



GOLDSMITH MEWS,
CHALK, GRAVESEND

Acoustic Assessment Report

Reference: 11917.RP01.AAR.1

Prepared: 13 July 2022

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Stem Homes

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Acoustic Assessment Report



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0	First issue of report	7 July 2022	Sebastian Chesney	Alex J Wyatt
1	Actual proposed ASHP unit assessment added	13 July 2022	Sebastian Chesney	Alex J Wyatt

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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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1.0 INTRODUCTION

A new residential development is proposed at Goldsmith Mews, Chalk, Gravesend. The development consists of 4 No. dwelling houses with associated parking and garden areas. Each dwelling is three-stories high and has an ASHP located in the rear garden area.

An assessment has been carried out in relation to the noise levels likely to be incident on the proposed building façades and to provide acoustic performance specifications such that acceptable internal noise criteria can be achieved.

This report details the results of the noise survey and sets out the acoustic performance requirements of the external building fabric elements. In addition, suitable plant noise emission criteria have been developed based upon the survey results and the requirements of Gravesham Borough Council leading to the specification of a limiting level for the proposed ASHPs.

This report has been provided in support of the planning application to discharge Planning Condition 15.

A summary of acoustic terminology is included in Appendix A attached.

2.0 SITE DESCRIPTION

The site is shown in relation to its surroundings in the attached Site Plan in Figure 1 (Appendix G). The site is currently used as private parking, with garages. Adjacent to the site, there is a small public car park, with approximately 25-30 spaces.

The site is bounded by Chalk Road/Lower Higham Road to the north and Osney Way to the west. The surrounding area predominantly consists of other residential dwellings.

To the east of the site is Chalk Parish Hall. It is anticipated that operation of Chalk Parish Hall will not emit excessive levels of noise as there are other residential dwellings within close proximity. This is also borne out by the measured levels which indicate no noticeable increase in noise levels during operation of the Hall.

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Survey Methodology

Monitoring of the prevailing background noise was undertaken over the following period:

Thursday 16th June to Monday 20th June 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 Locations

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

Measurement Position 1 (MP1)

Measurements were taken at this position with the microphone in the centre of the site overlooking Osney Way and Chalk Road/Lower Higham Road. The microphone was attached to the existing garages via a pole and elevated to a height of approximately 3m to gain line-of-sight to the roads.

The prevailing noise climate was noted to mainly consist of traffic movements along Chalk Road/Lower Higham Road. This is a local road mainly serving residential areas within the area.

The measurement position is considered typical of the proposed development façades closest to Chalk Road/Lower Higham Road.

The measurement position is also illustrated on the site plan attached in Figure 1 and photos in Figure 2 (Appendix G).

3.3 Instrumentation

For information regarding the equipment used for the measurements please refer to Appendix D attached.

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 measured L_{Aeq} , L_{A90} and $L_{Amax,f}$ 15-minute period levels are shown as time-histories on the attached Graphs 1-2 (Appendix G). The averaged daytime and night-time L_{Aeq} noise levels are summarised in Table 1 below. Also shown are the typical $L_{Amax,f}$ noise levels, based upon the 90th percentile of 5-minute intervals during the night-time period.

Table 1 – Measured Levels

Measurement Position	Averaged $L_{Aeq, period}$ Noise Level (dB)		Typical $L_{Amax,f}$ Noise Level (dB)
	Daytime (07:00-23:00 hrs)	Night-time (23:00-07:00 hrs)	Night-time (23:00-07:00 hrs)
MP1	52	46	65

The typical-lowest L_{A90} (15 minute) background sound level can be determined statistically as the lowest $L_{A90,15mins}$ level which is exceeded for 90% of the assessment period, or alternatively termed the 10th percentile of the measured $L_{A90,15mins}$ levels. The typical-lowest background noise levels ($L_{A90,15mins}$) at the measurement position are summarised in Table 2 below. This data can be used to set plant noise emission criteria for use in the assessment of noise emissions from any proposed plant at the development.

Table 2 – Measured Typical-Lowest $L_{A90,15mins}$ Noise Levels

Measurement Position	Typical-Lowest $L_{A90,15mins}$ Noise Level during period (dB)	
	Daytime (07:00-23:00 hrs)	Night-time (23:00-07:00 hrs)
MP1	38	31

A histogram presenting the distribution of the measured $L_{A90,15mins}$ levels is provided in Graph 3 in Appendix G attached.

4.0 PLANNING CONDITION

The section below provides the details of Planning Condition 15 associated with the proposed development.

Prior to any above ground works, a suitable noise impact assessment demonstrating compliance with the following requirements, including details of the glazing and ventilation strategy and their respective noise reduction values, shall be submitted to and approved by the Local Planning Authority:

- a) *The internal ambient noise levels in all habitable rooms of the residential dwellings shall not exceed the guideline L_{Aeq} values in Table 4 of BS 8233:2014*
- b) *The maximum internal noise levels in all habitable rooms should not normally exceed 45dB L_{Amax} more than 10 times per night in accordance with the Professional Practice Guidance on Planning & Noise and the WHO Guidelines for Community Noise.*
- c) *Where relevant, the rating noise from fixed building services/mechanical plant/equipment associated with/in the vicinity of the development (e.g. the air conditioning unit or similar on the flank wall of the Parish Hall adjacent to the proposed development) shall be at least 10dB below the existing L_{A90} background level at the nearest noise sensitive receptors (i.e. dwellings) when measured and assessed in accordance with BS4142:2014*

Any mitigation measures recommended in the noise impact assessment in order to meet the above criteria as agreed by the Local Planning Authority shall be implemented prior to first occupation of the development.

Where compliance with the above criteria will rely on closed windows, the development must include sufficient and suitable ventilation to affected residential dwellings by means other than opening windows to ensure that the internal noise levels required by the above conditions can be retained all year round.

This report has been provided in support of discharging the above condition.

5.0 EXTERNAL BUILDING FABRIC CRITERIA

This section outlines typical assessment criteria in terms of the relevant standards.

5.1 British Standard 8233:2014

British Standards Institution (2014) *BS 8233:2014: Guidance on Sound Insulation and Noise Reduction for Buildings* draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions.

The noise level values given are in terms of an average (L_{Aeq}) level.

The standard advises internal ambient noise levels for achieving suitable resting and sleeping conditions within residential properties as set out in Table 3.

Table 3 – BS 8233:2014 Residential Criteria

Room	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)
Living Rooms	35 dB $L_{Aeq,16hour}$	--
Dining Room/area	40 dB $L_{Aeq,16hour}$	--
Bedrooms	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Although generally no specific numerical requirement is set in terms of an $L_{Amax,f}$ noise level, BS 8233:2014 does provide the following guidance with regards individual noise events:

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.

Guidance provided in the World Health Organisation's Guidelines for Community Noise further refines the requirements for individual noise events as outlined below. However, Table H.3 of BS 8233:2014 does state a range of 45-55dB L_{Amax} for hotel bedrooms during the night-time period.

5.2 World Health Organisation Guidelines

WHO (2018) *Environmental Noise Guidelines for the European Region* sets out to define "recommended exposure levels for environmental noise in order to protect population health". The guidance document relates specifically to external noise levels, and recommends that "all CNG [WHO (1999) *Guidelines for Community Noise*] indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid". RBA therefore make reference to Guidelines for Community Noise for recommendations on internal noise levels.

Guidelines for Community Noise describes guideline levels that are "essentially values for the onset of health effects from noise exposure". A table of guideline values is included, relating to adverse health effects, defined as any temporary or long-term deterioration in physical, psychological, or social functioning that is associated with noise exposure. The following is an extract from Table 4.1: Guideline values for community noise in specific environments, as stated in the WHO document.

Table 4 – Guideline Values for Community Noise

Specific Environment	Critical Health Effect(s)	L_{Aeq} (dB)	Time Base (hours)	$L_{Amax,f}$ (dB)
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-times	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

With reference to maximum noise levels the following guidance is provided within the WHO guidance:

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991) and most studies show an increase in the percentage of awakenings at SEL values of 55-60 dBA (Passchier-Vermeer 1993; Finegold et al. 1994; Pearsons et al. 1995). For intermittent events that approximate aircraft noise, with an effective duration of 10-30s, SEL values of 55-60 corresponds to a L_{Amax} value of 45dB. Ten to 15 of these events during an 8 hour night-time implies a $L_{Aeq, 8h}$ of 20-25dB. This is 10-15dB below the $L_{Aeq, 8h}$ or 30dB for continuous night-time noise exposure, and shows that intermittent character of noise must be taken into account when setting night-time noise limits for noise exposure. For example, this can be achieved by considering the number of noise events and the difference between the maximum sound pressure level and the background of these events."

Therefore, the frequency of occurrence of maximum noise events should not typically exceed 10-15 times in any night.

5.3 Summary

The adopted project criteria, in line with Planning Condition 15, are therefore as follows;

Bedrooms	Night-time (23:00-07:00)	30 dB L_{Aeq} and typically < 45 dB $L_{Amax,f}$ *
	Daytime (07:00-23:00)	35dB L_{Aeq}
Living Rooms	Daytime (07:00-23:00)	35dB L_{Aeq}

* Under WHO, 10-15 occurrences during the night-time in excess of 45dBA are "allowable". The new 2014 version of BS 8233 states L_{max} levels in the region of 45-55dBA could be considered acceptable.

6.0 EXTERNAL BUILDING FABRIC ASSESSMENT

6.1 Background

Analyses of the external building fabric have been undertaken in order to ascertain the required acoustic performance of the glazing and other external fabric elements to achieve the project criteria.

6.2 Assumptions

Our external building fabric analyses have assumed the following:

(a) Drawings

The assessment has been based on the information provided in the following drawings:

Drawing Number	Drawing Name	Dated
21366/100	Proposed Ground Floor Plan	09/2021
21366/101	Proposed First Floor Plan	09/2021
21366/102	Proposed Second Floor Plan	09/2021
21366/103	Proposed Roof Floor Plan	09/2021
21366/202	Proposed North Elevation	09/2021
21366/203	Proposed East Elevation	09/2021
21366/204	Proposed South Elevation	09/2021
21366/205	Proposed West Elevation	09/2021

(b) Noise Levels

The assessment has been based on the measured noise levels as detailed in Section 3.4.

(c) Room Absorption

The calculations assume that bedrooms are acoustically 'soft' with curtains and other soft furnishings. The living rooms are assumed to be less acoustically absorptive (with a hard floor finish, although with furnishings).

Details of the absorption coefficients assumed in the calculations are attached in Appendix B.

(d) External Wall

External non-glazed areas are to comprise the following:

- External lightweight cladding
- Cavity with rock mineral wool insulation
- 12mm cement particle board (sheathing)
- Light gauge steel infill framing (Metsec/SFS) with glass mineral wool
- 2x layers of 12.5mm plasterboard

As such, RBA have assumed the following sound reduction indices (equating to an overall R_w of 53 dB) for all non-glazed façade areas:

Table 5 – Sound Reduction Indices of Non-Glazed Elements

Assumed Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
21	32	45	55	55	55	55	55

Should the proposals for non-glazed areas change, it is critical RBA are informed at the earliest opportunity as this could have a significant impact on the sound insulation performance requirements of the glazing systems.

(e) Ventilation

We have assumed that the chosen strategy is natural ventilation via trickle ventilators where possible, i.e. continuous mechanical extract ADF System 3. These have also been assessed and the acoustic performance specification for such trickle ventilators is detailed below.

It should be noted the trickle ventilators typically provide background ventilation only and that windows are to generally be openable to provide purge ventilation. During those periods where windows are opened for purge/rapid ventilation, noise levels will naturally be increased internally.

We understand that the site has been registered with Building Control and works will commence before June 2023, and therefore there is no formal requirement to comply with the new Approved Document O (ADO). However, due to the low prevailing noise levels at the proposed development, it is considered that relying on opening windows is a suitable strategy to overcome any potential overheating issues that may arise, being that the measured levels are in the 'Negligible Risk' category of AVO Guidance, i.e. L_{eq} 's are <53dB day and <48dB night.

6.3 Specification & Guidance Constructions

Appendix C attached details the sound reduction performance specification for the ventilators and glazed elements of the external building fabric.

The glazing performance specifications apply to the glazing package as a whole - inclusive of glazing, louvres, spandrel panels, framing, opening lights, doors, seals, etc. The performance of the glazing system will depend on many factors such as the glazing configuration, size of window panels, quality of framing, quality of sealing, etc.

Please note – The glazing configurations described in Table 6 and ventilator types described in Table 7 are given for costing purposes only. All window systems should be capable of meeting the performance specifications shown in Appendix C, with laboratory test certificates being made available in support of the quoted performance. Glazing proposals which simply reflect the guidance constructions indicated in this report will not, in isolation, be sufficient evidence that a window configuration will meet the performance specification.

For guidance purposes RBA would typically expect the following glazing configuration to prove commensurate with achieving the sound insulation performance specifications detailed within Appendix C.

Table 6– Guidance on Glazing Constructions

Glazing Type	Example Glazing Configuration
G1	Any standard thermal double glazing. Please note a better performance is achieved with panes of differing thicknesses, e.g. 4mm glass/12mm cavity/6mm glass

It should be noted that due to the non-acoustic reasons (security, thermal or structural purposes), the specifications may exceed those stated above in some locations.

For guidance purposes RBA would typically expect the following trickle ventilator type to prove commensurate with achieving the sound insulation performance specifications detailed within Appendix C.

Table 7 – Guidance on Trickle Ventilators

Ventilator Type	Example Ventilator Type
V1	Any nominally acoustically rated “through-the-frame” trickle ventilator

The above specifications should be applied to all floor levels on all façades to all room types.

The assessment indicates that using the above glazing and ventilation strategy, the internal noise levels are within the adopted criteria, and therefore, suitable for discharging Parts (a) and (b) of Planning Condition 15. An example, worst-case calculation of the predicted internal noise levels within a bedroom is presented in Appendix F attached for information.

6.4 Flanking Specification

We are not aware of any proposed continuous glazing systems, i.e. curtain walling, etc., at this stage. However, we advise on the flanking specification for any such systems (if they were to be proposed) as follows to aid the development of such systems.

Flanking Performance Specification

The previous Sections are in relation to external noise intrusion through any curtain walling systems to internal areas. Separating wall and floor sound insulation performance can often be compromised by curtain walling systems. It is thus important that an additional specification for the curtain walling package be introduced, which will limit the amount of sound transfer across separating wall and floor lines through the curtain walling system. A flanking performance specification is attached within Appendix C – Section 3.0.

Achievement of the specification can be demonstrated by laboratory acoustic testing in general accordance with BS EN ISO 10848-2:2006. This is admittedly a complex and costly testing procedure and therefore the supplier may – following tender reviews – be allowed to demonstrate by other means that the specification can be achieved. This is reflected in the specification wording. The specification should also be incorporated within any other packages, which could affect the transmission of flanking sound at separating wall and floor lines.

It is likely insulated double/split mullions and transoms will be required in order to achieve the attached flanking specification. This obviously has a large impact on the design and style of any curtain walling system and should be investigated at the earliest opportunity to ensure the specification is achieved.

7.0 PLANT NOISE ASSESSMENT

7.1 Plant Noise Criteria at Existing Receptors

Planning Condition 15 stipulates that noise from any fixed plant shall be at least 10dB below the existing background sound level, L_{A90} . This would result in a criterion of 21dBA at night-time, based upon the measured noise levels [Table 2 above].

We suggest that imposing a noise emission limit as low as 21dBA is both; unnecessary to achieve acceptable conditions at the nearest existing noise-sensitive properties, and unenforceable with regard to the ability of normal (Class 1) instrumentation to measure the noise contribution of new plant.

The current version of BS 4142:2014+A1:2019 states:

"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."

In addition, Section 1 of the 'old' version of BS4142:1997 stated:

"The method is not suitable for assessing the noise measured inside buildings or when the background and rating noise levels are both very low...For the purposes of the standard, background noise levels below about 30dB...are considered to be very low"

Under such circumstances, we propose a criterion that mechanical services be designed so that noise emissions from the plant do not exceed the existing background sound level as a realistic target to work to at the nearest *existing* residential receptors. Notwithstanding this, all reasonable efforts should be made to reduce noise levels as much as is reasonably practicable.

Table 8 – Plant Noise Emission Limits to *Existing* Receptors

Measurement Position	Noise Level $L_{Aeq,T}$ (dB) limit at the nearest <i>existing</i> noise sensitive receptors	
	Daytime (07:00-23:00 hrs)	Night-time (23:00-07:00 hrs)
Position 1	38	31

In line with BS 4142:2014+A1:2019, 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 existing residential adjacencies and alternative criteria should be incorporated if there are also commercial properties affected by the proposed plant installations.

7.2 Proposed Development Receptors

Where the nearest noise sensitive receptors to the plant locations are the windows of the residences that form part of the proposed development, we have developed more relevant criteria based on guidance from applicable industry standards.

We propose maximum emission limits that would result in acceptable internal noise levels in the dwellings in the event of partially open windows. BS 8233:2014 provides guidance on suitable internal noise levels of 35dB $L_{Aeq,16hr}$ (daytime) and 30dB $L_{Aeq,8hr}$ (night-time) – see Section 5.1, above, for further information. A level of 5dB below these internal noise criteria is targeted.

Based on the sound reduction given by a partially open window as outlined in BS 8233:2014, internal noise levels are anticipated to be approximately 15dB lower than external noise levels. We therefore propose that cumulative noise emissions from mechanical services plant to the nearest proposed development receptors should be below the levels detailed in Table 9, below.

Table 9 – Plant Noise Emission Limits to *Own Development* Receptors

Position	L _{Aeq} Noise Level limit of all operating plant (dB) at 1m from the nearest <i>proposed</i> Receptor	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
All Own Development Windows	45	40

The 40dBA night-time value stated in the above table is 5dB lower than the WHO guidance for noise levels outside a bedroom to minimise sleep disturbance - reference Table 4 in Section 5.2 above.

In line with BS 4142, 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.

However, we will attempt to minimise the noise emissions such that they approach the Existing Receptor criterion (31dBA) as near as practicably possible.

7.3 Atmospheric Plant Noise Levels – Limit

Information regarding the proposed ASHP units is not yet finalised and known at this stage.

It is understood the ASHP units will primarily be used for the central heating system and heating of domestic water. Therefore, we do not anticipate that the units will be operating at full load capacity during the night-time, however, the below design target will ensure that potential noise impacts are minimised. It is assumed the units will be horizontal discharge, i.e. fan facing forwards, as opposed to a “bin” unit (vertical discharge).

The below “limiting” level has been “back-calculated” to the nearest receptors (both the existing receptor and the adjacent house within the proposed development) accounting for:

- Source Term SPL
- 20LogR Distance Attenuation
- Reflections (situated up against rear wall of house)
- Directivity (45° horizontally & 90° vertically)

Detailed calculations using the below limiting level for the ASHP are presented in Appendix F attached to indicate compliance with the project criteria. In fact, the units achieve a level of 34dBA at the own development receptor, which is only marginally above background and significantly below the WHO guidelines.

Therefore, a design target “limiting” noise level for each ASHP, inclusive of any required noise mitigation, is detailed as follows:

Table 10 – ASHP Limiting Noise Level

Plant	Sound Pressure Level (L _{Aeq}) at 1m
ASHP	51dB

The project's M&E sub-contractors and their supply chain should ensure compliance with the above limiting level via the inclusion of suitable acoustic kits or acoustic enclosures (or similar) to be specified 'by others'. As domestic ASHP units generally operate within the range of 50 to 65dB L_{Aeq} at 1m, additional attenuation measures may be likely required, depending on the selected units. These measures could include an acoustic kit or enclosure around the units.

Ensuring compliance with the above limiting level of 51dBA at 1m will ensure compliance with the design criteria for plant noise emissions at the nearest noise-sensitive receptors, and should therefore be suitable for the discharge of Part (c) of Planning Condition 15.

7.4 Proposed ASHP Units

It is now understood that the proposed ASHP units are the 8.5kW rated Mitsubishi Ecodan PUZ-WM85VAA Monobloc, horizontal discharge units. The manufacturer's datasheet indicates a sound pressure level rating of 45dBA @ 1m. This is obviously lower/quieter than the above 51dBA Limiting Level (see Table 10) and should therefore be acceptable.

However, as confirmation, calculations have now been undertaken based upon the actual proposed units and these are shown in Appendix F attached. To summarise, predicted receive noise levels at the receptors are as follows;

At existing receptor – 24dBA
At proposed receptor – 29dBA

As a reminder, the typical lowest night-time background L_{90} noise level was 31dBA (see Table 2 in Section 3.4 above). As can be seen from the above, the predicted receive levels are 7dB and 2dB below the otherwise prevailing background respectively and therefore, in line with BS 4142 guidance, would indicate a low risk of potential complaint, i.e. *"Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact"*.

7.5 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). It is good practice to isolate items of plant and, to this end, the following is advisable:

- ASHPs – Neoprene in-shear mounts with minimum 6mm static deflection

8.0 CONCLUSION

A new residential development is proposed at Goldsmith Mews, Chalk, Gravesend. The development consists of 4 No. dwelling houses with associated parking and garden areas. Each dwelling is three-stories high and has an ASHP located in the rear garden area.

RBA Acoustics have undertaken noise monitoring at the proposed development site at Goldsmith Mews, Chalk, Gravesend. The measured noise levels are presented within this report. The resultant noise levels have been used in the assessment of the glazing requirements to ensure suitable internal noise levels are achieved at the proposed development with reference to BS 8233 and WHO.

Configurations have been suggested for the glazing and ventilation constructions that should be capable of achieving the required specifications detailed within Appendix C, which are very nominal due to the low ambient noise levels around the site. These low noise levels also mean it is acceptable to rely on the opening of windows to mitigate any overheating issues.

A design target noise level ["limiting" level] of 51dBA @ 1m has been provided for each ASHP in order to achieve the criteria required by Gravesham Borough Council, as stipulated in Planning Condition 15, at the nearest noise-sensitive receptors. The proposed Ecodan units are rated at 45dBA @ 1m and therefore should be considered acceptable.

On the basis of the above, we therefore recommended that Gravesham Borough Council consider discharging Planning Condition 15.

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.
$L_{eq,T}$	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.
$L_{Amax,T}$	The instantaneous maximum A-weighted sound pressure level which occurred during the measurement period, T . It is commonly used to measure the effect of very short duration bursts of noise, e.g. sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the ambient level.
Octave band	A frequency band in which the upper limit of the band is twice the frequency of the lower limit.
1/3 Octave band	A frequency band which is one-third of an octave band.
R_w	A single number quantity which characterises the airborne sound insulation of a material or building element in a laboratory test.

Appendix B – Room Absorption Coefficients

For the purposes of the analyses RBA have assumed the absorption coefficients detailed in Table B1 for bedrooms and Table B2 for living rooms.

Table B1 – Bedroom Absorption Coefficients

Absorption Coefficient (α) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
0.15	0.18	0.25	0.27	0.31	0.32	0.32	0.32

Table B2 – Living Room Absorption Coefficients

Absorption Coefficient (α) at Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
0.15	0.18	0.20	0.22	0.22	0.22	0.23	0.27

Appendix C – External Building Fabric Acoustic Specification

External facade constructions and components, such as brise soleil, grilles, ventilators, curtain walling systems or other architectural features, are not to give rise to intrusive whistling, creaking, rattling or other noises as a result of wind or other climatic effects.

The Contractor shall take reasonable precautions to avoid unwanted noise including creaking, rattling and whistling being generated by the Contractors works when subject to environmental conditions (including wind) and thermal expansion over the life of the façade.

1.0 Window Sound Insulation Performance

Glazed units (inclusive of glazing, louvres, timber panels, spandrel panels, infill panels, framing, opening lights, balcony/terrace doors, seals, etc. as appropriate) should achieve the following minimum sound reduction indices as tested in general accordance with BS EN ISO 10140-2:2021:

Table C1 – Window Sound Insulation Performance Specification

Type	Minimum Recommended Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)								R_w (dB)
	63	125	250	500	1k	2k	4k	8k	
G1	16	20	19	23	32	35	35	35	29

Note: R_w is the “overall weighted sound reduction index” tested in a laboratory.

N.B. as the internal noise criteria are expressed in overall terms, other frequency-specific performance levels may ultimately prove acoustically acceptable. Test data for representative samples of all glazing systems shall be submitted to RBA Acoustics for approval to demonstrate compliance with the above performance specifications.

2.0 Ventilator Sound Insulation Performance

Trickle ventilators (in their open state) should achieve the following minimum element-normalised level differences as tested in accordance with BS EN 20140-10:2021:

Table C2 – Ventilator Sound Insulation Performance Specification

Type	Minimum Recommended $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)								$D_{n,e,w}$ (dB)
	63	125	250	500	1k	2k	4k	8k	
V1	22	28	31	34	33	31	31	31	33

Note: $D_{n,e,w}$ is the “overall weighted element normalised level difference” tested in a laboratory.

Please note the above specifications assumes one trickle ventilator will be installed per room, i.e. a continuous mechanical extract system (ADF System 3) will be utilised. The specifications should be increased by a factor of $10\log(N)$ should N ventilators be required per room, i.e. increase by +3dB or +5dB respectively should two or three ventilators be required per room.

N.B. as the internal noise criteria are expressed in overall terms, other frequency specific performance levels may ultimately prove acoustically acceptable. Test data for the trickle vents in their open state shall be submitted to RBA Acoustics for approval.

3.0 Acoustic Flanking Specification

Extent

There is potential for any curtain walling or continuous system to transmit sound across the separating floors and walls, and to thus result in future sound insulation problems.

The following specification should therefore be introduced within the tender documentation in order to ensure the system components are adequately designed.

The following specifications apply to all curtain walling or continuous elements between residential units and, if applicable, between residential units and commercial areas. Between non-residential areas (e.g. commercial to commercial, etc.) it is standard practice to relax the specification to a value of 50dB $D_{n,f,w}$.

With regard to potential flanking through the panels, the specification is commensurate with relatively high sound insulation levels. Achievement of this specification will require careful consideration of the panel design, in particular the insulation type and construction make-up of the panel skin. In addition, it is likely to be necessary to design the cladding such that double/twin insulated mullions and transoms are included.

Horizontal Flanking at Separating Wall Lines

The curtain walling/continuous system shall achieve a horizontal weighted normalised flanking level difference of 60dB $D_{n,f,w}$ when tested in general accordance with BS EN ISO 10848-2:2006 [previously BS EN 20140-9:1994] (the methodology amended accordingly).

The supplier shall demonstrate by the provision of previous test reports (and comparative calculations if required) that the specification can be achieved. The Client, however, reserve the right to insist on laboratory acoustic testing if any doubts remain in relation to the flanking performance of the system.

The curtain walling system shall provide suitable surfaces against which a good acoustic seal can be made with future separating walls.

Vertical Flanking at Separating Floor Lines

The curtain walling system shall achieve a vertical weighted normalised flanking level difference of 60dB $D_{n,f,w}$ when tested in general accordance with BS EN ISO 10848-2:2006 [previously BS EN 20140-9:1994] (the methodology amended accordingly).

The supplier shall demonstrate by the provision of previous test reports (and comparative calculations if required) that the specification can be achieved. The Client, however, reserve the right to insist on laboratory acoustic testing if any doubts remain in relation to the flanking performance of the system.

The curtain walling system shall provide suitable surfaces against which a good acoustic seal can be made with future separating floors.

Appendix D – Instrumentation

The following equipment was used for the measurements.

Table D1 – Equipment Calibration Details

Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Expiry Date
Norsonic Type 1 Sound Level Meter	Nor140	1406116	U36615	17 December 2022
Norsonic Pre Amplifier	1209	20295		
Norsonic ½" Microphone	1225	344468	36614	
Norsonic Sound Calibrator	1255	34037	U36613	

Appendix E – CDM Considerations

The likelihood the harm will occur can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Remote (almost never)
- 2 – Unlikely (occurs rarely)
- 3 – Possible (could occur, but uncommon)
- 4 – Likely (recurrent but not frequent)
- 5 – Very likely (occurs frequently)

The severity of harm can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Trivial (e.g. discomfort, slight bruising, self-help recovery)
- 2 – Minor (e.g. small cut, abrasion, basic first aid need)
- 3 – Moderate (e.g. strain, sprain, incapacitation for more than 3 days)
- 4 – Serious (e.g. fracture, hospitalisation for more than 24 hours, incapacitation for more than 4 weeks)
- 5 – Fatal (single or multiple)

The rating value is obtained by multiplying the two scores and is then used to determine the course of action.

Table E1 – Risk Ratings

Rating Bands (Severity x Likelihood)		
Low Risk (1 – 8)	Medium Risk (9 -12)	High Risk (15 – 25)
May be ignored but ensure controls remain effective	Continue, but implement additional reasonably practicable controls where possible	Avoidance action is required; therefore alternative design solutions must be examined. Activity must not proceed until risks are reduced to a low or medium level

The following hazards pertinent to our design input have been identified and control measures suggested:

Table E2 – Risk Assessment

Hazard	Risk Of	At Risk	Rating			Control Measures	Controlled		
			L	S	R		L	S	R
Mineral wool within drywalls and linings	Skin and respiratory irritation	Contractors	4	3	12	Wear gloves and mask	1	3	3
Acoustic glazing - weight	Strain of neck, limbs or back. Fall from height.	Contractors	3	5	15	Provide sufficient manpower, lifting gear and structural support	1	5	5
Vibration Isolators	Injury to hands	Contractors	3	3	9	Care needs to be taken during adjustment. Follow manufacturers guidance	1	3	3

L: Likelihood S: Severity R: Rating

Appendix F – Example Calculations

External Building Fabric Analysis				(BS 8233:1999/2014 Calculation)																																																																											
Job No.	11917	Job Title	Oldsmith Mews, Chalk, Gravesend	Room Description	Bedroom																																																																										
Area of Windows (S _w)	1	m ²	Room Length	3	m	Analysis Type																																																																									
Area of External Wall 1 (S _{w1})	2.9	m ²	Room Width	4	m	BS 8233:2014 Criteria Bedroom																																																																									
Area of External Wall 2 (S _{w2})	0	m ²	Room Height	2.3	m																																																																										
Area of Ceiling / Roof (S _c)	0	m ²	Room Surface Area	56.2	m ²																																																																										
Total area (S)	3.9	m ²	Room Volume	27.6	m ³																																																																										
<table border="1"> <thead> <tr> <th></th> <th>63</th> <th>125</th> <th>250</th> <th>500</th> <th>1k</th> <th>2k</th> <th>4k</th> <th>8k</th> <th>dBA</th> </tr> </thead> <tbody> <tr> <td>Leq Day - Lp Out</td> <td>59.7</td> <td>56.7</td> <td>52.4</td> <td>48.8</td> <td>47.6</td> <td>42.8</td> <td>37.9</td> <td>30.5</td> <td>52.2</td> </tr> <tr> <td>Corrected Lp Out</td> <td>59.7</td> <td>56.7</td> <td>52.4</td> <td>48.8</td> <td>47.6</td> <td>42.8</td> <td>37.9</td> <td>30.5</td> <td>52.2</td> </tr> <tr> <td>Leq Night - Lp Out</td> <td>52.6</td> <td>47.9</td> <td>43.9</td> <td>43.0</td> <td>41.3</td> <td>36.8</td> <td>34.5</td> <td>26.3</td> <td>45.9</td> </tr> <tr> <td>Corrected Lp Out</td> <td>52.6</td> <td>47.9</td> <td>43.9</td> <td>43.0</td> <td>41.3</td> <td>36.8</td> <td>34.5</td> <td>26.3</td> <td>45.9</td> </tr> <tr> <td>Lmax,f - Lp Out</td> <td>70.8</td> <td>64.4</td> <td>62.0</td> <td>59.3</td> <td>60.6</td> <td>56.3</td> <td>54.9</td> <td>48.7</td> <td>64.6</td> </tr> <tr> <td>Corrected Lp Out</td> <td>70.8</td> <td>64.4</td> <td>62.0</td> <td>59.3</td> <td>60.6</td> <td>56.3</td> <td>54.9</td> <td>48.7</td> <td>64.6</td> </tr> </tbody> </table>											63	125	250	500	1k	2k	4k	8k	dBA	Leq Day - Lp Out	59.7	56.7	52.4	48.8	47.6	42.8	37.9	30.5	52.2	Corrected Lp Out	59.7	56.7	52.4	48.8	47.6	42.8	37.9	30.5	52.2	Leq Night - Lp Out	52.6	47.9	43.9	43.0	41.3	36.8	34.5	26.3	45.9	Corrected Lp Out	52.6	47.9	43.9	43.0	41.3	36.8	34.5	26.3	45.9	Lmax,f - Lp Out	70.8	64.4	62.0	59.3	60.6	56.3	54.9	48.7	64.6	Corrected Lp Out	70.8	64.4	62.0	59.3	60.6	56.3	54.9	48.7	64.6
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Sound Reduction of Window	R _w	16	20	19	23	32	35	35	35	R _w	29.0	Choose Between Original Data and Smoothed																																																																			
Sound Reduction of External Wall 1	R _w	21	32	45	55	55	55	55	55	R _w	53.0	Light-weight External Wall																																																																			
System Description: Unite modular external wall (render, 60mm polystyrene, 30mm cavity, sheathing board (12mm pyrok), modular stud, 75mm Rockwool, 10mm cement particle board, 15mm wallboard)																																																																															
Insulation of Trickle Ventilator	D _{tr}	22	28	31	34	33	31	31	31	D _{tr}	33.0	MINIMUM of ALL																																																																			
Sound Reduction of Roof / Ceiling	R _{tr}	99	99	99	99	99	99	99	99	R _{tr}	100	Traditional																																																																			
System Description: No Roof Transmission																																																																															
Reverberation Time	R _{tr}	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2																																																																						
Equivalent Absorption Area	A	8.4	10.1	14.1	15.2	17.4	18.0	18.0	18.0																																																																						
<table border="1"> <thead> <tr> <th colspan="10">L_{eq} - Day</th> </tr> </thead> <tbody> <tr> <td>Leq - Lp In</td> <td>44.1</td> <td>34.3</td> <td>27.1</td> <td>19.5</td> <td>15.6</td> <td>12.5</td> <td>7.6</td> <td>0.2</td> <td>NR</td> <td>16</td> </tr> <tr> <td>A Weightings</td> <td>-26.2</td> <td>-16.1</td> <td>-8.6</td> <td>-3.2</td> <td>0</td> <td>1.2</td> <td>1</td> <td>-1.1</td> <td></td> <td></td> </tr> <tr> <td>A Weighted Level</td> <td>17.9</td> <td>18.2</td> <td>18.5</td> <td>16.3</td> <td>15.6</td> <td>13.7</td> <td>8.6</td> <td>-0.9</td> <td></td> <td></td> </tr> <tr> <td>dBA (125-2kHz)</td> <td>23.8</td> <td></td> <td></td> <td>dBA (125-4kHz)</td> <td>23.9</td> <td></td> <td>dBA (63-8kHz)</td> <td>24.9</td> <td></td> <td></td> </tr> </tbody> </table>												L _{eq} - Day										Leq - Lp In	44.1	34.3	27.1	19.5	15.6	12.5	7.6	0.2	NR	16	A Weightings	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1			A Weighted Level	17.9	18.2	18.5	16.3	15.6	13.7	8.6	-0.9			dBA (125-2kHz)	23.8			dBA (125-4kHz)	23.9		dBA (63-8kHz)	24.9																
L _{eq} - Day																																																																															
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dBA (125-2kHz)	34.4			dBA (125-4kHz)	34.9		dBA (63-8kHz)	36.0																																																																							

ASHP Limiting Level calculations

Table F1 – Example Calculation of ASHP to Existing Residential Receptor Bedroom Window

Parameter	Octave-band Noise Level (dB) at Octave-band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level at 1m ("limit")	52	52	51	50	45	42	36	30	51
Distance Loss @ 15m	-24	-24	-24	-24	-24	-24	-24	-24	-
Reflections	+3	+3	+3	+3	+3	+3	+3	+3	-
Resultant Noise Level at Receiver	31	31	30	30	25	22	15	10	31

Table F2 – Example Calculation of ASHP to Own Development Residential Receptor Bedroom Window

Parameter	Octave-band Noise Level (dB) at Octave-band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level at 1m ("limit")	52	52	51	50	45	42	36	30	51
Distance Loss @ 7m	-17	-17	-17	-17	-17	-17	-17	-17	-
Reflections	+3	+3	+3	+3	+3	+3	+3	+3	-
Directivity (45° / 90°)	-0.5	-0.3	-0.8	-1.3	-5.8	-9	-9	-9	-
Resultant Noise Level at Receiver	38	38	36	35	25	19	13	7	34

Proposed ASHP calculations – PUZ-WM85VAA

Table F1 –Calculation of Proposed ASHP to Existing Residential Receptor Bedroom Window

Parameter	Octave-band Noise Level (dB) at Octave-band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level at 1m	47.5	47.5	49	43.5	36	34.5	27	20	45
Distance Loss @ 15m	-24	-24	-24	-24	-24	-24	-24	-24	-
Reflections	+3	+3	+3	+3	+3	+3	+3	+3	-
Resultant Noise Level at Receiver	27	27	28.5	23	15.5	14	7	0	24

Table F2 –Calculation of Proposed ASHP to Own Development Residential Receptor Bedroom Window

Parameter	Octave-band Noise Level (dB) at Octave-band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level at 1m	47.5	47.5	49	43.5	36	34.5	27	20	45
Distance Loss @ 7m	-17	-17	-17	-17	-17	-17	-17	-17	-
Reflections	+3	+3	+3	+3	+3	+3	+3	+3	-
Directivity (45° / 90°)	-0.5	-0.3	-0.8	-1.3	-5.8	-9	-9	-9	-
Resultant Noise Level at Receiver	33	33	34	28	16	12	4	0	29

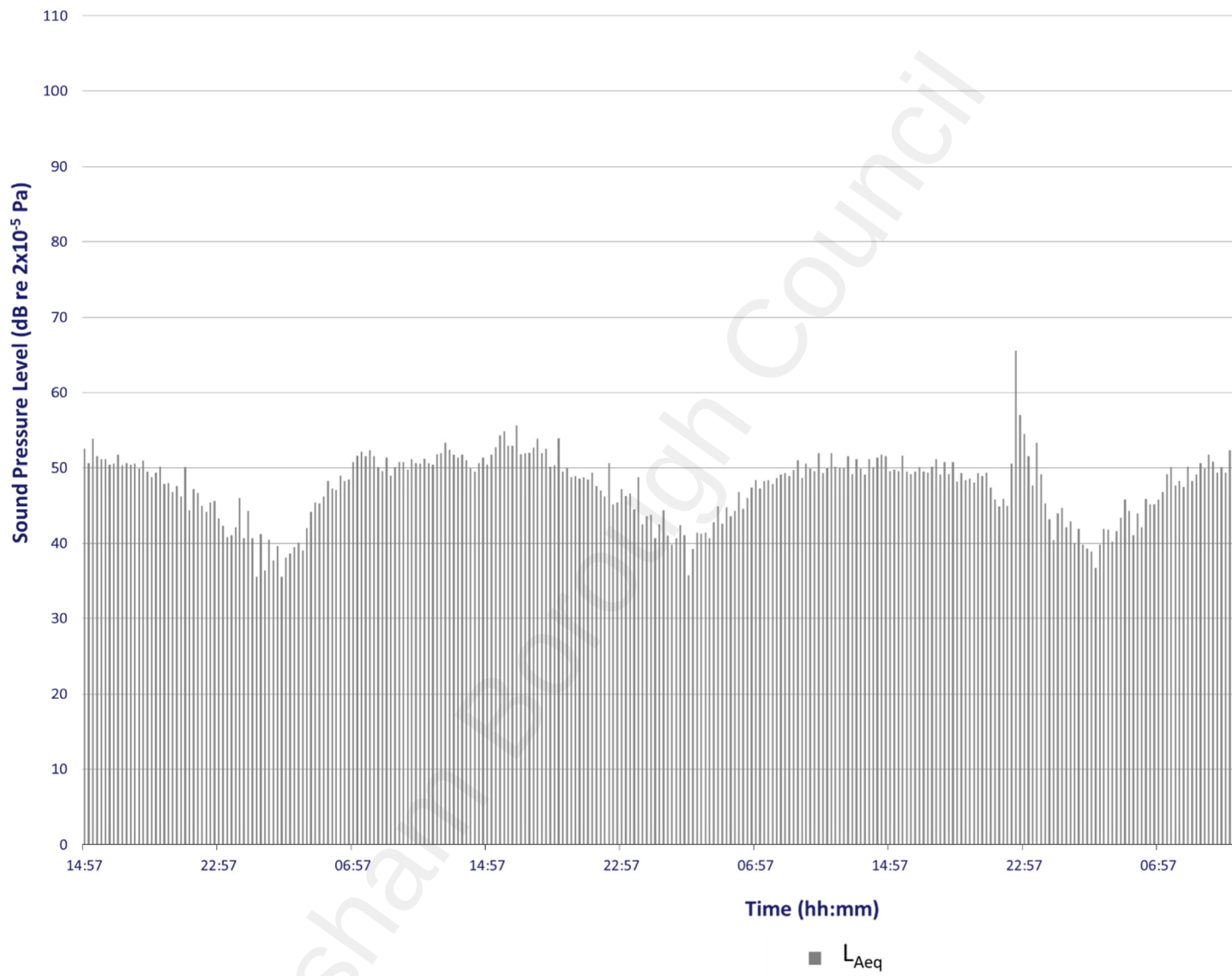
Appendix G – Graphs and Figures

Gravesham Borough Council

Goldsmith Mews, Chalk, Gravesend

L_{Aeq} Time History

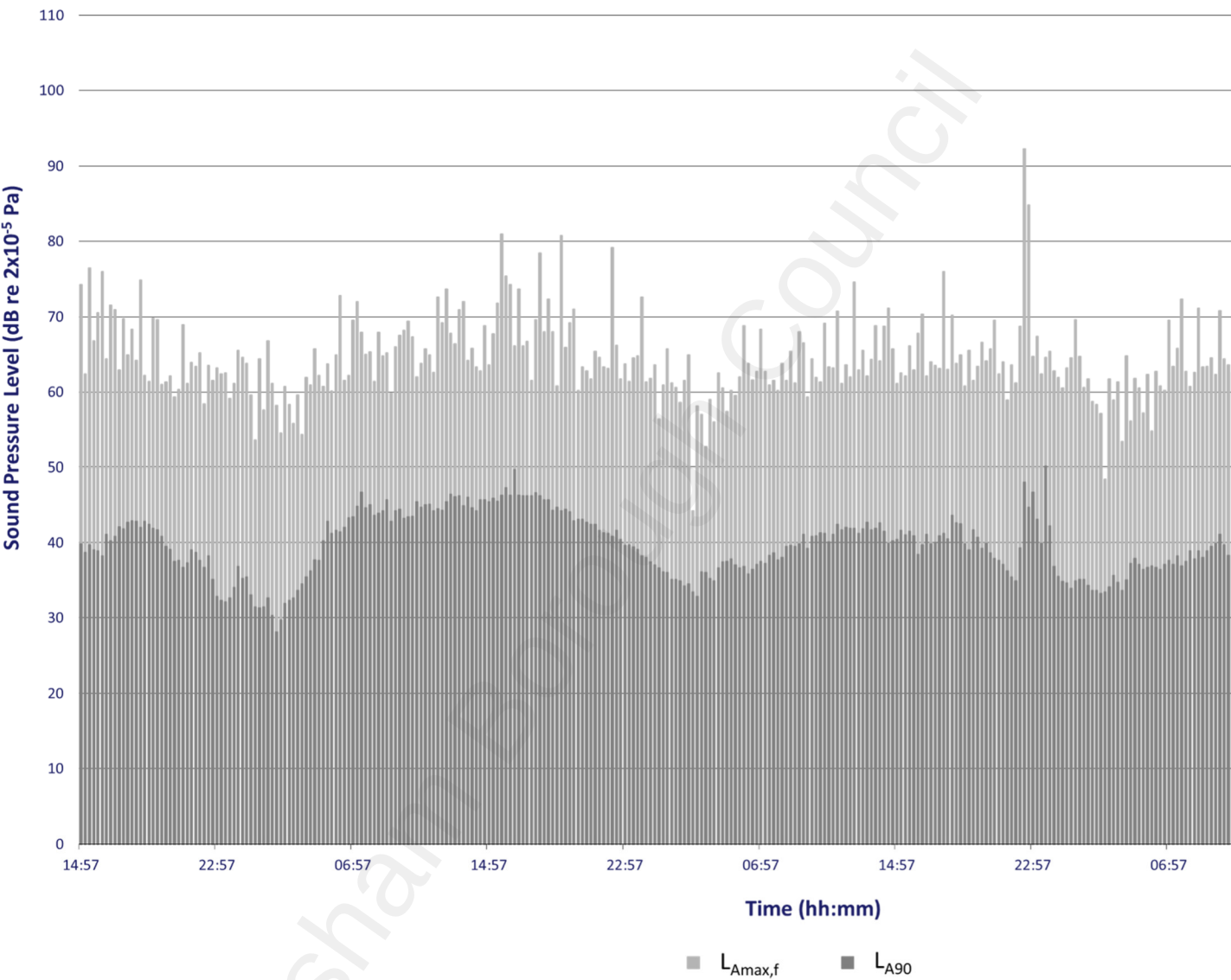
Measurements Position 1, Thursday 16th June to Monday 20th June



Goldsmith Mews, Chalk, Gravesend

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

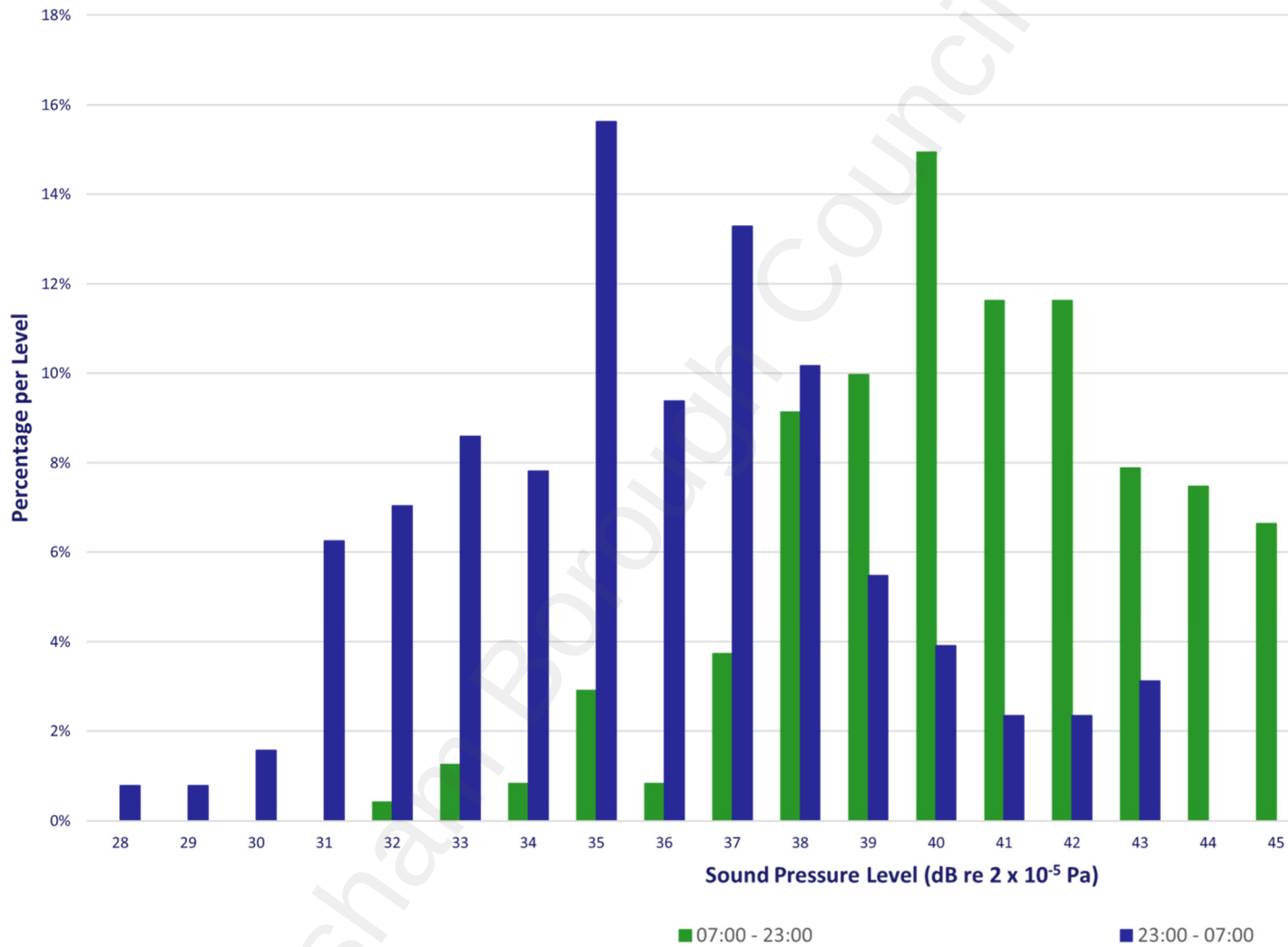
Measurements Position 1, Thursday 16th June to Monday 20th June

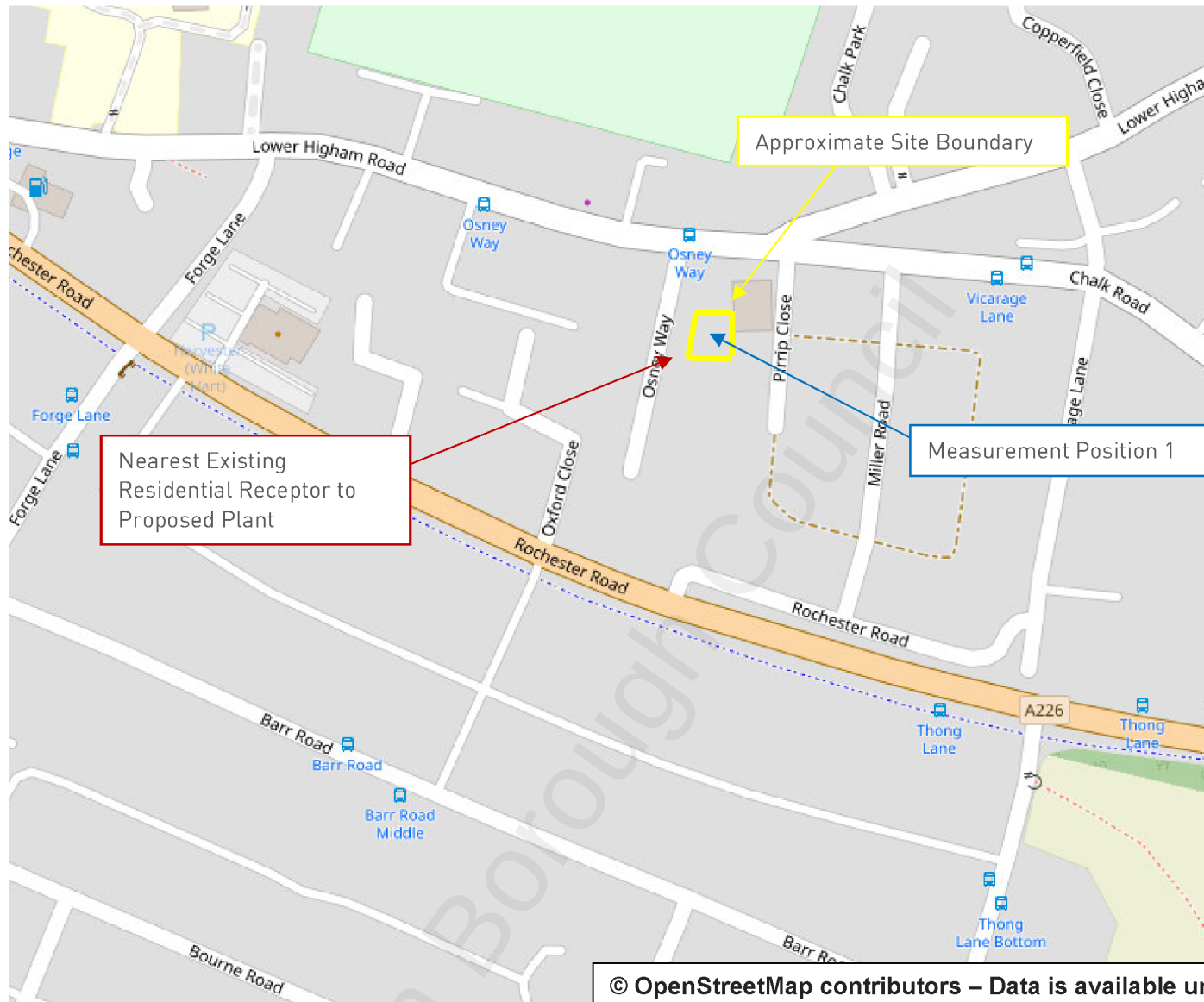


Goldsmith Mews, Chalk, Gravesend

L_{A90,15 minutes} Histogram

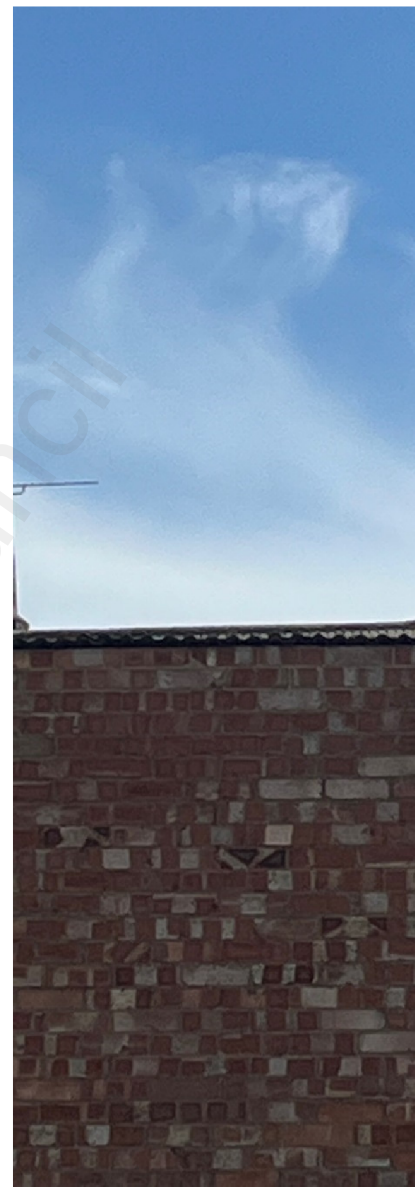
Measurements Position 1, Thursday 16th June to Monday 20th June





Goldsmith Mews, Chalk, Gravesend
 Site Plan showing Measurement Location & Nearest Receptor
 Project 11917

Figure 1
 13 July 2022
 Not to Scale



Goldsmith Mews, Chalk, Gravesend
Photographs showing Measurement Position 1
Project 11917

Figure 2
13 July 2022
Not to Scale

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