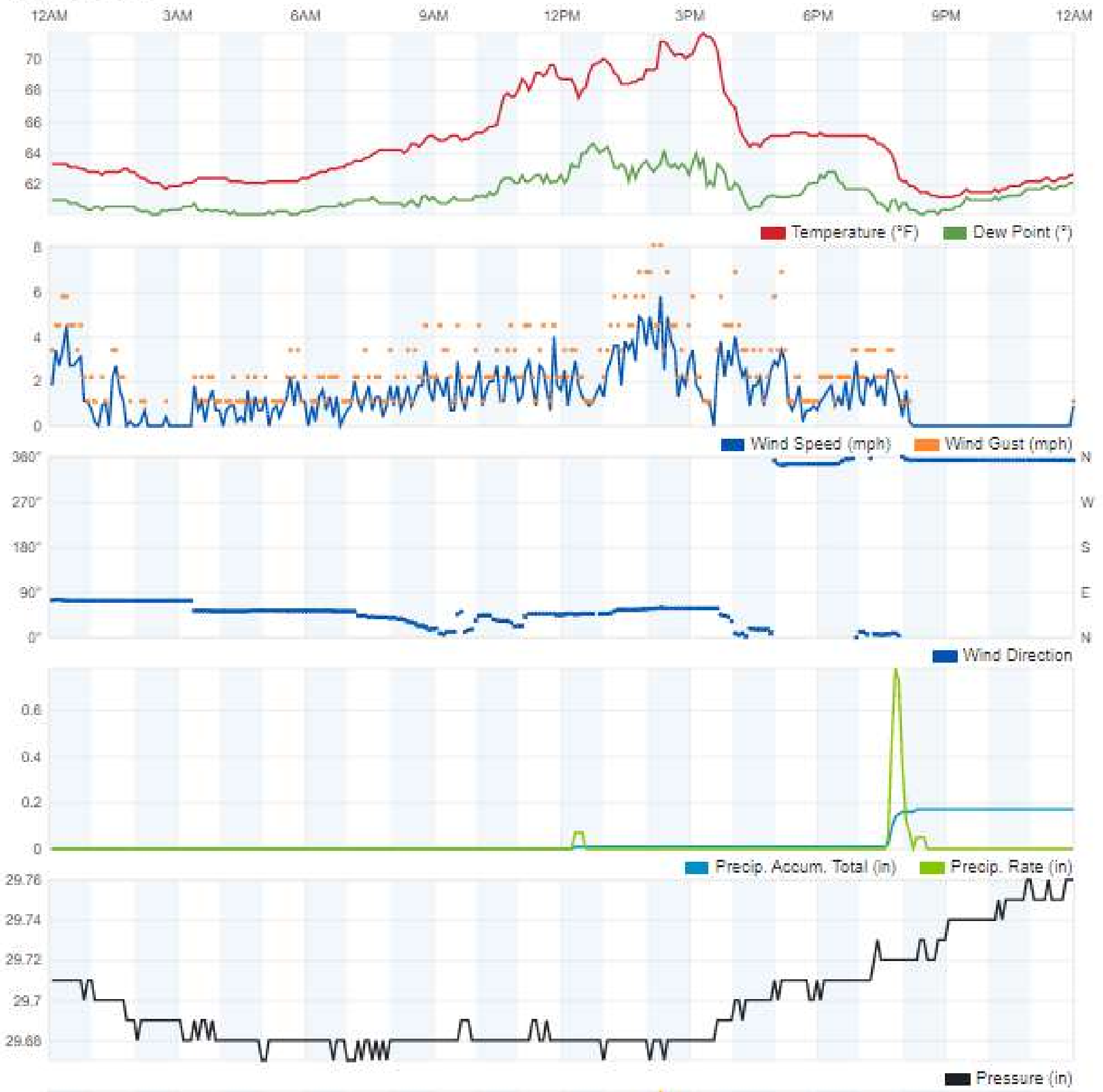
July 25, 2021

	High	Low	Average
Temperature	71.6 °F	61.0 °F	64.5 °F
Dew Point	64.8 °F	59.9 °F	61.2 °F
Humidity	98 %	70 %	89 %
Precipitation	0.17 in	--	--

	High	Low	Average
Wind Speed	5.8 mph	0.0 mph	0.5 mph
Wind Gust	8.1 mph	--	0.9 mph
Wind Direction	--	--	NE
Pressure	29.76 in	29.66 in	--

Graph Table

July 25, 2021



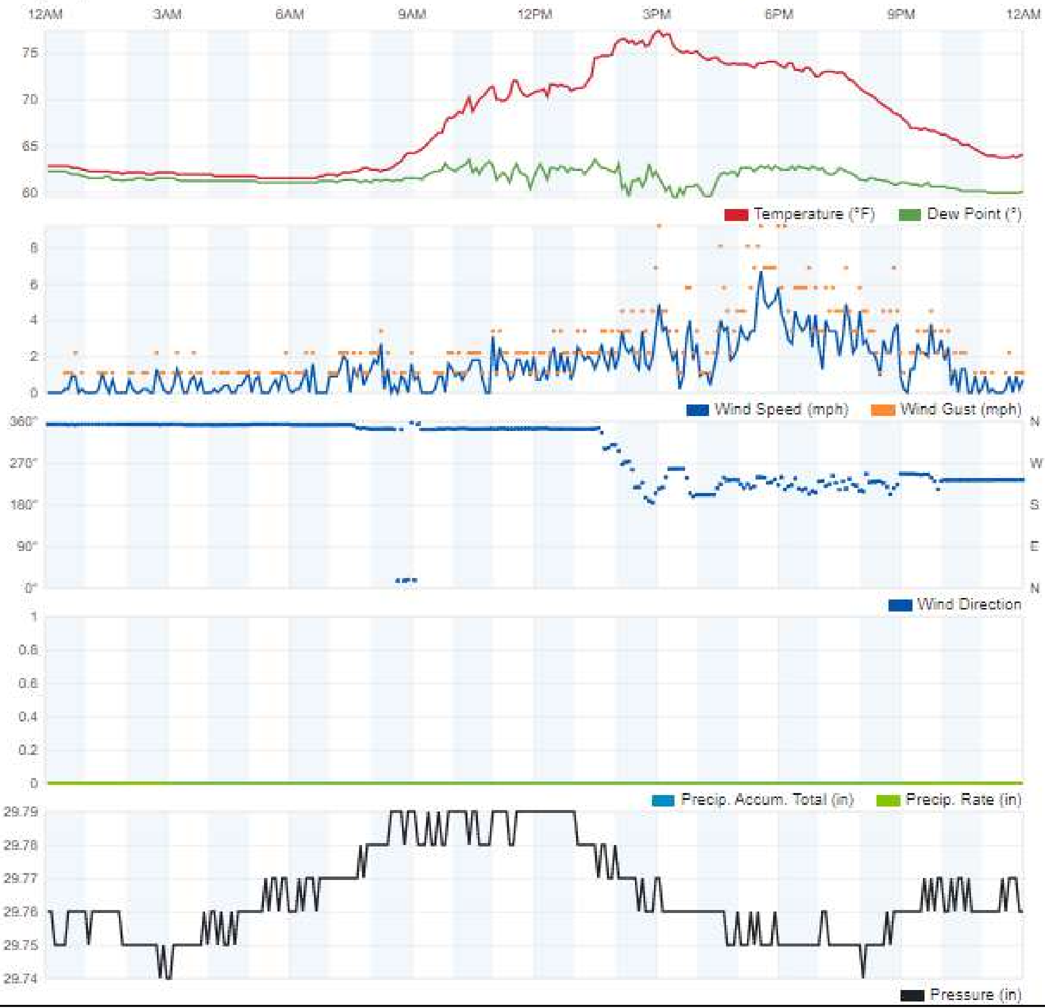
July 26, 2021

	High	Low	Average
Temperature	77.4 °F	61.3 °F	67.4 °F
Dew Point	63.5 °F	57.7 °F	61.1 °F
Humidity	98 %	53 %	82 %
Precipitation	0.00 in	--	--

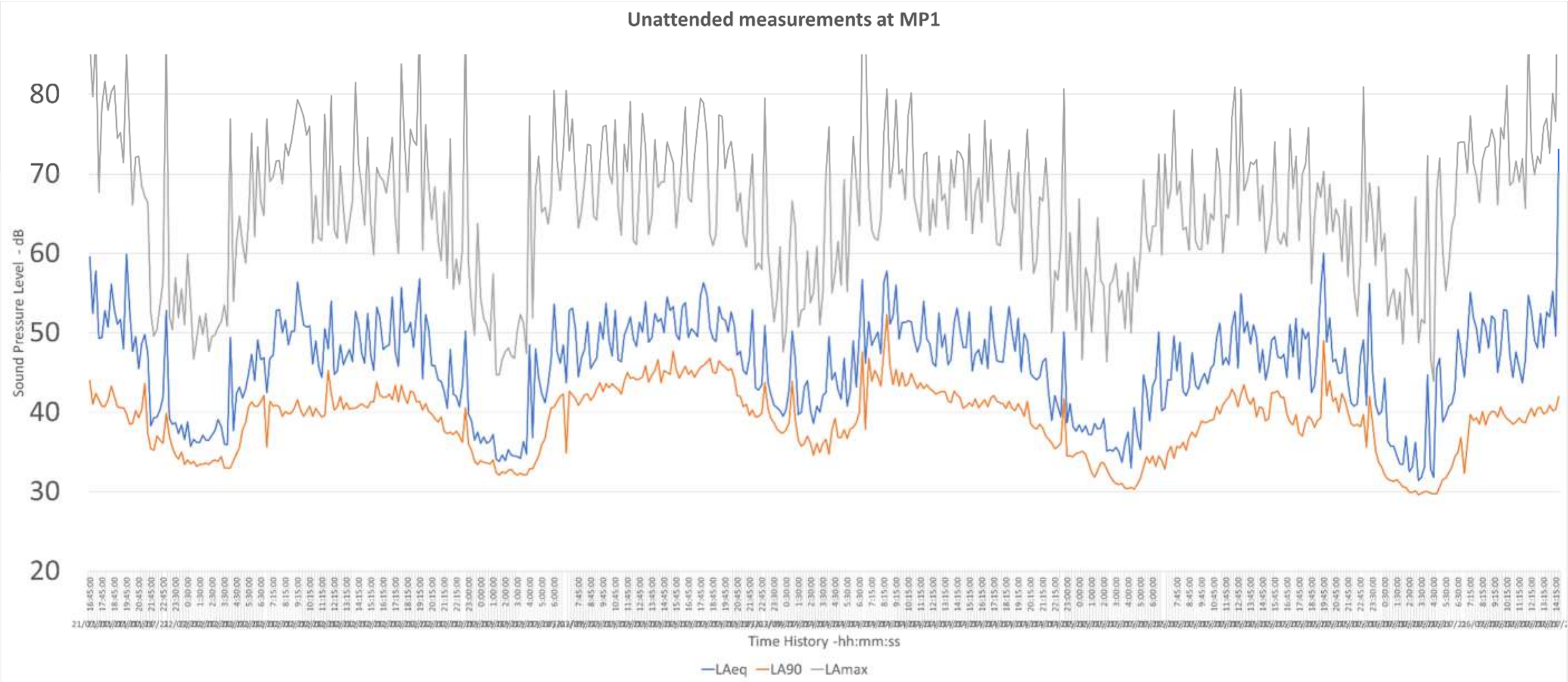
	High	Low	Average
Wind Speed	6.7 mph	0.0 mph	0.5 mph
Wind Gust	9.2 mph	--	0.9 mph
Wind Direction	--	--	West
Pressure	29.79 in	29.74 in	--

Graph | Table

July 26, 2021



A2.3 ENVIRONMENTAL NOISE SURVEY DATA



APPENDIX 3
ARCHITECTURAL DESIGN DRAWINGS

DRAWING NOTES

ISSUE	REASON FOR ISSUE	DATE
A	Design updates	13/10/2021

KEY PLAN

stitch
Architects & Urban Designers
Suite 6, Fusion House, 28 Rochester Place, London, NW1 9DF
www.stitch-studio.co.uk, +44 (0)20 3617 8725

PROJECT
Sidcup Library

PROJECT CODE	CLIENT
20217	BexleyCo

DRAWING TITLE	STATUS
Site ground floor proposed	Draft

SCALE	SHEET	DATE OF FIRST ISSUE
1:500 @ A3	A3	17.09.21

DRAWING NUMBER	REVISION
20217-STCH-XX-00-0051	-

DRAWING NOTES

ISSUE	REASON FOR ISSUE	DATE
A	Design updates	13/10/2021

KEY PLAN

stitch
Architects & Urban Designers

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PROJECT
Sidcup Library

PROJECT CODE: 20217
CLIENT: BexleyCo

DRAWING TITLE: Site plan proposed
STATUS: Draft

SCALE: 1:500 @ A3
SHEET: A3
DATE OF FIRST ISSUE: 17.09.21

DRAWING NUMBER: 20217-STCH-XX-00-0050
REVISION: -