THE HALL SCHOOL, NW3

Acoustic Assessment

Reference: 12092.RP01.PNA.0
Prepared: 21 September 2022
Revision Number: 0

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Revision	Comment	Date	Prepared By	Approved By
0	First issue of report	21 September 2022	Doug Shearer	David Johnston

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The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and will need to be developed into full working drawings by the lead designer to incorporate all other design disciplines.

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1. INTRODUCTION

As part of refurbishment and expansion works, it is proposed to locate a new item of plant at The Hall School Senior School, Crossfield Road NW3. As part of the planning application, Camden Council requires consideration be given to atmospheric noise emissions from the proposed equipment to the nearest noise-sensitive receptors. Consideration must also be given to internal noise levels within proposed classrooms to ensure that suitable conditions can be achieved in teaching spaces.

RBA Acoustics have been commissioned to undertake measurements of the prevailing noise conditions at the site and to determine the atmospheric noise emission limits in accordance with Camden Council's requirements, and predicted internal noise levels in accordance with the requirements of BB93: Design Guide for Schools. This report presents the results of the noise measurements, associated criteria and provides the required assessment.

A summary of acoustic terminology is included in Appendix A.

2. SITE DESCRIPTION

The site is a large school located in Belsize Park, NW3 set over two buildings; one a period red brick building of three stories, the other, to the south, being of late 20th century design over two floors. The school faces onto Crossfield Road, with residential dwellings opposite. Further residential dwellings lie to the rear (east) and south of the school some 30-50m away.

The noise climate around the school is outer urban in nature and is dominated by traffic noise from adjoining streets and noise from school play areas.

The refurbishment will be focused around the newer building, featuring an extension at the rear comprising new classrooms above an existing hall space. These classrooms will be served by an additional Air Source Heat Pump (ASHP) located on the roof alongside existing plant.

The site is shown in relation to its surroundings in the site plan in Figure 1 (Appendix D).

3. ENVIRONMENTAL NOISE SURVEY

3.1 Survey Methodology

Monitoring of the prevailing background noise was undertaken by Doug Shearer of RBA Acoustics over the following 24-hour period:

14 September to 15 September 2022.

As the survey was unattended it is not possible to comment with certainty regarding meteorological conditions throughout the entire survey period. However, based on observations during the site visits and weather reports for the area, conditions were generally considered suitable for obtaining representative noise measurements, being predominantly dry with little wind.

Measurements were made of the L_{A90}, L_{Amax} and L_{Aeq} noise levels over sample periods of 15 minutes.

3.2 Measurement Location

To determine the existing noise climate around the site measurements were undertaken at the following location:

Measurement Position 1 – Rear of School. The microphone was attached to a pole and mounted to a fire escape railing at 3rd floor level at the rear of the building at the southeast corner of the school. The noise climate at the time of our visit was quiet suburban and was dominated by traffic noise from Crossfield Road (via a gap between school and adjacent buildings) and from children in the playground to the rear.

The measurement position is also illustrated on the site plan attached in Figure 1 and photos in Figure 3 (Appendix D).

3.3 Instrumentation

For information regarding the equipment used for the measurement please refer to Appendix B.

The sound level meter was calibrated both prior to and on completion of the survey with no significant calibration drift observed.

3.4 Results

The noise levels measured are shown as time-histories on the attached Graphs 1-2 and L_{A90} histogram in Graph 3 (Appendix D).

The typical lowest L_{A90} and the period averaged L_{Aeq} noise levels measured are summarised in Table 1.

Table 1 – Measured Levels

Measurement Period	Position 1 – 3rd floor Rear SE Corner	
	Typical Lowest $L_{A90,15min}$ (dB)	$L_{Aeq,period}$ (dB)
Daytime (07:00 – 23:00)	37	60
Night-time (23:00 – 07:00)	33	40

The daytime L_{Aeq} levels are dominated by existing noise generated by the school when students are using the playground. This noise should be specifically excluded from the assessment of internal ambient noise levels, as discussed in Section 7.0, below.

In order to establish a suitable design level, hourly L_{Aeq} measurements are shown in order to determine typical external levels outside the proposed classrooms.

Table 2 – Hourly Measured Levels

Time	Position 1 – 3rd floor Rear SE Corner
	$L_{Aeq,1hour}$ (dB)
08:00	56
09:00	58
10:00	65
11:00	61
12:00	62
13:00	68
14:00	61
15:00	57
16:00	58
Average, Breaktimes Excluded	***59***

School hours are from 08:15 to 16:00. This period includes times when the students are on breaktime and are in the playground, namely from 10:00 to 11:10 for breaktimes and from 12:20 to 13:45 for lunchtimes. These periods have been excluded from our analysis, but even outside these times, we observe elevated levels beyond that attributable to traffic noise from surrounding roads. It is not clear whether these levels outside break times are due to external school activities such as games lessons, or from noise from the neighbouring school.

4. PLANT NOISE CRITERIA

The requirements of Camden Council's Environmental Health Department regarding new building services plant are understood to be as outlined in Appendix 3 of their Local Plan 2017 as follows.

"Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion)."

When considering the existing background levels of a site, BS 4142:2014 "Methods for Rating and Assessing Industrial and Commercial Sound" recommends assessing to the "typical" measured $L_{A90,\ 15mins}$ background levels, BS 4142:2014 goes on to state:

"In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."

BS 4142:2014 suggests that statistical analysis is a suitable method to determine the "typical" background level. This can be carried out by calculating the level of the most-commonly occurring $L_{A90,\ 15mins}$ period during the proposed operating hours of equipment.

We generally consider that designing to the most-commonly occurring $L_{A90,\ 15mins}$ period is not sufficient during those slightly quieter periods. In our opinion, a more representative value would be the "typical-lowest" level, which can be determined statistically as the lowest rounded $L_{A90,\ 15mins}$ level which occurs for at least 10% of the assessment period. In line with the above requirements, we would propose items of mechanical services be designed so that noise emissions from the plant do not exceed the following levels when assessed at the nearest noise sensitive location:

- Daytime (07:00 to 23:00) 27 dBA
- Night-time (23:00 to 07:00) 23 dBA

In line with BS 4142: 2014, should the proposed plant be identified as having intermittent or tonal characteristics, a further penalty should be subtracted from any of the above proposed noise emission limits.

It should be noted that the above requirements are applied at the nearest residential adjacencies and alternative criteria should be incorporated if there are also commercial properties affected by the proposed plant installations.

5. PLANT NOISE ASSESSMENT

This assessment has been based on the information provided to RBA by Elementa Consultants, the project M&E Consultants and is described in the following sections.

5.1 Proposed Plant Items

The following plant is proposed for the scheme:

Table 3 – Plant Type

Manufacturer/Model/Duty	Plant Type
Mitsubishi PUZ-HWM140VHA	ASHP Outdoor Unit

5.2 Plant Locations

The plant is to be located opposite existing plant in the gap between two plant enclosures at the south end of the school roof. It is to face north and be mounted slightly away from the supporting wall. The equipment positions are indicated on the site plans in Figure 1 and Figure 2 in Appendix D.

5.3 Plant Noise Levels

Information regarding the noise levels of the proposed plant has been provided by the manufacturer of the unit. The associated plant noise levels are detailed as follows:

Table 4 – Plant Noise Levels

Unit	L_p @ 1m	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
PUZ-HWM140VHA	53	57	58	54	51	48	43	39	36

Review of the octave band data provides no indication of any tonal characteristics associated with the proposed plant.

5.4 Location of the Nearest Noise-Sensitive Receptors

Based on observations made on site and discussions with the design team we understand the nearest noise-sensitive receptors to the proposed plant to be as follows:

Receptor 1 – 28 Crossfield Road 4th Floor

The receptor is directly across Crossfield Road from the plant, such that the adjacent plant enclosures offer no screening. The receptor is also slightly above the plant such that the roof parapet of the school offers no screening. The receptor is some 30m from the plant location.

Receptor 2 – 24 Crossfield Road 2nd Floor Rear

The receptor is in the building next door to the school. The rear bedroom window at 2nd floor is some 13m distant and 3m below the plant location. The roof boiler room enclosure and the massing of the southern end of the school building provide significant screening.

Two other receptors were considered:

- Eton Court (30-43 Eton Avenue) 4th floor rear (western end of Eton Court) to the south
- 12 Strathray Gardens 4th floor to the east

Receptors 1 & 2 above were considered the worst cases and will be reported here.

The receptors are shown in the site plan in Figure 1 in Appendix D.

5.5 Calculation of Noise Levels at Nearest Noise-Sensitive Receptors

Our calculation method for predicting noise levels from the proposed plant at the nearest noise-sensitive receptors, based on the information above, is summarised below.

- Source Term SPL
- Distance Attenuation
- Directivity
- Reflections
- Screening

Calculation sheets are attached for further information in Appendix C.

The results of the calculations indicate the following noise levels at the nearest affected residential windows:

Table 5 – Predicted Noise Levels

Operating Period	Noise Level (dB) at Receptor 1 – 28 Crossfield Road		Noise Level (dB) at Receptor 2 – 24 Crossfield Road	
	Prediction	Criterion	Prediction	Criterion
Daytime (07:00 – 23:00)	21	27	18	27
Night-time (23:00 – 07:00)	21	23	18	23

Noise from the proposed plant installations is within the criteria.

6. VIBRATION CONTROL

In addition to the control of airborne noise transfer, it is also important to consider the transfer of noise as vibration to adjacent properties (as well as to any sensitive areas of the same building).

We would typically advise that ASHP units be isolated from the supporting structure by means of either steel spring isolators or rubber footings. For particularly sensitive locations, or when on lightweight structures the mounts should ideally be caged and be of the restrained type.

It is important the isolation is not "short-circuited" by associated pipework or conduits. To this end, any conduits should be looped and flexible connectors should be introduced between the condenser and any associated pipework. Pipework should be supported by brackets containing neoprene inserts.

7. INTERNAL NOISE CRITERIA

This section outlines typical assessment criteria in terms of the relevant standards. A brief explanation of the acoustic terminology used in this report is shown within Appendix A.

Building Bulletin 93 – Acoustic design of schools: performance standards (BB93) sets out indoor ambient noise levels (IANL), $L_{Aeq,30min}$, in unoccupied spaces which should not be exceeded in order to provide clear communication of speech between teacher and student and suitable study conditions. This project incorporates the BB93 indoor ambient noise level criteria for new-build educational buildings. We understand it is proposed for the new building to be designed to achieve the BB93 acoustic criteria for mainstream only, i.e. there is no SEN provision. The guidance provided in this report assumes this approach. Should there subsequently be a requirement for SEN provision it is critical we are advised at the earliest opportunity as this will impose more stringent internal noise criteria and, potentially, require changes in the glazing/ventilation sound insulation performance.

The recommended internal ambient noise levels apply to the contributions from external noise sources, internal building services systems and vibration re-radiated noise levels. Applicable criteria for new-build schools have been used in our ventilation strategy assessment, based on current plans, as shown below.

Building Bulletin 93 defines differing IANL limits for different types of teaching space. For secondary schools, a level of 35 dB $L_{Aeq,30min}$ is required.

The above limits are to be achieved with the ventilation scheme working in normal duty and are inclusive of both mechanical building services noise and external noise intrusion (e.g.: road traffic noise). The IANL excludes noise contributions from teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. Therefore, the noise levels measured outside school break-time hours have been used in this assessment.

The mechanical services noise within the rooms should be controlled such that the above limits are not exceeded in all cases, however when the primary means of ventilation is via a natural or hybrid ventilation scheme, the above limits can be relaxed by +5 dB when windows are open to provide ventilation, i.e. the IANL contribution from external noise ingress can be 5 dB higher.

For a standard secondary school classroom, this would result in the following maximum permissible internal ambient noise levels:

- Windows closed 35 dB $L_{Aeq,30min}$
- Windows open 40 dB $L_{Aeq,30min}$

Furthermore, when using a natural or hybrid ventilation scheme, to control overheating during the hottest 200 hours of the summertime and under local control of the teacher, BB93 recommends that that IANLs should not exceed an upper limit of 55dB, $L_{Aeq,30mins}$ if windows are opened for additional cooling.

'Acoustics of Schools: A Design Guide', the companion document to BB93, also proposes, "Noise levels in unoccupied playgrounds, playing fields and other outdoor areas should not exceed 55dB $L_{Aeq,30min}$ and there should be at least one area suitable for outdoor teaching activities where noise levels are below 50dB $L_{Aeq,30min}$."

This assessment therefore assumes these criteria in assessing the likelihood of acceptable acoustic conditions in and around the proposed new teaching block.

8. NOISE INGRESS ASSESSMENT

8.1 Assumptions

Our external building fabric analyses have assumed the following:

(a) Drawings

The assessment has been based on the latest site drawings developed by Norr Consultants Ltd, dated September 2022.

(b) Noise Levels

The assessment has been based on noise levels measured during our baseline site noise survey, detailed in Section 3.

(c) External Wall

For the purposes of this assessment, we have assumed the sound insulation performance of the non-glazed elements of the building envelope will be significantly higher than the glazing, i.e. noise ingress will be primarily through windows.

(d) Ventilation

It is understood the preferred strategy is natural ventilation via trickle vents and openable windows, where appropriate.

8.2 Assessment

As detailed in section 3.4, existing measured noise levels may have been influenced by playground noise and from other activities associated with the Hall School. Levels measured during Hall School break times have been excluded from our analysis but it is not clear what influence other Hall School activities or noise from the neighbouring school have had.

Therefore, when noise from Hall School breaktimes is disregarded, internal noise levels with windows open are predicted to be above the requirements for naturally ventilated teaching spaces in secondary schools with windows open. The noise environment at The Hall School is not that of the typical of the urban noise environment and the measured noise levels should be viewed in that context.

9. CONCLUSION

RBA Acoustics have undertaken noise monitoring at The Hall School NW3. The measured noise levels are presented within this report. These levels have been used to determine the required criteria for atmospheric noise emissions from the proposed plant installations.

The results of the assessment indicate atmospheric noise emissions from the proposed plant are within the criteria required by Camden Council. As such, the proposed plant installations should be considered acceptable in terms of noise.

From measured noise levels, an assessment of the acoustic suitability of the site has been undertaken, along with an assessment of the likelihood of acceptable internal noise levels being achieved when windows are open for ventilation.

This assessment concludes that external and internal noise levels at the proposed new teaching block are above the recommended levels in BB93, although the degree to which school activities have influenced the measured levels is not completely clear. Further investigations will be conducted at design stage. When windows are closed and ventilation is provided via other passive means (trickle vents) the resultant internal noise levels are acoustically suitable.

Appendix A – Acoustic Terminology

A-weighting (e.g. dB(A))	A correction applied across the frequency bands to take into account the response of the human ear, and therefore considered to be more representative of the sound levels people hear.
DeciBel (dB)	Unit used for many different acoustic parameters. It is the logarithmic ratio of the level being assessed to a standard reference level.
L_{eq}	The level of a notional steady sound which, over a stated period of time, T, would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
$L_{Aeq,T}$	The A-weighted level of a notional steady sound which, over a stated period of time, T, would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
L_{An} (e.g. L_{A10}, L_{A90})	The sound level exceeded for n% of the time. E.g. L_{A10} is the A-weighted level exceeded for 10% of the time and as such can be used to represent a typical maximum level. Similarly, L_{A90} is the level exceeded for 90% of the measurement period, and is often used to describe the underlying background noise.
NR	Noise Rating – A single figure term to describe a measured noise level which considers the frequency content of the noise, generally used for internal noise level measurements (particularly mechanical services plant).

Appendix B – Instrumentation

The following equipment was used for the measurements.

Table B1 – Equipment Calibration Details: Position 1

Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Valid Until
01dB A&V Type 1 Sound Level Meter	Black Solo 01	65678	U40836	3 March 2024
01dB A&V Pre Amplifier	PRE 21 S	16316		
01dB A&V ½" Microphone	MCE 212	166503	U40834	3 March 2024
01dB-Stell Calibrator	Cal 21	35242481	40385	3 March 2024

Appendix C – Plant Calculation

Table C1 – Example Calculation, PUZ-HWM140VHA to 28 Crossfield Road

Parameter	Octave-band Noise Levels (dB) at Octave-band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Source L_p @1m	57	58	54	51	48	43	39	36	53
Reflections from 2 Adjacent Surfaces	5	5	5	5	5	5	5	5	
Directivity losses @ 90 degrees	-2	-3	-4	-9	-13	-13	-13	-13	
Distance losses @ 30m	-30	-30	-30	-30	-30	-30	-30	-30	
Noise level at Receptor 1	30	30	25	17	10	5	1	-2	21
Criterion									23

Appendix D – Graphs and Site Plans

The Hall School

L_{Aeq} Time History

Position 2: Rear

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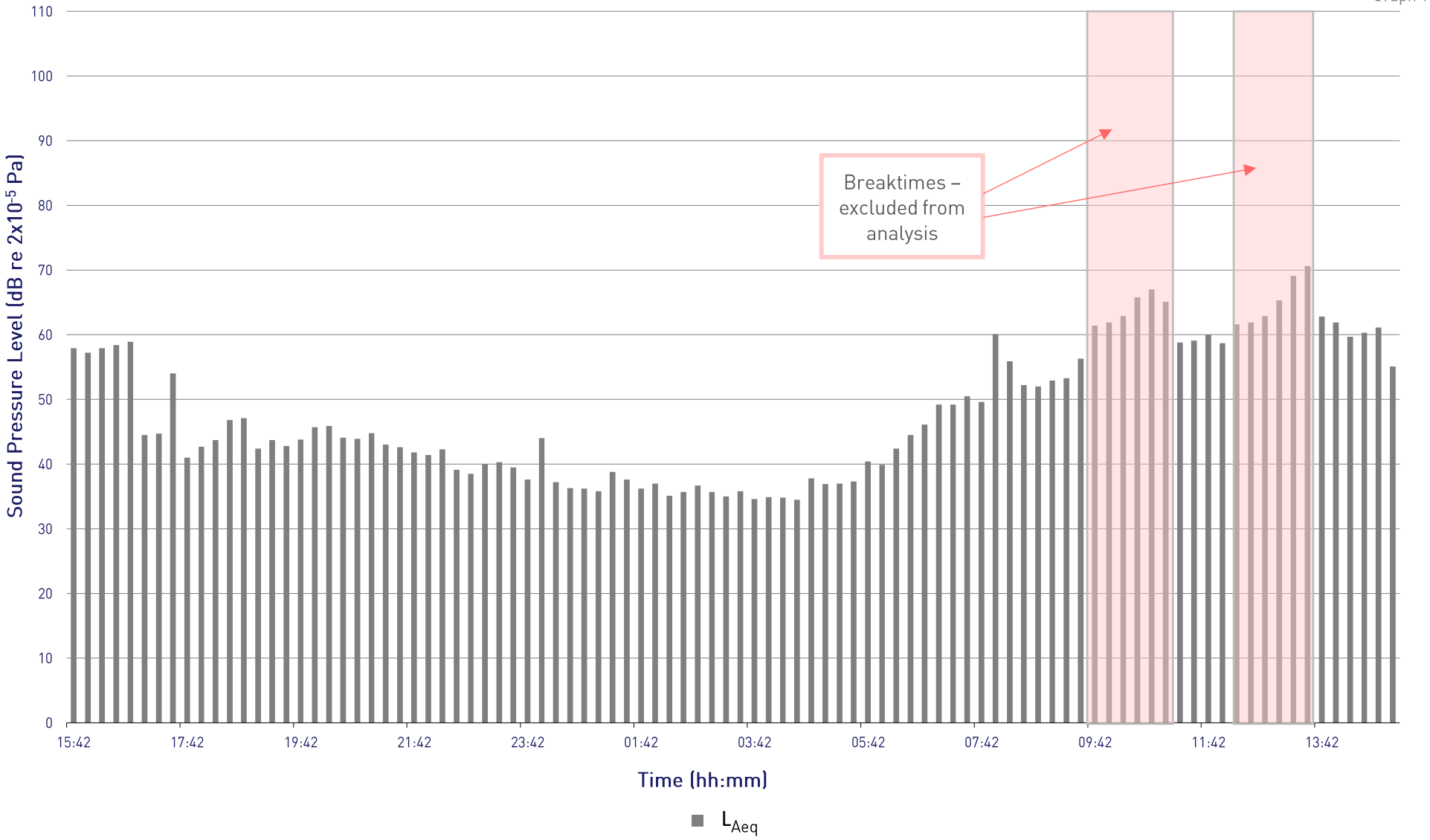
Graph 1



The Hall School

$L_{Amax,f}$ and L_{A90} Time History

Position 2: Rear

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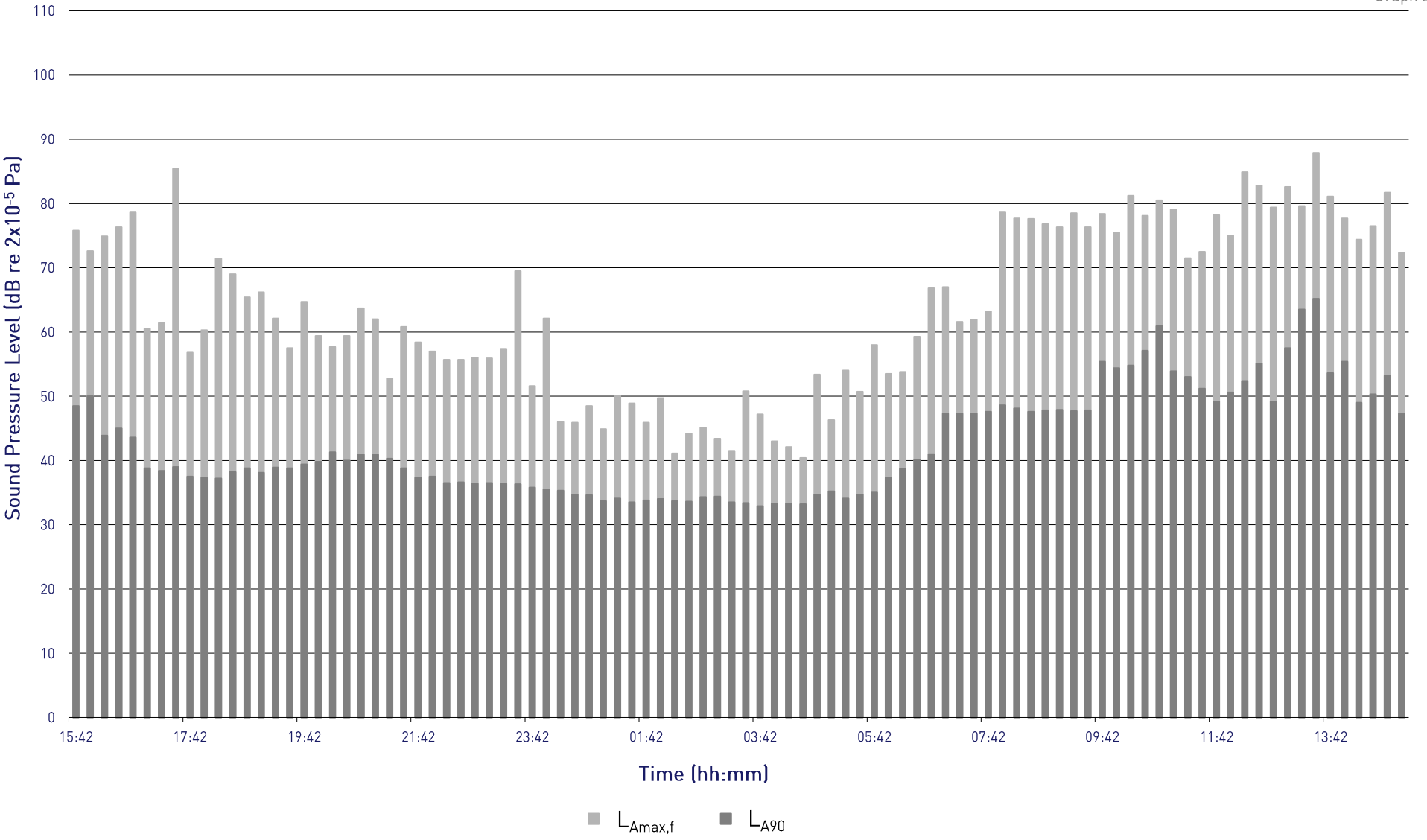
Graph 2



The Hall School

$L_{A90,15\ minutes}$ Histogram

Position 2: Rear

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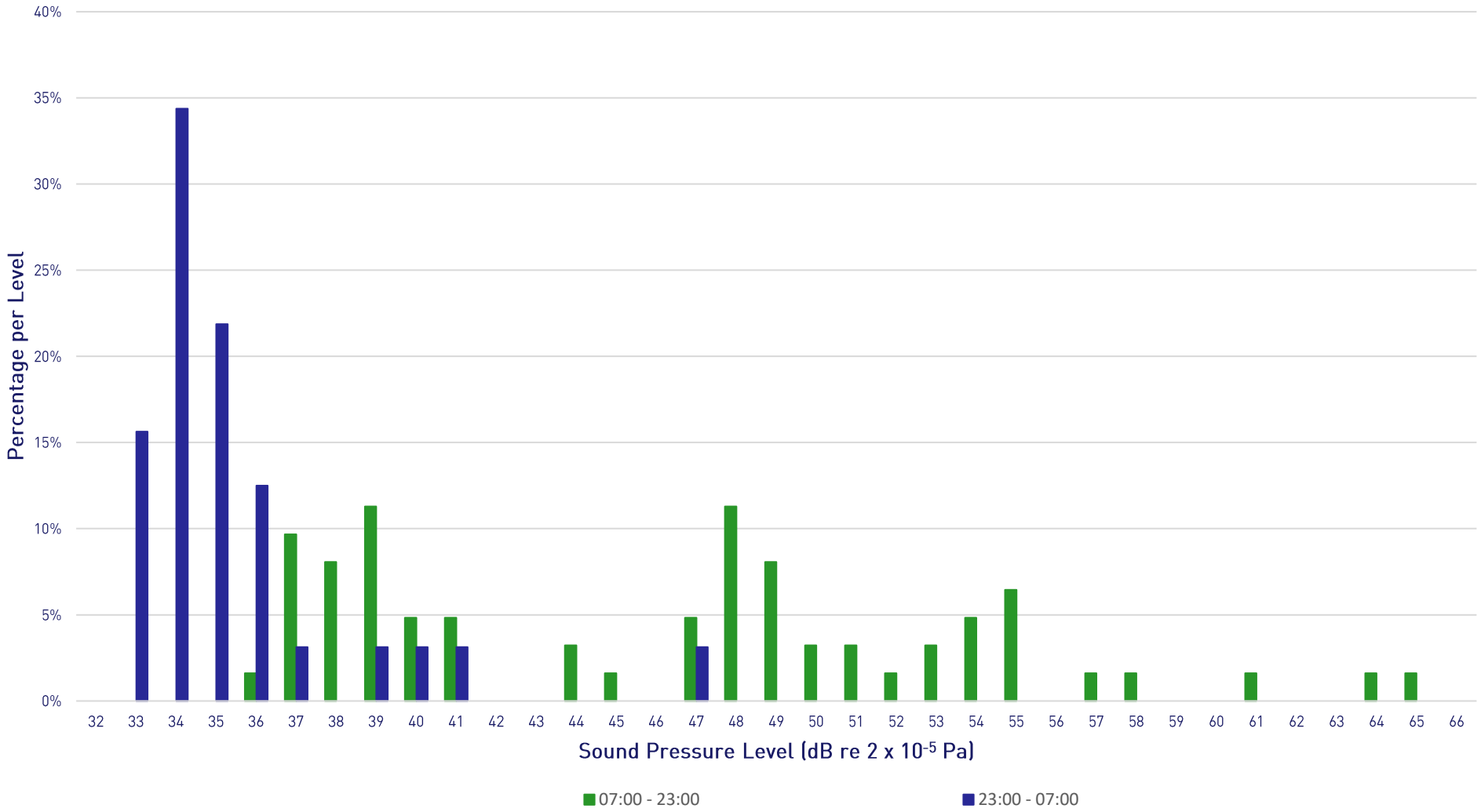
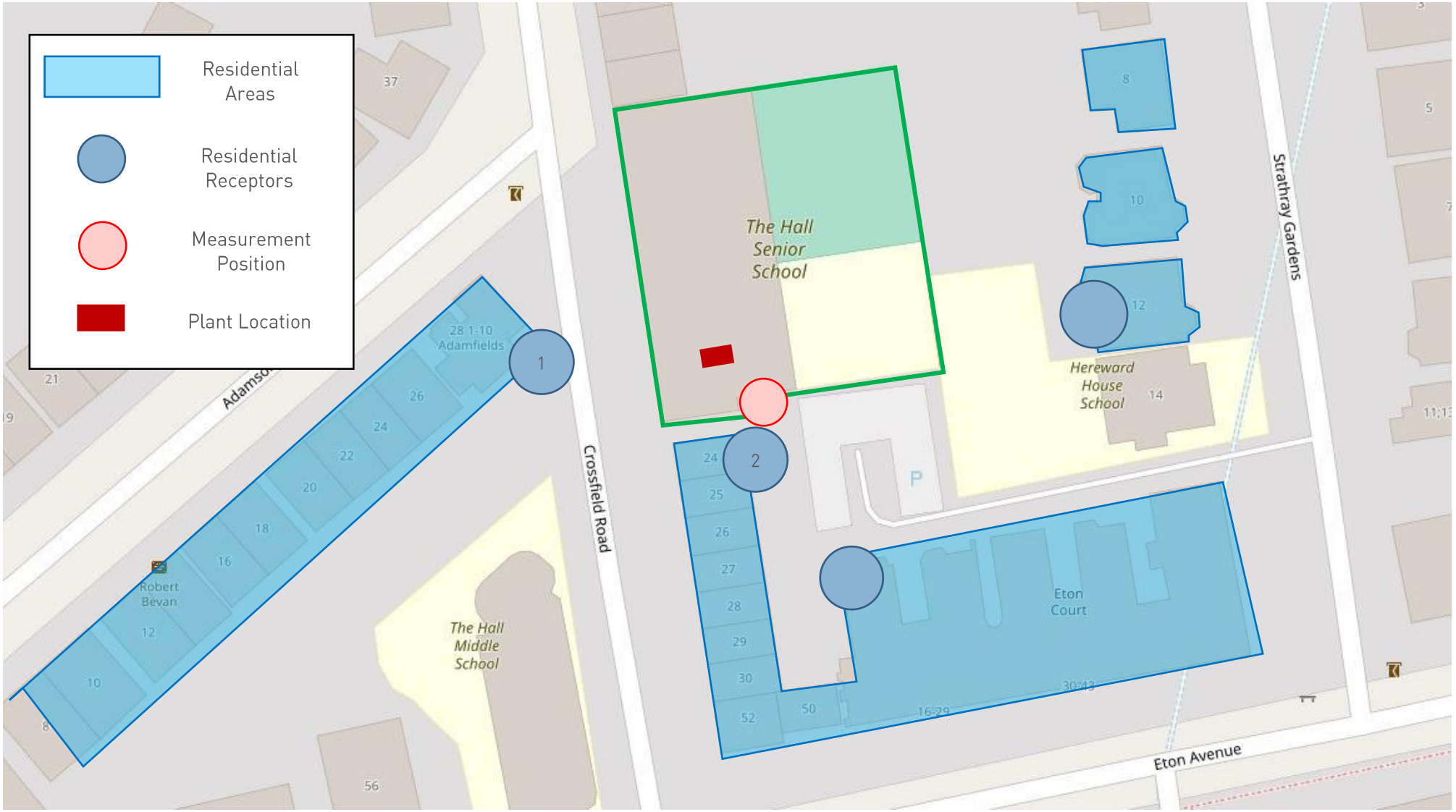
Graph 3





The Hall School, NW3

Site Plan Showing Measurement Locations and Nearest Residential Receptors

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Figure 1

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Not to Scale

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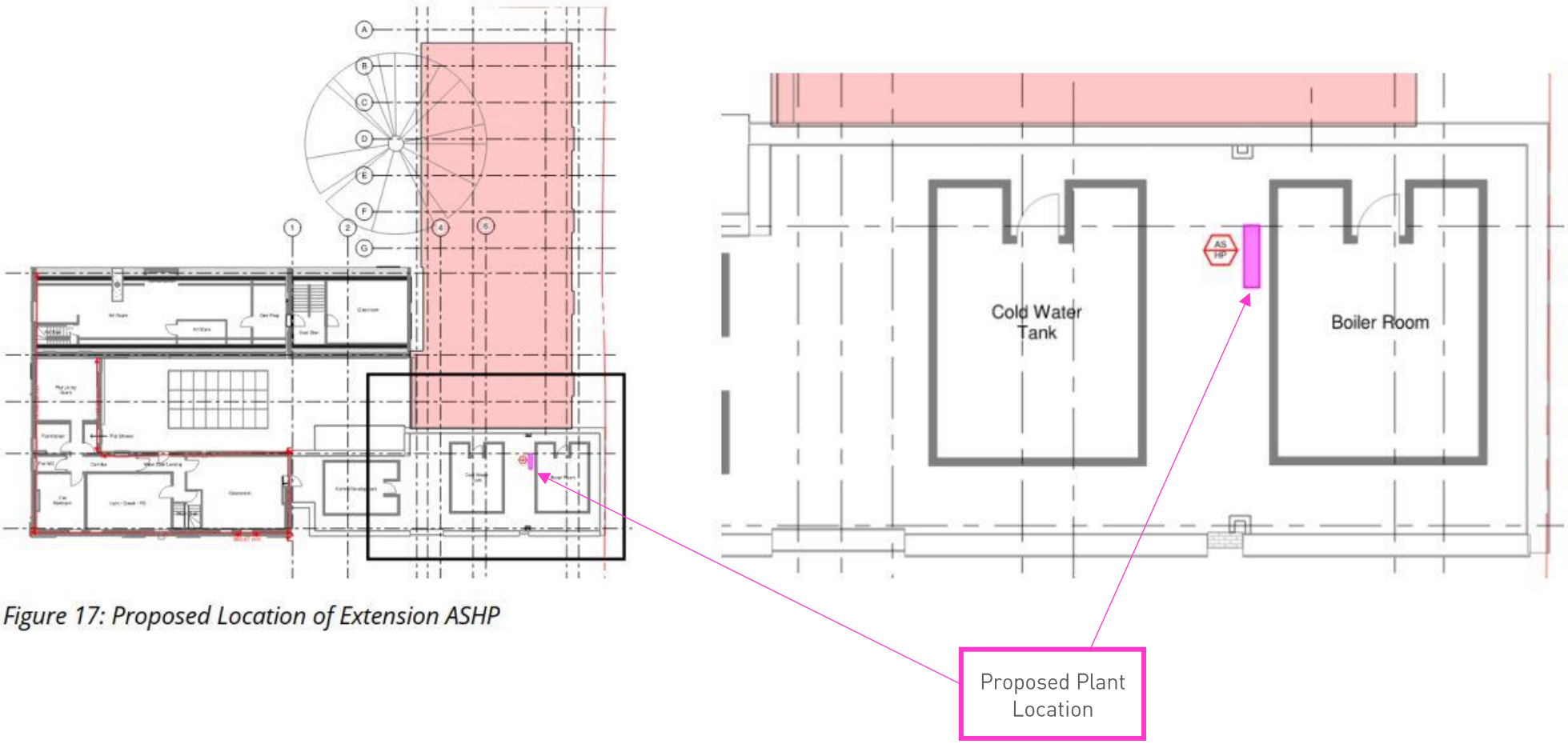

Figure 17: Proposed Location of Extension ASHP

The Hall School, NW3

Roof Plan Showing Proposed Plant Location

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Figure 2

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Not to Scale

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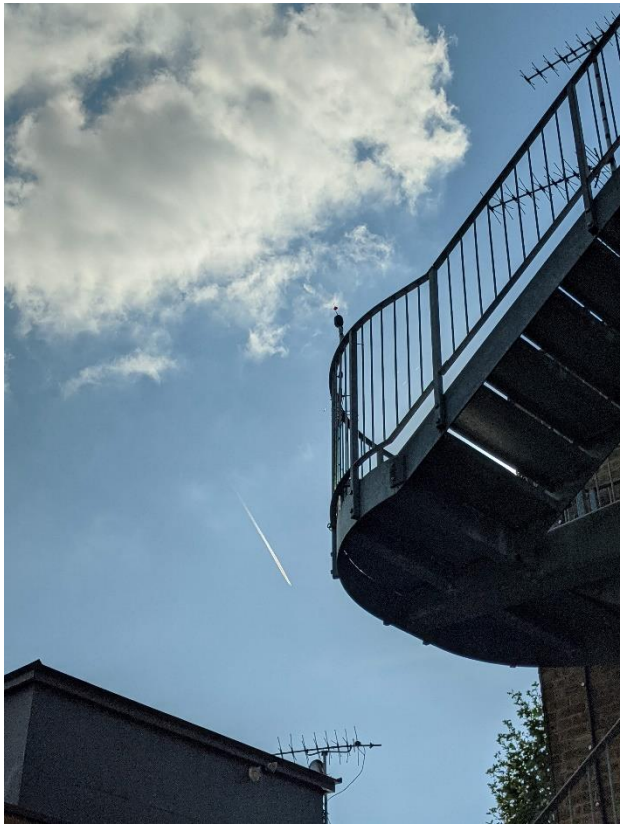

The Hall School, NW3

Photographs Showing Measurement Position

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Figure 3

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Not to Scale

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