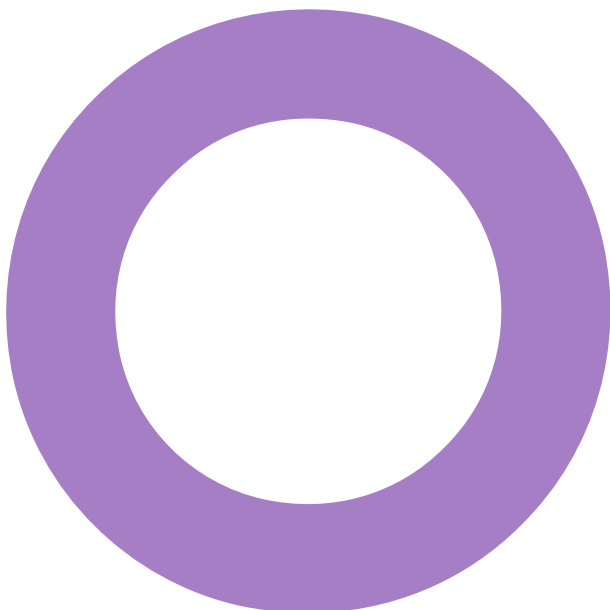


Waterfront Square.  
Reading.  
Packaged Living Limited.

**ACOUSTICS**  
ENVIRONMENTAL NOISE ASSESSMENT

REVISION 03 – 16 JULY 2024



## Audit sheet.

| Rev. | Date       | Description of change / purpose of issue | Prepared  | Reviewed | Authorised |
|------|------------|------------------------------------------|-----------|----------|------------|
| 00   | 04/07/2024 | Draft issue (internal use only)          | PT/NS     | BD       | BD         |
| 01   | 05/07/2024 | Updated following review                 | PT/NS/BRD | BRD      | BRD        |
| 02   | 11/07/2024 | Updated following feedback               | PT/NS/BRD | BRD      | BRD        |
| 03   | 16/07/2024 | Updated following client team feedback   | BRD       | BRD      | BRD        |
|      |            |                                          |           |          |            |
|      |            |                                          |           |          |            |
|      |            |                                          |           |          |            |
|      |            |                                          |           |          |            |

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Project number: 10/15013

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## Executive summary.

Hoare Lea has conducted an environmental noise survey for the proposed demolition of the former Covea Insurance building and construction of residential-led development, access from Norman Place and associated car parking, infrastructure and landscaping.

A noise impact assessment has been carried out to accompany the planning application for the development advising of provisions to enable compliance with the local authority requirements and to provide sufficient acoustic comfort for the residents of the new development.

An environmental noise survey has been undertaken at the site to establish existing ambient and background noise levels.

This has been used to set limiting noise levels at nearby noise sensitive receptors for building services plant emissions, and to determine the sound insulation performance requirements for the building envelope to protect the occupants from environmental noise.

An initial facade assessment has been undertaken which has determined that suitable internal noise levels can be achieved with double-glazed systems throughout.

An initial assessment of daytime and night-time noise intrusion when mitigating overheating using open windows has been undertaken.

- The assessment indicates that compliance with Approved Document O (ADO) internal noise levels in bedrooms at night is possible at most facades overlooking the podium garden with a geometric window opening of 0.5m<sup>2</sup>.
- Compliance with BS8233 + 5dB and within Acoustics, Ventilation and Overheating Guidance (AVOG) is possible for some facades overlooking the podium garden with a geometric window opening of 0.5m<sup>2</sup>.
- An alternative means of mitigating overheating using MVHR with tempered cooling will be required where windows cannot be opened due to site noise constraints.

The guidance provided within this report is sufficient to demonstrate the site suitability in respect of noise and satisfy the requirements of Reading Borough planning policies, in our professional opinion.

## 1. Introduction.

### 1.1 Description of Development

Demolition of the former Covea Insurance building and construction of residential-led development, access from Norman Place and associated car parking, infrastructure and landscaping.

The Proposed Development seeks to deliver 254 studio, one, two and three bedroom residential dwellings (Use Class C3), together with 278m<sup>2</sup> (GEA) of flexible Class E floorspace at ground floor level. A series of internal and external amenity spaces feature within the layout. New pedestrian accesses are proposed from Vastern Road and Norman Place and a vehicular access to a ground floor undercroft car parking area is proposed from Norman Place. Substantial public realm surrounds the development, providing significant visual improvement to Vastern Road, Norman Place and the River Thames frontage.

### 1.2 Summary of work undertaken

An environmental noise survey has been undertaken to quantify the existing ambient and background noise levels at the site and nearby noise sensitive receptors.

The survey data has been used to establish the design constraints on noise emissions from the operation of plant as well as to determine the required sound insulation performances for the building envelope to achieve suitable internal sound levels. Early assessments of the façade sound insulation requirements and impact of noise on relief of overheating on the proposed development have also been carried out.

The survey and assessments have been undertaken in accordance with the relevant British Standards, the Local Authority requirements, and their current guidance.

This report presents the survey methods and results and provides details of the above assessments in support of the planning application from the development.

To aid in the understanding of the assessment, definitions of technical terms used have been included in Appendix A.

## 2. Site description.

### 2.1 Existing site and surroundings.

The site location in the context of its surroundings is shown in Figure 1. It is located within the Abbey Ward in Reading, highlighted in pink. The site is bound Thames Path and River Thames to the north, George Street leading to Reading Bridge on the east, Norman Place to the west and Vastern Road to the south.

The nearest noise sensitive areas are identified as the existing commercial offices to the east of the site and commercial and residential receptors across proposed development.. These receptors are highlighted in Figure 1.

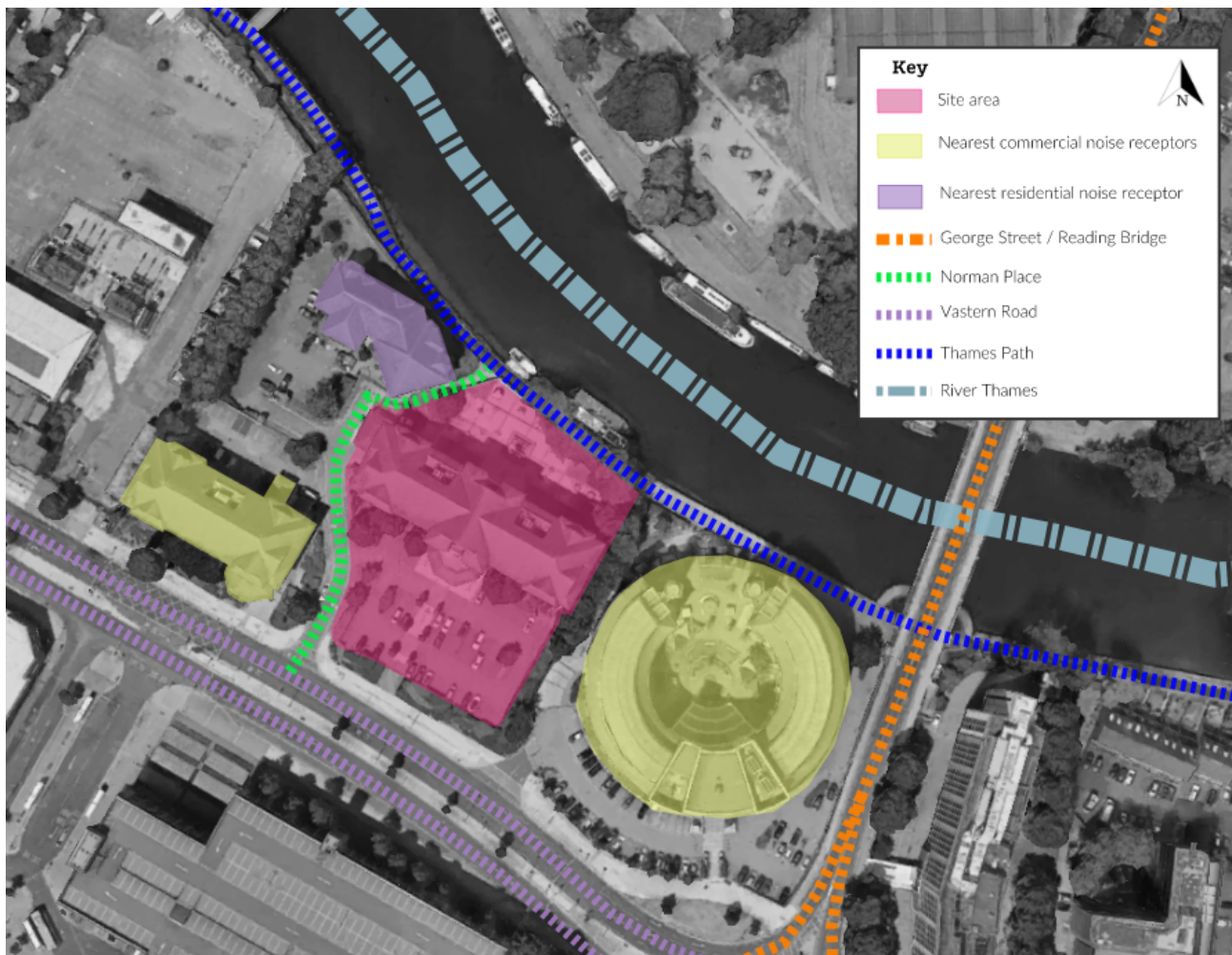


Figure 1: The site context.

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### 2.2 Local noise environment.

The surrounding noise climate is predominantly formed of road traffic noise from the Vastern Road. In addition, road traffic from Reading Bridge, pedestrian activity, water way in River Thames, park activities and some aircrafts also contribute to the overall sound environment. Railway noise may occasionally be audible during the quieter road traffic periods. There are distant construction works that may be heard as well around the site.

### 3. Basis of assessment.

The following policy and guidance have been used for the survey and assessment:

- National Planning Policy Framework (NPPF), 2023
- British Standard 8233:2014 *Guidance of sound insulation and noise reduction for buildings* (BS8233)
- ProPG: Planning & Noise Professional Practice and Guidance on Planning and Noise (ProPG)
- Approved Document O *Overheating* (ADO)
- Acoustics, Ventilation and Overheating Residential Design Guide (AVOG)
- British Standard 4142:2014 *Methods for rating and assessing industrial and commercial sound* (BS4142)
- British Standard 7445-1:2003 *Description and measurement of environmental noise: Part 1 Guide to quantities and procedures* (BS7445)
- World Health Organisation *Environmental Noise Guidelines for the European Region*, 2018 (WHO)
- Reading Borough Local planning policies

#### 3.1 National planning policy framework (NPPF): 2023.

The revised National Planning Policy Framework published in July 2023 sets out the Government's current planning policies for England and how these are expected to be applied. The NPPF supersedes the previous NPPF published in June 2021.

With regards to local noise and vibration, paragraph 191 states:

*"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 impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

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

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

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

#### 3.2 BS 4142: 2014 + A1: 2019.

Current Government advice to Local Planning Authorities in both England and Wales makes reference 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.

This method is only applicable for external noise levels.

### 3.3 BS 8233: 2014.

BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings' is the current British Standard providing guidance for acoustic requirements within buildings. The Standard advises appropriate criteria and limits for different building types including dwellings as in Table 1.

Table 1: BS 8233:2014 internal design criteria for dwellings.

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

BS 8233 Section 7.7.2 Note 7 advises that 'reasonable' living conditions can be achieved for levels up to 5dB greater than those given in the Table 1 above.

Section G1 of BS8233 advises that the typical sound reduction that is achievable through open windows is limited to 15dB. However, Section 9.5 of the standard acknowledges that additional sound reduction will result from room furnishings and states '*The reduction in noise within a room where the source is outside the room is limited to approximately 3 dB for each doubling of total sound absorption within the room*'. Available test data indicates that, for mid-frequencies typical of road traffic noise, the overall sound reduction from outside to inside is approximately 20dB for a window open by approximately 100mm onto a furnished room. These findings are supported by extensive test data for a range of open window types in Napier University report NANR 116 2007 '*Sound insulation through ventilated domestic windows*' that was commissioned by DEFRA.

For gardens and terraces, BS8233 states that it is desirable that the steady noise level does not exceed  $L_{Aeq,T}$  50dB whilst a level of  $L_{Aeq,T}$  55dB would be acceptable in noisier environments. The Standard notes that, in certain situations where development might be desirable, higher noise levels may be acceptable and the development should seek to minimise sound levels as far as practicable but should not be prohibited.

In addition to the above, the guidance in ProPG recommends that internal noise levels from individual events should not normally exceed  $L_{AFmax}$  45 dB within bedrooms more than 10 times a night.

### 3.4 Overheating guidance.

Part O of the Building Regulations requires that noise in relation to risk of overheating in homes must be assessed, with criteria given in Approved Document O (ADO).

The key minimum required criteria are that noise inside bedrooms at night must not exceed 40 dB  $L_{Aeq}$  and 55 dB  $L_{Amax}$  with windows open. These represent a 10 dB exceedance over recommended levels within BS 8233.

Acoustics Ventilation and Overheating Residential Design Guide (AVO) provided the guidance for Level 2 assessment of noise from transport noise sources relating to overheating condition in Table 3-3 of the guidance document.

Guidance has been provided for instances of outcomes corresponding to the ranges of internal ambient noise levels in terms of  $L_{Aeq,T}$  during the daytime (07:00 – 23:00).

- For  $L_{Aeq,T} \leq 35$  dB it is expected that noise can be heard, but does not cause any change in the behaviour
- For  $35 < L_{Aeq,T} \leq 50$  dB, there is a range of outcomes where there is limited behavioural change at lower noise levels and significant impact at higher levels. The exact impact at various levels may not be clear.
- For  $L_{Aeq,T} > 50$  dB it is expected that noise will cause change in behaviour e.g., having to close windows most of the time.

### 3.5 Local planning policy.

#### 3.5.1 Reading Borough Local Plan, November 2019.

The Reading Borough Local Plan adopted in November 2019 contains policies for how Reading will develop up to 2036.

In respect of noise, the Local Plan contains four relevant policies, these are *Policies CC8, N16, EN17 and CR6*.

##### 3.5.1.1 Policy CC8: Safeguarding amenity.

*Policy CC8 states the following:*

*“Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:*

- *Privacy and overlooking;*
- *Access to sunlight and daylight;*
- *Visual dominance and overbearing effects of a development;*
- *Harm to outlook;*
- *Noise and disturbance;*
- *Artificial lighting;*
- *Vibration;*
- *Dust and fumes;*
- *Smell;*
- *Crime and safety; or*
- *Wind, where the proposals involve new development of more than 8 storeys.”*

##### 3.5.1.2 Policy EN16: Pollution and water resources.

*Policy EN16 states the following:*

*“Development will only be permitted where it would not be damaging to the environment and sensitive receptors through land, noise or light pollution ...*

*Proposals for development that are sensitive to the effects of noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution unless adequate mitigation measures are provided to minimise the impact of such pollution.”*

##### 3.5.1.3 Policy EN17: Noise generating equipment.

*Policy EN17 states the following:*

*“Where noise generating equipment is proposed, the noise source specific level (plant noise level) should be at least 10 dBA below the existing background level as measured at the nearest noise sensitive receptor.”*

##### 3.5.1.4 Policy CR6: Living in Central Reading.

*Policy CR6 states the following:*

*“Proposals for residential development within the central area will be assessed against the following criteria:*

- ii) *Proposals for new residential development within the central area will be required to demonstrate how the issue of potential noise disturbance from neighbouring land uses and other sources, and air quality*

*implications of residential development, have been considered and if necessary, mitigated. New residential development should not be located next to existing town centre uses where those uses would give rise to unacceptable levels of noise and disturbance to the occupiers of the new scheme, unless this can be mitigated.”*

### 3.6 Proposed standards.

Given the lack of specific guidance within Reading Borough Council's planning policy in relation to internal noise levels, it is deemed appropriate to base assessment on current guidance and British Standards. This is considered to be BS 8233: 2014.

#### 3.6.1 Building services – noise.

On the basis of guidance contained within Reading Borough Council's Draft Local Plan and based on previous conditions imposed by Reading Borough Council, all building services plant shall be designed to achieve the following noise emission limits.

Table 2: Noise emission limits for building services.

| Description of noise source | Noise emission limit                    |
|-----------------------------|-----------------------------------------|
| Building services plant     | $L_{Ar,Tr} = L_{A90,T} - 10 \text{ dB}$ |

Additionally, for plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 2 above need to include a character correction as defined within BS 4142: 2014.

#### 3.6.2 Environmental noise – internal noise levels.

On the basis of guidance provided by Reading Borough Council, the development will be designed to enable achievement of the internal noise levels contained within BS 8233 and the BCO Guide to Specification.

Table 3: Proposed internal noise level criteria.

| Location                        | Daytime<br>(0700 to 2300) | Night-time<br>(2300 to 0700)             |
|---------------------------------|---------------------------|------------------------------------------|
| <b>Residential</b>              |                           |                                          |
| Living Room                     | 35 dB $L_{Aeq,16hr}$      | -                                        |
| Bedroom                         | 35 dB $L_{Aeq,16hr}$      | 30 dB $L_{Aeq,8hr}$ & 45 dB $L_{Amax,T}$ |
| <b>Commercial</b>               |                           |                                          |
| Restaurant / café / retail unit | 40 dB $L_{Aeq,T}$         | -                                        |

## 4. Environmental noise survey.

### 4.1 Summary.

An acoustic survey has been carried out to establish the baseline environmental noise conditions local to the site. The environmental sound survey consisting of long-term unattended measurements were undertaken between Thursday 21<sup>st</sup> of September and 28<sup>th</sup> of September 2023. Additional short-term attended measurements were carried out on the 28<sup>th</sup> of September 2023. Full details of the survey including equipment details and results have been provided in Appendix B.

Position L1 (Level 3 balcony overlooking Thames River) to the north and L2 (Level 02 roof terrace overlooking the Vastern Road) to the south were the long-term measurement locations. Short-term measurements were carried out at four positions around the site at ground level around the site. The locations of these short-term measurements are shown in Figure 2 and were measured as hand-held samples positioned at a height of 1.2 m above local ground floor level.

Further details of the long-term measurements are set out in Section 4.2.

Sound level data at Position L1 was measured at approximately 1 m from the building façade, and therefore are regarded as façade levels. Measurements at Position L2 are considered representation of free-field conditions.

A summary overview of the measurement positions and the pertinent statistical sound level data is provided in Figure 2. The following long-term results are presented:

- Averaged ambient sound level measured,  $L_{Aeq,T}$ ;
- 10<sup>th</sup> Highest  $L_{Amax,15min}$ ;
- Lowest 10<sup>th</sup> percentile background noise level,  $L_{A90,15min}$ .

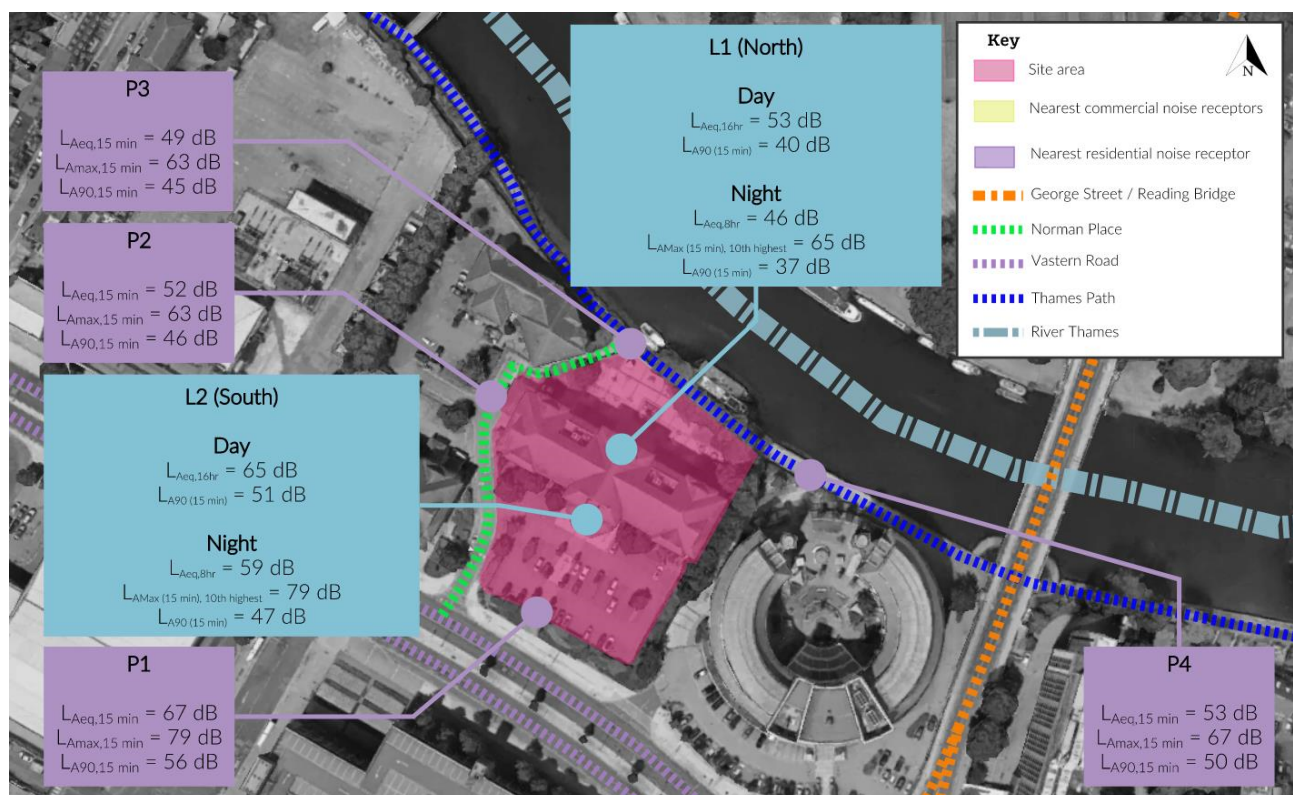


Figure 2: Summary of measured noise levels.

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#### 4.2 Long-term unattended measurements.

Unattended sound monitoring equipment was installed on the level 3 balcony overlooking the Thames River (position L1) and on the roof terrace located on level 2 overlooking Vastern Road (position L2). The survey was undertaken to understand the variation of sound levels in the area from day to night and to establish background sound levels to set plant noise limits.

At position L1, the measurements were collected in continuous 15-minute samples between the 21<sup>st</sup> of September and 28<sup>th</sup> of September 2023. The intent of this measurement location was to establish background sound levels experienced by the north side of the site and the residential receptor in the vicinity across Norman Place. The sound levels at this position were dominated by the road traffic on George Street and Reading Bridge with occasional pedestrian activities from Thames Path.

The measurements at position L2 were set to log as free-field measurements in continuous 15-minute samples between 21<sup>st</sup> of September and 28<sup>th</sup> of September 2023 with the intention of measuring existing ambient and background sound levels experienced by the front or south side of the site. The sound levels at this position were dominated by the road noise from the Vastern Road and occasional aircraft.

## 5. Building services plant noise.

Noise emissions from any new building services plant items introduced as a part of the proposed scheme will need to be controlled to minimise the impact on the nearby noise sensitive receptors identified in Figure 1 as required by the local authority.

Noise levels due to building services serving the proposed development are advised to meet the following noise level criteria shown below in Table 4, one metre from the nearest noise sensitive area as identified in section 2.1. These are based on the typical background noise levels measured at position L1 and L2 which are deemed representative of the nearest noise sensitive receptors. At position L1, the limits are given as façade noise limits.

Table 4: Plant noise emission limits for normally operating noise generating equipment.

| Noise sensitive area                      | Time period                | Lowest measured free-field background sound level, $L_{A90,15min}$ (dB) | Plant noise limit at 1m from nearest noise sensitive receptor, $L_{Ar,Tr}$ (dB) |
|-------------------------------------------|----------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| North side receptors (around position L1) | Daytime (07:00 – 23:00)    | 40                                                                      | 30                                                                              |
|                                           | Night-time (23:00 – 07:00) | 37                                                                      | 30*                                                                             |
| South side receptors (around position L2) | Daytime (07:00 – 23:00)    | 51                                                                      | 41                                                                              |
|                                           | Night-time (23:00 – 07:00) | 47                                                                      | 37                                                                              |

\*Note: From the old version of BS4142:1997, background noise levels below about 30 dB are considered as very low, so values obtained below 30dB have been rounded up to 30 dB.

It should be noted that each of the limits stated above are the combined operational noise levels of the plant at the nearest noise sensitive façade. As such, the combined operational noise levels of all plant are required to achieve the noise limits defined above.

For plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 4 above need to include character correction in accordance with BS 4142:2014.

It is understood that the roof plant has the potential to operate at any time of day and night. Consideration could be given to a slightly higher noise emission limit during the night-time, as level for the north side is very low and may not be achievable.

At this stage, final selections for building services plant items are not available. Further work including plant noise assessments shall be performed and its impact and mitigation measures shall be reported as a part of further scope or works.

## 6. Control of external sound intrusion.

### 6.1 Internal noise levels.

The sound insulation properties of the building envelope depend upon the external noise levels present at the facade and the proposed design criteria for the internal noise levels of specific rooms, dependent on their use.

Guidance on the desirable range of internal sound levels to be achieved within residential dwellings has been adopted from BS 8233:2014. These are set out in Table 3.

In addition to this consideration has been given to the criteria given in ADO and guidance from AVO with regards to the risk of overheating in homes.

### 6.2 Discussion of façade proposals and assessment.

The examples shown represent the recommended sound reduction performance for window system (accounting for glazing, seals, frames etc.) of each façade as identified on the first floor plan in Figure 3 below, based on predicted noise level from acoustic modelling.



Figure 3: Facade locations on first floor plan.

Further floor plans are provided in Appendix C, showing the predicted facade acoustic performance requirement.

It should be noted that in Table 5, the highest-level acoustic performances ( $R_w + C_{tr}$ ) are shown for living rooms and bedrooms as these spaces are considered most sensitive and provide the most onerous requirements.

Table 5: Notional sound insulation values of glazed elements in facade.

| Location on Facade | Room Type                     | Noise levels (dB)                    |                                     |                                        |
|--------------------|-------------------------------|--------------------------------------|-------------------------------------|----------------------------------------|
|                    |                               | Predicted external noise level dB(A) | Required internal noise level dB(A) | Minimum sound reduction $R_w + C_{tr}$ |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 40                                   | 35                                  | 5                                      |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 35                                   | 30                                  | 5                                      |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 55                                   | 45                                  | 10                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 45                                   | 35                                  | 10                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 40                                   | 30                                  | 10                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 60                                   | 45                                  | 15                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 50                                   | 35                                  | 15                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 45                                   | 30                                  | 15                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 65                                   | 45                                  | 20                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 55                                   | 35                                  | 20                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 50                                   | 30                                  | 20                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 70                                   | 45                                  | 25                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 60                                   | 35                                  | 25                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 55                                   | 30                                  | 25                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 75                                   | 45                                  | 30                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 65                                   | 35                                  | 30                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 60                                   | 30                                  | 30                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 80                                   | 45                                  | 35                                     |
|                    | Living Room ( $L_{Aeq,T}^1$ ) | 68                                   | 35                                  | 35                                     |
|                    | Bedroom ( $L_{Aeq,T}^1$ )     | 63                                   | 30                                  | 33                                     |
|                    | Bedroom ( $L_{AFmax}^2$ )     | 83                                   | 45                                  | 40                                     |

Note 1: Living room (day)  $L_{Aeq,16hr}$  (07:00 – 23:00) and bedroom (night)  $L_{Aeq,8hr}$  (23:00 – 07:00).

Note 2: Bedroom  $L_{Amax,T}$  (23:00 – 07:00).

Note 3: Non-glazed facade elements shall achieve  $R_w + C_{tr}$  45 dB.

### 6.3 Facade sound insulation requirements.

Sound insulation requirements for the proposed building are typical of an urban environment. The facades exposed to the highest noise levels require glazing systems that achieve  $R_w + C_{tr}$  35 – 40 dB. Facades overlooking the podium garden are exposed to much lower levels of noise with glazing systems needing to achieve  $R_w + C_{tr}$  5 – 15 dB, which are minimal levels of sound insulation. Whilst the level of performance is achievable with commercially available double glazed window systems, it should be noted that the upper end of this range is approaching the limit of what can be achieved. Careful selection of the window systems will be required as the design is progressed post planning.

For non-glazed facade elements, the requirements are not considered overly onerous and will be achievable with conventional façade systems, lightweight or masonry. This would be reviewed during the design post planning.

### 6.4 Overheating and Approved Document O

Part O of the Building Regulations requires that noise in relation to risk of overheating in homes must be assessed, with criteria given in Approved Document O (ADO). This document only provides acoustic criteria for bedrooms at night.

The key minimum required criteria are that noise inside bedrooms at night must not exceed 40 dB  $L_{Aeq}$  and 55 dB  $L_{Amax}$  with windows open. These represent a 10 dB exceedance over recommended levels within BS 8233.

Compliance with these bedroom criteria using a partially open window is possible for facades marked in green and yellow in Appendix C, if the window geometric opening area is not more than 0.5m<sup>2</sup>. If this opening is larger to mitigate overheating, these facades may not be suitable using an open window. If the open area is smaller to mitigate overheating, more facades may become suitable.

This requires further assessment using an overheating model to determine the opening area of the window to mitigate overheating.

### 6.5 Overheating and compliance with BS8233 + 5dB

An uplift in the internal noise levels (day and night) of +5dB compared with BS8233 is typically acceptable when using a window to mitigate overheating.

Compliance with these criteria in living rooms and bedrooms using a partially open window is possible for facades marked in green in Appendix C, if the window geometric opening area is not more than 0.5m<sup>2</sup>. If this opening is larger to mitigate overheating, these facades may not be suitable using an open window. If the open area is smaller to mitigate overheating, more facades may become suitable.

### 6.6 Overheating alternative mitigation to an open window

Where the allowable geometric open area for windows is not enough to mitigate overheating and achieve the required noise reduction, alternative design provision will need to be made to mitigate overheating within apartments using MVHR unit with tempered cooling coils or similar allowing residents to keep window closed. Please note that all residents will have openable windows.

#### 6.7 Roof terraces.

Assuming a direct line of sight from the Vastern Road, the predicted noise levels in the worst-affected external amenity areas (first to third floors) are expected to be in the region of 55-65 dB  $L_{Aeq}$  during the daytime period.

Predicted noise levels therefore exceed the recommended upper limit given in BS 8233 by up to 10 dBA. However, BS 8233 states that the optimal design range may not always be achievable, particularly in urban areas.

However, the proposed upper floor layouts suggest the presence of residential spaces surrounding the central amenity area, which is expected to reduce noise levels across the amenity area to below 55 dB  $L_{Aeq}$ . If this proposal changes, then further provision of a solid barrier, with a minimum height of 1.2 m and a minimum mass of 10 kg/m<sup>2</sup> would need to be allowed for.

## Appendix A – Acoustic terminology.

### Sound

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

### The Sound Pressure

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

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

### The Sound Pressure Level

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

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

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

Where:

$L_p$  = sound pressure level (dB)

$p$  = sound pressure (Pa)

$p_{ref}$  =  $2 \times 10^{-5}$  – reference sound pressure (Pa)

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

### Decibel (dB)

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

In accordance with the logarithmic scale, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

### Sound Pressure Level of Some Common Sources

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

| Source               | Sound Pressure Level<br>dB |
|----------------------|----------------------------|
| Threshold of Hearing | 0                          |
| Rustling Leaves      | 20                         |
| Quiet Whisper        | 30                         |
| Home                 | 40                         |
| Quiet Street         | 50                         |
| Conversation         | 60                         |
| Inside a Car         | 70                         |

| Source               | Sound Pressure Level<br>dB |
|----------------------|----------------------------|
| Loud Singing         | 80                         |
| Motorcycle (10m)     | 90                         |
| Lawn Mower (1m)      | 100                        |
| Diesel Truck (1m)    | 110                        |
| Amplified Music (1m) | 120                        |
| Jet Plane (1m)       | 130                        |

### Frequency

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

### Octave and Third Octave Bands

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

There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz.

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

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequency than to low frequencies within the range. This is the basis of the A-weighting.

### A-Weighting

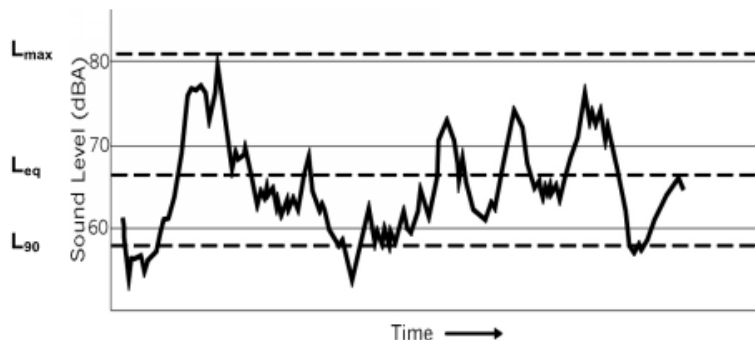
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

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

### Noise Units

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

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



#### $L_{eq,T}$

The  $L_{eq,T}$  is a parameter defined as the equivalent continuous sound pressure level over a defined time period 'T'. It is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal.

The  $L_{eq,T}$  can be thought of as an 'average' sound pressure level over a given time period (although it is not an arithmetic average). Typically, the  $L_{eq,T}$  will be an A-weighted noise level in dB(A) and is commonly used to describe all types of environmental noise sources.

#### $L_{01,T}$

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

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

#### $L_{10,T}$

The  $L_{10,T}$  is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe road traffic noise.

#### $L_{90,T}$

The  $L_{90,T}$  is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe the prevailing background noise level.

#### $L_{max,T}$

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

#### **Specific Noise Level, $L_{Aeq,T,r}$**

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

#### **Free Field**

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

#### **Façade**

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

#### $R_w$

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

## Appendix B – List of measurement equipment.

Measurements were undertaken in accordance with BS 7445:2003 *Description and measurement of environmental noise*.

Temperatures varied between 24 degrees during the day and 15 degrees at night. Wind speeds did not typically exceed 5 m/s.

### Measurement equipment details.

The equipment used for the short-term and long-term surveys are detailed below in Table 6. All equipment used was within their respective dates of calibration and calibration certificates are available upon request. All sound level meters and microphones were calibrated before and after the measurements and no significant calibration drift was observed.

| Item                                            | Description       | Manufacturer | Model | Serial number | Calibration date | Calibration certificate number |
|-------------------------------------------------|-------------------|--------------|-------|---------------|------------------|--------------------------------|
| Attended short-term measurements                | Sound Level Meter | Rion         | NA-28 | 01260201      | 10/02/2022       | UCRT20/1165                    |
|                                                 | Microphone        | Rion         | UC-59 | 00281         | 10/02/2022       | UCRT20/1165                    |
|                                                 | Pre-amp           | Rion         | NH-23 | 60104         | 10/02/2022       | UCRT20/1165                    |
|                                                 | Calibrator        | Rion         | NC-74 | 34172704      | 04/08/2023       | UCRT23/2030                    |
| Unattended long-term measurements (position L1) | Sound Level Meter | Rion         | NL-52 | 01276555      | 20/06/2022       | UCRT22/1787                    |
|                                                 | Microphone        | Rion         | UC-59 | 12612         | 20/06/2022       | UCRT22/1787                    |
|                                                 | Pre-amp           | Rion         | NH-25 | 76774         | 20/06/2022       | UCRT22/1787                    |
|                                                 | Calibrator        | Rion         | NC-74 | 34557134      | 14/11/2022       | UCRT21/2390                    |
| Unattended long-term measurements (position L2) | Sound Level Meter | Rion         | NL-52 | 00810564      | 14/01/2022       | CONF012203                     |
|                                                 | Microphone        | Rion         | UC-59 | 19955         | 14/01/2022       | CONF012203                     |
|                                                 | Pre-amp           | Rion         | NH-25 | 11107         | 14/01/2022       | CONF012203                     |
|                                                 | Calibrator        | Rion         | NC-74 | 34557134      | 14/11/2022       | UCRT21/2390                    |

Table 6: Details of equipment used in short-term external sound surveys.

### Unattended noise monitoring.

Unattended noise monitoring was undertaken at two positions at roof level of the existing building. The north monitor was located 1.5 m above the 3<sup>rd</sup> floor and south monitor was located 1.5 m above 2<sup>nd</sup> floor.

The measurements were undertaken between the 21<sup>st</sup> of September and 28<sup>th</sup> of September 2023 in continuous 15-min samples.

A summary of the measured ambient and background noise level results is presented in Table 7 and Table 8, respectively, for location L1, and Table 9 and Table 10, respectively, for location L2. Measurements at L1 are façade noise, which need to apply a correction of -3 dB. Measurements at L2 are free-field noise levels.

Time history plots are shown in Figure 4 and Figure 5 for location L1 and L2 respectively.

Table 7 Summary of long-term ambient measurements at L1.

| Date       | Ambient sound pressure levels measured (dB) at position North side (L1) |                                              |
|------------|-------------------------------------------------------------------------|----------------------------------------------|
|            | Day Time (07:00 - 23:00)<br>$L_{Aeq, 16hr}$                             | Night Time (23:00 - 07:00)<br>$L_{Aeq, 8hr}$ |
| 21/09/2023 | 53                                                                      | 46                                           |
| 22/09/2023 | 54                                                                      | 46                                           |
| 23/09/2023 | 53                                                                      | 45                                           |
| 24/09/2023 | 53                                                                      | 47                                           |
| 25/09/2023 | 53                                                                      | 48                                           |
| 26/09/2023 | 53                                                                      | 46                                           |
| 27/09/2023 | 54                                                                      | 46                                           |
| 28/09/2023 | 52                                                                      | N/A                                          |

Table 8 Summary of long-term background measurements at L1.

| Date       | Background sound pressure levels measured (dB) at position North side (L1) |                                                 |
|------------|----------------------------------------------------------------------------|-------------------------------------------------|
|            | Daytime (07:00 - 23:00)<br>Lowest LA90,15min                               | Night-time (23:00 - 07:00)<br>Lowest LA90,15min |
| 21/09/2023 | 43                                                                         | 38                                              |
| 22/09/2023 | 43                                                                         | 38                                              |
| 23/09/2023 | 43                                                                         | 38                                              |
| 24/09/2023 | 40                                                                         | 37                                              |
| 25/09/2023 | 40                                                                         | 39                                              |
| 26/09/2023 | 40                                                                         | 37                                              |
| 27/09/2023 | 44                                                                         | 37                                              |
| 28/09/2023 | 47                                                                         | N/A                                             |

Table 9 Summary of long-term ambient measurements at L2.

| Date       | Ambient sound pressure levels measured (dB) at position South side (L2) |                                              |
|------------|-------------------------------------------------------------------------|----------------------------------------------|
|            | Day Time (07:00 - 23:00)<br>$L_{Aeq, 16hr}$                             | Night Time (23:00 - 07:00)<br>$L_{Aeq, 8hr}$ |
| 21/09/2023 | 65                                                                      | 59                                           |
| 22/09/2023 | 65                                                                      | 60                                           |
| 23/09/2023 | 64                                                                      | 59                                           |
| 24/09/2023 | 64                                                                      | 59                                           |
| 25/09/2023 | 64                                                                      | 59                                           |
| 26/09/2023 | 64                                                                      | 59                                           |
| 27/09/2023 | 65                                                                      | 59                                           |
| 28/09/2023 | 65                                                                      | N/A                                          |

Table 10 Summary of long-term background measurements at L2.

| Date       | Background sound pressure levels measured (dB) at position South side |                                                 |
|------------|-----------------------------------------------------------------------|-------------------------------------------------|
|            | Daytime (07:00 - 23:00)<br>Lowest LA90,15min                          | Night-time (23:00 - 07:00)<br>Lowest LA90,15min |
| 21/09/2023 | 55                                                                    | 47                                              |
| 22/09/2023 | 55                                                                    | 48                                              |
| 23/09/2023 | 53                                                                    | 48                                              |
| 24/09/2023 | 51                                                                    | 47                                              |
| 25/09/2023 | 52                                                                    | 47                                              |
| 26/09/2023 | 53                                                                    | 47                                              |
| 27/09/2023 | 55                                                                    | 48                                              |
| 28/09/2023 | 57                                                                    | N/A                                             |

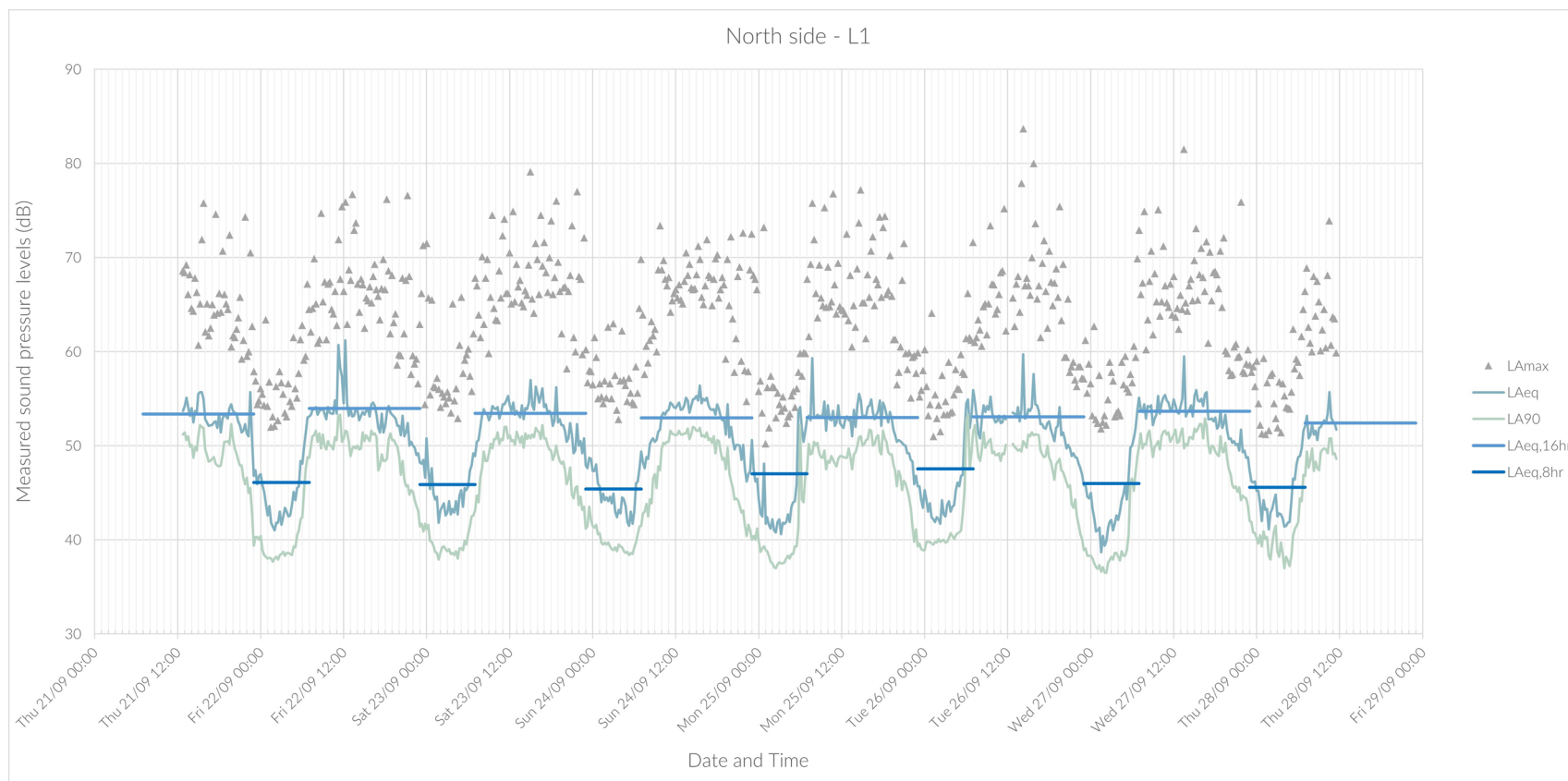


Figure 4: Graphical representation of unattended long-term monitoring results at L1 or north side of the building.

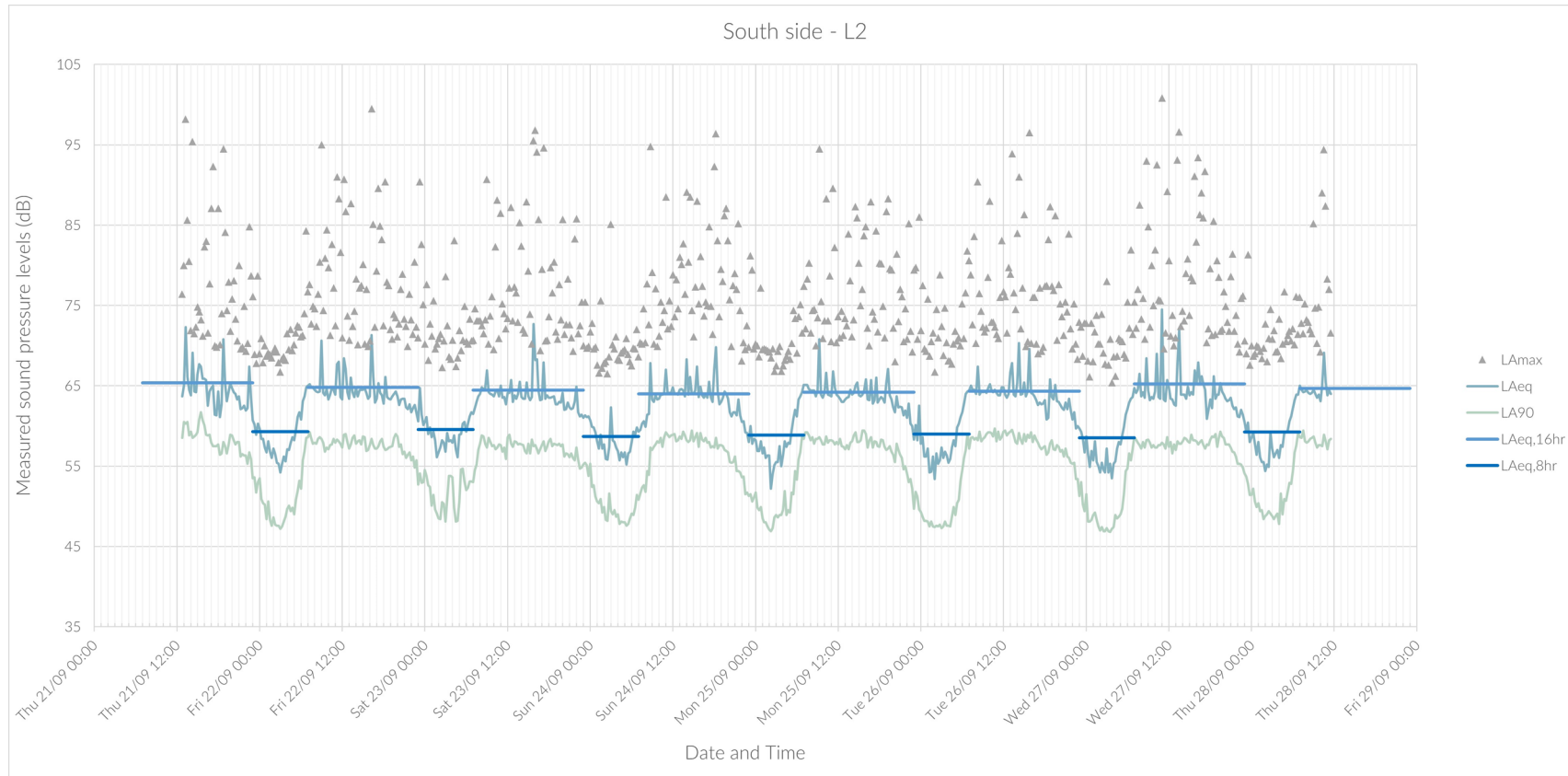


Figure 5 - Graphical representation of unattended long-term monitoring results at L2 or south side of the building.

### Short-term noise monitoring.

Short-term attended measurements were conducted on 28<sup>th</sup> of September 2023 to obtain typical ambient and background levels at the boundaries of the site. All measurements were undertaken at a height of 1.2 m from the ground.

The results are summarised in Table 11. All measurements are free-field noise levels.

Table 11 Summary of short-term measurements.

| Position   | Description      | Measurement start time | Measurement Duration, T | Ambient sound pressure level, dB L <sub>Aeq,T</sub> | Maximum sound level, dB L <sub>AFmax,T</sub> | Background sound level. dB L <sub>A90,T</sub> |
|------------|------------------|------------------------|-------------------------|-----------------------------------------------------|----------------------------------------------|-----------------------------------------------|
| Position 1 | Vastern Road     | 28/09/2023 09:10       | 00:05:00                | 67                                                  | 73                                           | 58                                            |
|            |                  | 28/09/2023 09:55       | 00:05:00                | 66                                                  | 74                                           | 56                                            |
|            |                  | 28/09/2023 10:45       | 00:05:00                | 68                                                  | 79                                           | 56                                            |
| Position 2 | Norman Place     | 28/09/2023 09:25       | 00:05:00                | 52                                                  | 61                                           | 46                                            |
|            |                  | 28/09/2023 10:10       | 00:05:00                | 52                                                  | 60                                           | 46                                            |
|            |                  | 28/09/2023 10:55       | 00:05:00                | 52                                                  | 63                                           | 47                                            |
| Position 3 | Thames Path      | 28/09/2023 09:35       | 00:05:00                | 48                                                  | 59                                           | 46                                            |
|            |                  | 28/09/2023 10:20       | 00:05:00                | 48                                                  | 59                                           | 45                                            |
|            |                  | 28/09/2023 11:05       | 00:05:00                | 51                                                  | 63                                           | 47                                            |
| Position 4 | Clearwater Court | 28/09/2023 09:45       | 00:05:00                | 53                                                  | 67                                           | 50                                            |
|            |                  | 28/09/2023 10:30       | 00:05:00                | 52                                                  | 63                                           | 50                                            |
|            |                  | 28/09/2023 11:15       | 00:05:00                | 54                                                  | 67                                           | 50                                            |

## Appendix C – Mark-up of facade sound insulation performances.



**NEHA SHARMA**  
ACOUSTICS ENGINEER

+44 20 3668 7094  
NEHASHARMA@HOARELEA.COM

HOARELEA.COM

Western Transit Shed  
12-13 Stable Street  
London  
N1C 4AB  
England

