GILLIERON SCOTT
ACOUSTIC DESIGN

Report No:
Highgate Cemetery – Noise Impact Assessment 22102024

Date:
22/10/2024

For: Hopkins Architects

HIGHGATE CEMETERY, SWAIN'S LANE, LONDON N6 6PJ
NOISE IMPACT ASSESSMENT

By:
Gillieron Scott Acoustic Design
130 Brixton Hill
London SW2 1RS

t - 020 8671 2223
e - info@gsacoustics.org
w - www.gsacoustics.org

Revision Control

Document Revision	Date	Document Title	Details	Prepared by	Approved by
00	02/08/2024	Highgate Cemetery – Noise Impact Assessment 02082024	DRAFT FOR COMMENT	Lucie Zalberg 	Tim Scott 
01	22/10/2024	Highgate Cemetery – Noise Impact Assessment 22102024	ISSUED	Lucie Zalberg 	Tim Scott 

Contents

1.0 Introduction

Highgate Cemetery was first opened in 1839 and is now run by the Friends of Highgate Cemetery Trust, a charitable organisation. It operates as a visitor attraction as well as a working cemetery and is open daily (except for Christmas Day and Boxing Day). The site comprises a total of nine buildings, each with a different use. Current plans are to increase the level of visitor activity in the Chapel and proposed Community and Education Space, together with the installation of mechanical plant to service these and other buildings around the site. Additionally, there is a proposed visitor café with indoor and outdoor seating, a meeting space and offices for cemetery staff, and facilities for the gardening staff.

In terms of mechanical plant, it is proposed to install three heat pumps externally and one internally to three new buildings, and an air handling unit internally to one of these, which would be ducted to the atmosphere at the building's exterior.

Gillieron Scott Acoustic Design (GSAD) have been commissioned to undertake a background noise survey at the site and a noise impact assessment in accordance with The London Borough of Camden's noise policy in order to ensure the necessary requirements are met for this project.

GSAD have carried out a background noise survey at one fixed monitoring location during the period 10.30 on 5th July and 19.00 on 8th July 2024. In addition to this, a second measurement position was used to conduct short-term attended measurements on the 9th of July 2024.

The operating hours of the proposed plant are between 09.00 and 21.00, except for the air handling unit which could have the facility to operate up to 24 hours a day. Buildings are to be used for activities between 09.00 and 17.00 with some evening use for events up to 21.00 in the Community and Education building and between 09.00 and 18.00 with some evening use for late working and meetings up to 21.00 in the Visitor & Operations building.

2.0 Brief

- Undertake long term unattended noise measurements at a fixed monitoring location over an extended period.
- Undertake short-term attended measurements at a second position.
- Identify noise-sensitive dwellings located close to the site and assess the topography of the intervening ground.
- Analyse the site-acquired data and determine the appropriate criteria to adopt from The London Borough of Camden's noise policy.
- Undertake a noise impact assessment for:
    - Noise from proposed items of fixed plant, according to the methodology contained within British Standard 4142: 2014+A1:2019 and Local Authority noise policy;
    - Noise from visitor activities on site, in accordance with Local Authority policy.
- Provide a technical report detailing findings of the noise survey.

3.0 Context

Highgate Cemetery is an historic cemetery, dating from the 19th century. After falling into disrepair in the 1970s, it has since been renovated and cared for by the Friends of Highgate Cemetery Trust, a charitable organisation that is mainly volunteer-led, and supported by paid staff. As well as continuing to operate as a functional cemetery with funeral facilities, it is also a visitor attraction due to its historical significance. There is a proposed visitor centre and café on site, community meeting spaces and facilities for the garden maintenance staff.

The proposals under consideration for this planning application include an expansion of the staff, volunteers, community and visitor aspects of the cemetery. Specifically, in terms of noise emission, it is proposed to install three heat pump units externally and one internally, one each for the Community and Education (externally) and Gardeners' buildings (internally), and two for the Visitor and Operations building (externally). In addition to this, the Community and Education building will also have an air handling unit installed internally at basement level, which would be ducted to the atmosphere. It is these items of plant which are the subject of this noise impact assessment.

In terms of the existing soundscape, this is a relatively peaceful location. The primary sound sources noted at the time of our surveys included wind in trees, birdsong, occasional voices of people passing, and nearby road traffic noise (Swain's Lane).

The nearest noise-sensitive receptors (NSRs) have been identified as:

- NRS1 No.81 John Winter's House, to the south of the west side of the site.
- NSR2 Retcar Place / Lulot Gardens (Whittington Estate) to the east of the site.
- NSR3 Holly Lodge Mansions.

Holly Lodge Mansions, on the corner of Swain's Lane and Oakeshott Avenue has also been identified as a noise sensitive receptor. Despite being farther away than NSR1, it does not benefit from shielding effects from barriers or other buildings and has direct line of sight to the plant units at the Community and Education Building. At this receptor (NSR3), noise levels have been determined to be higher than at the nearest NSRs and have been included in the assessment.

All other NSRs are situated at a greater distance from the sound sources, or shielded by other buildings, and will therefore experience lower sound levels. Site plans showing the proposed layout, the nearest NSRs and the survey locations are provided in Appendix A.

4.0 Summary

A background noise survey was undertaken during the period between 10.30 on 5th July and 19.00 on 8th July 2024 at one fixed monitoring location. A second short-term attended measurement was conducted on the 9th of July at a separate location.

It is assumed that the proposed heat pump units would have the facility to operate between the hours of 09.00-21.00 daily. Additionally, the air handling unit may operate at all times of day and night. In practice, it is unlikely that it would operate continuously all year round, but this scenario is assessed here as it represents a worst-case scenario. Manufacturer-supplied noise data is provided in Appendix I: Manufacturer Noise Data.

The Local Authority (The London Borough of Camden), requires any installation of new plant machinery to be in accordance with BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', and the National Planning Policy Framework (NPPF). Appendix 3 of the Camden Local Plan 2017 specifies noise thresholds for fixed plant installations and for entertainment (customer) noise. In the case of the former, the 'rating level' must not exceed 10 dB below the background sound level. In addition, noise from events at night must not exceed 57 dB L_{Amax}. In terms of customer activity noise in daytime hours, this must not exceed 55 dB, or 10 dB below the existing $L_{Aeq,5min}$, whichever is the greater. During the evening, the former of these is reduced to 50 dB.

Results from the survey show representative background sound levels of 38 dB $L_{A90,15min}$ during daytime, and 33 dB $L_{A90,15min}$ at night. Meanwhile, a representative $L_{Aeq,5min}$ of 47 dB has been determined during daytime, and of 38 dB during the evening.

The site location, measurement positions and measured results are detailed in the following sections and appendices.

5.0 Assessment Criteria

National Planning Policy Framework

The National Planning Policy Framework was introduced by the Department of Communities and Local Government in March 2012. The document sets out the Government's planning policies for England and how these are expected to be applied.

The Framework provides for the production of distinctive local and neighbourhood plans by Councils, in consultation with local people, which should be developed to reflect the needs and priorities of their communities.

It states that the planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to or being put at unacceptable risk from or being adversely affected by unacceptable levels of noise pollution.

Therefore, planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development,
- Mitigate and reduce to a minimum other adverse impact on quality of life arising from noise from new development, including through the use of planning conditions,
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established, and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

National Policy Statement for England

The Noise Policy Statement for England (NPSE) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

The statement sets out the long-term vision of the government's noise policy, which is to "promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development".

The guidance promotes the effective management and control of noise, within the context of Government policy on sustainable development and thereby aims to:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible, contribute to the improvements of health and quality of life.

The statement adopts established concepts from toxicology that are currently being applied to noise impacts. The concept details noise levels, at which the effects of an exposure may be classified into a specific category. The classification categories as detailed within NPSE are as follows:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected;
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

It is recognised that SOAEL does not have a single objective noise-based level that is applicable to all sources of noise in all situations and therefore the SOAEL is likely to be different for different sources, receptors and at different times of the day.

The first aim of the Statement is to avoid significant adverse effects on health and quality of life taking into account the guiding principles of sustainable development. The second aim considers situations where impacts are established between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur. The third aim seeks to improve health and quality of life, where possible, through the pro-active management of noise, whilst also taking account of the guiding principles of sustainable development.

Plant Noise: British Standard 4142:2014 + A1:2019 "Methods for rating and assessing industrial and commercial sound"

In addition to the above, The London Borough of Camden's noise policy requires new plant machinery installations to be in accordance with BS 4142:2014 + A1:2019.

BS 4142:2014 + A1:2019 provides methods for rating and assessing industrial and commercial sound. The standard is used to rate sound from fixed installations and sound from the loading and unloading of goods and materials at commercial premises. The standard requires a 'specific sound level', in terms of L_{Aeq}, to be determined either by measurement or calculation at a receptor location. The specific sound level may then be corrected for the character of sound, following which it is termed the 'rating level'.

Once the rating level has been determined, the background sound level is subtracted from it – with a larger or smaller difference between the two indicating a larger or smaller likelihood of an 'adverse impact' respectively. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact. The standard advocates that each site and situation should take the context of the scenario into consideration and that "not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact".

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

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

The standard provides reference periods over which the assessment should take place which have been reproduced in the table below.

Table 1: Reference periods

Period	Hours
Typical Daytime	07:00 – 23:00
Typical Night-time	23:00 – 07:00

Local Authority Noise Policy

The London Borough of Camden's noise policy provides limits for noise from industrial and commercial sources. These are stated in Appendix 3 of the Camden Local Plan 2017 and are reproduced below.

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

Figure 1: Camden Local Plan noise limits for industrial & commercial sources

In addition to the standard criteria of BS 4142, the London Borough of Camden's policy requires that the rating level of the plant noise is at least 10 dB below the background sound level. The guidance goes on to state that, "10 dB should be increased to 15 dB if the noise contains audible tonal elements."

Appendix 3 of the Camden Local Plan 2017 also provides the following guidance on entertainment noise. This is deemed to be applicable in terms of customer activity noise at this site.

"Assessments for noise from entertainment and leisure premises must include consideration to amplified and unamplified music, human voices, footfall and vehicle movements and other general activity. Appropriate metrics must be used to measure and assess the noise impact including L_{Aeq} and L_{Amax} metrics and appropriate frequency spectrum."

The following limits for entertainment noise are specified.

Table D: Noise levels applicable to proposed entertainment premises (customer noise)

Noise sensitive receptor	Assess-ment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings	Garden used for amenity (free field)	Day	The higher of 55dB $L_{Aeq,5min}$ Or 10dB below existing $L_{Aeq,5min}$ Without entertainment noise	56dB to 60dB $L_{Aeq,5min}$ Or 9dB to 3dB below existing $L_{Aeq,5min}$ Without entertainment noise	The higher of 61dB $L_{Aeq,5min}$ Or 2dB below existing $L_{Aeq,5min}$ Without entertainment noise
Dwellings	Garden used for amenity (free field)	Evening	The higher of 50dB $L_{Aeq,5min}$ Or 10dB below existing $L_{Aeq,5min}$ Without entertainment noise	51dB to 55dB $L_{Aeq,5min}$ Or 9dB to 3dB below existing $L_{Aeq,5min}$ Without entertainment noise	The higher of 56dB $L_{Aeq,5min}$ Or 2dB below existing $L_{Aeq,5min}$ Without entertainment noise
Dwellings	Garden used for amenity (free field)	Night	The higher of 45dB $L_{Aeq,5min}$ Or 10dB below existing $L_{Aeq,5min}$ Without entertainment noise	46dB to 50dB $L_{Aeq,5min}$ Or 9dB to 3dB below existing $L_{Aeq,5min}$ Without entertainment noise	The higher of 51dB $L_{Aeq,5min}$ Or 2dB below existing $L_{Aeq,5min}$ Without entertainment noise

Figure 2: Camden Local Plan noise limits for entertainment and customer noise

6.0 Survey Details and Results

A background noise survey was undertaken between 10.30 on 5th July and 19.00 on 8th July 2024 at one fixed monitoring location. A second short-term attended survey was undertaken at a different position between 08.45 and 09.45 on the 9th of July. The microphone positions are shown in Appendix A.

The levels were recorded in octave bands as L_{eq}, L_{max} and L_{90} with fast time-weighting, along with their respective A-weighted single-figure values. The clock on the sound level meter was synchronised to the correct time before deployment. The meter was then set to integrate sound levels over 15-minute periods in synchronisation mode. A list of the measurement equipment is listed in Appendix G.

A weather station was also deployed alongside the sound level meter during the long-term measurement. The wind speed did not exceed 1.4 m/s for the duration of the survey; the temperature varied between 12 and 21°C; a few brief periods of rainfall were recorded. Any measurement data obtained during significant rainfall periods has been discarded. Otherwise, conditions were generally considered conducive to acoustic measurement.

Full survey results to one decimal place are presented in Appendix E. Graphical representations of the measurement results are presented in Appendices B and C, and weather data in Appendix F.

Table 2: Summary of Representative Background Sound Levels

Representative Background Sound Level $L_{A90,15min}$	
Daytime (07.00-23.00hrs)	Night-time (23.00-07.00hrs)
38 dB(A)	33 dB(A)

Results of the short-term attended measurements show a higher background sound level. As such, our assessment of the proposed plant noise sources is based on the above background sound levels, as this represents a worst-case scenario.

The long-term measurement data have provided the following results in terms of representative $L_{Aeq,5min}$ levels.

Table 3: Summary of Representative $L_{Aeq,5min}$ Levels

Representative Level $L_{Aeq,5min}$	
Daytime (07.00-19.00hrs)	Evening (19.00-23.00hrs)
47 dB(A)	38 dB(A)

7.0 Plant Noise Assessment

We understand that the proposals include installation of four heat pumps, one each for the Community and Education (externally) and Gardeners' buildings (internally), and two for the Visitor and Operations building (externally). Additionally, an air handling unit would be installed to one of these buildings. Plans showing the proposed locations of these items are included in Appendix D. In summary, they are as follows.

Table 4: Proposed items of plant

Description	Make & Model	Sound power level	Location	Distance to…	
				NSR 1	NSR 2
Heat pump ASHP1	Mitsubishi Electric Ecodan PUZ-WM112VAA	60 dB(A)	Visitor and Operations building / Building 2, west side	30 m	323 m
Heat pump ASHP2	Mitsubishi Electric Ecodan PUZ-WM112VAA	60 dB(A)	Visitor and Operations building / Building 2, west side	30 m	323 m
Heat pump ASHP3	Mitsubishi Electric Ecodan PUZ-HWM140VHA	67 dB(A)	Community and Education building / Building 1, east side	20 m	280 m
Heat pump ASHP4	Mitsubishi Electric Ecodan PUZ-WM85VAA	58 dB(A)	Gardeners' building / Building 6, east side	268 m	31 m
Air handling unit AHU	Systemair Topvex TR30-R-HWH	73.6 dB(A) (exhaust) 63.0 dB(A) (outdoor inlet)	Community and Education building / Building 1, east side	22 m	278 m

We understand that the heat pumps may operate daily between the hours of 09.00-21.00, while the air handling unit may be required to provide some cooling at night; as such, we assume a worst-case scenario whereby it operates continuously around the clock.

We understand that the AHU unit is to be located internally at basement level, and ducted to atmosphere on the south elevation, on the south-east corner of the building. An attenuator providing a minimum of 5dB(A) attenuation should be installed between the unit and the exhaust grille.

The cumulative noise impact assessment for the nearest/most affected residential properties has been carried out below. This includes noise from fixed plant and extract systems. Operational hours have been applied to the relevant items.

Both daytime and night-time levels have been determined at a distance of 1 metre from the building's façades, as per London Borough of Camden's requirements.

Below are shown the maximum L_{Aeq} results of the noise modelling.

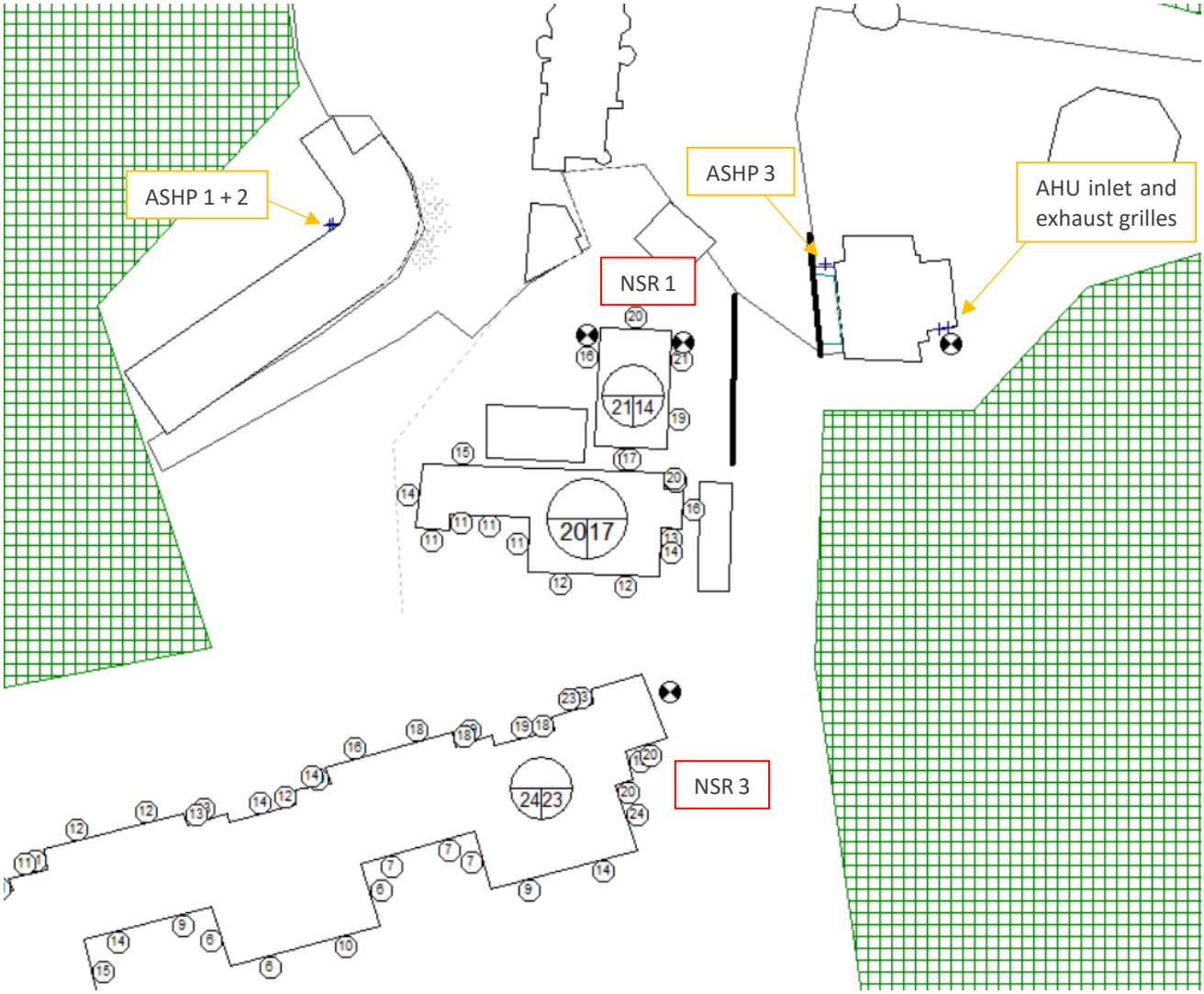


Figure 3: Noise map of daytime specific sound levels affecting John Winter's House and Holly Lodge Mansions (L_{Aeq} dB)

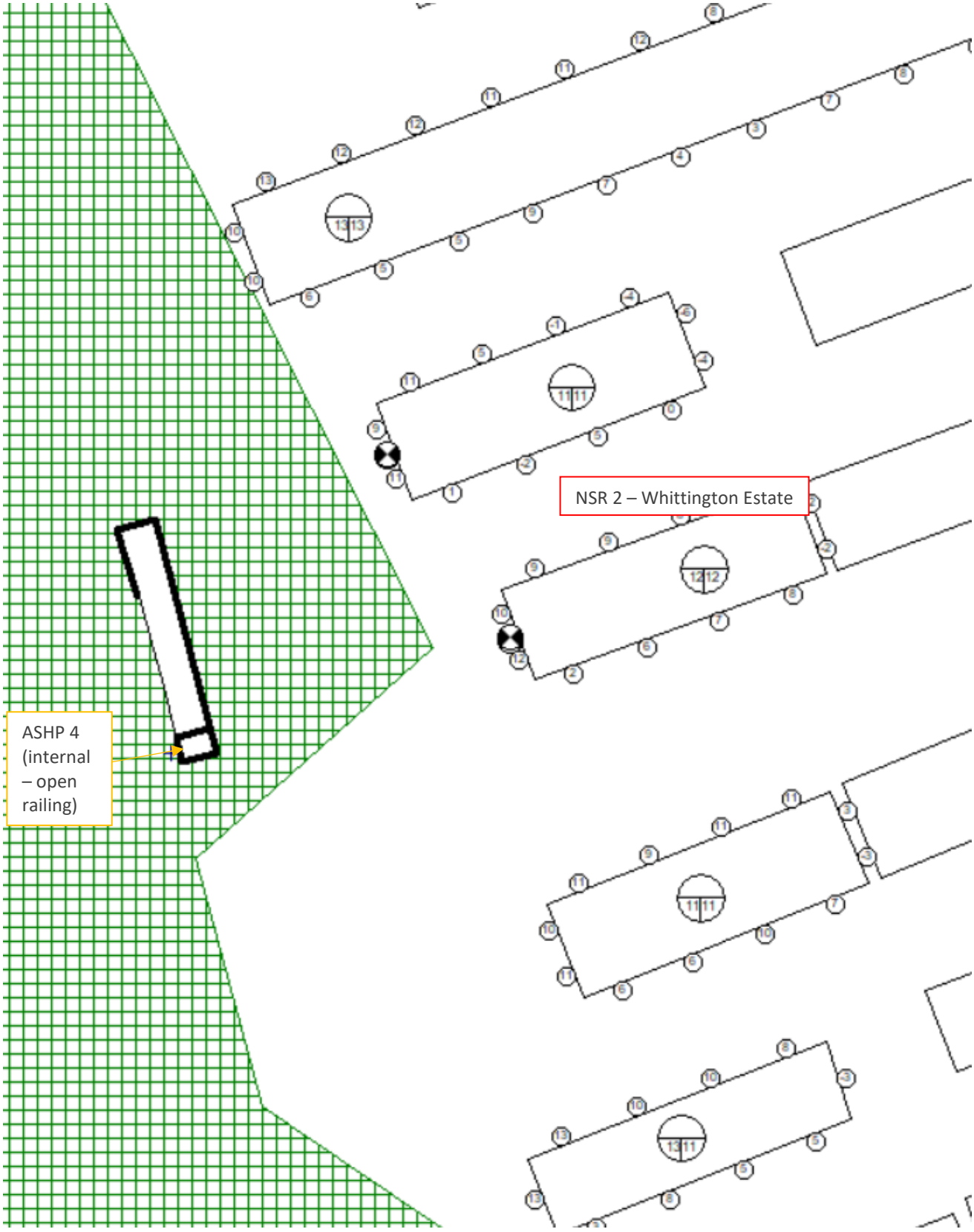


Figure 4: Noise map of daytime specific sound levels affecting Retcar Place (Whittington Estate) (L_{Aeq} dB)

Table 5 below details the daytime noise impact assessment for each noise-sensitive receiver location. Specific sound levels have been taken directly from the CadnaA model.

Table 5: Noise Impact Assessment – Daytime (07:00-23:00hrs)

Element	Level dB(A)			Comments
	NSR 1	NSR 2	NSR3	
Specific Sound Level, L_s	21	13	24	Cumulative specific sound level before acoustic feature corrections, as calculated with CadnaA noise mapping software.
Acoustic Feature Correction	0	0	0	The specific sound level is low with respect to the existing background sound level; therefore, no acoustics features should be readily distinguishable.
Rating Level, $L_{Ar,Tr}$	**21**	**13**	**24**	**At each receptor**
Representative background sound level	38			Representative measured $L_{A90,15min}$ during day-time reference period.
Difference (Rating Level – Background)	-17	-25	-14	The rating level is at least 15 dB below the representative background sound level. This is an indication of a low adverse impact in the context of this site and complies with the local authority criteria.

As can be seen from Table 5 above, the cumulative rating level at the most affected residential receptor has been calculated to be 14 dB below the representative background sound level at NSR3 during the daytime operating hours. This is a positive indication of a low adverse impact in the context of this site. This meets the requirements of the Local Authority.

The results of the modelling for nighttime levels are presented in the table below.

Table 6: Noise Impact Assessment – Night-time (23:00-07:00hrs)

Element	Level dB(A)			Comments
	NSR 1	NSR 2	NSR3	
Specific Sound Level, L_s	17	13	23	Cumulative specific sound level before acoustic feature corrections, as calculated with CadnaA noise mapping software.
Acoustic Feature Correction	0	0	0	The specific sound level is low with respect to the existing background sound level; therefore, no acoustic features should be readily distinguishable.
Rating Level, $L_{Ar,Tr}$	**17**	**13**	**23**	**At each receptor**
Representative background sound level	33			Representative measured $L_{A90,15min}$ during night-time reference period.
Difference (Rating Level – Background)	-16	-20	-10	The rating level is -10 dB below the representative background sound level at NSR3. This is an indication of a low adverse impact in the context of this site and complies with the local authority criteria.

Table 6 details the calculated night-time impact level based on the proposed operation of the AHU at the Community and Education Building. The Rating Noise Level is calculated to be at least 10 dB(A) below the representative background noise level at NSR3 during this period. Due to direct line of sight between NSR3 and the proposed AHU's inlet and exhaust grilles at the south-eastern corner of the Community and Education Building, an attenuator should be included on the exhaust side of the unit providing a minimum of 5 dB(A) attenuation.

8.0 Activity Noise Assessment

The following details about the proposed use of the new facilities have been provided to us by the client, and these form the basis of our noise impact assessment.

Table 7: Proposed new activities

Project No. / Building (please refer to site plan)	Opening Hours	Use / Activities
Project 1 Community & Education Building	09.00-17.00 with some evening use for events up to 21.00	For use by groups of Cemetery visitors (school classes, etc.) and as a space for local community groups to use. Gathering Space at ground level (30 people) Gathering Space at basement level (30 people) Audio Visual Equipment TBC
Project 2 Visitor & Operations Building	09.00-18.00 with some evening use for late working and meetings up to 21.00 (café open until 17.00)	Visitor Ticketing Desk Visitor Café (circa 35 covers, internally + outdoor seating) Offices & Meeting Space for Cemetery Staff (16 people) & Volunteers (10 people)

The activity noise sources are all located within the west compound; NSR 1 is the closest and most affected location. All other NSRs are either at a greater distance and/or shielded by buildings, and thus will experience lower sound levels from the proposed activities. Our assessment therefore focuses only on NSR 1.

In terms of the sound egress from the Community and Education Building, the plans show two spaces, each accommodating up to 30 people; one is at ground floor level, another at basement level. Both spaces would have windows or doors facing west which could be openable. An internal sound pressure level (SPL) of 87 dB(A) has been used as a typical representative level of this type of space when fully occupied, included amplified music and activity noise from occupiers. The same scenario has been applied to both ground-floor and basement-level spaces. The sound egress has been modelled using a transmission loss of 10 dB(A), representing a partially open window/door.

For the café, a typical level of conversational voice has been taken from a study published by the Journal of the Acoustical Society of America at 62dB(A) sound pressure level at 1m. Using this

reference level, we have modelled a maximum of 17 people talking within the café (up to half of the 35 people speaking at any one time) and low background music in café area. The overall level with 17 people talking is calculated at 72 dB(A) sound pressure level at 1m when fully occupied, has been used. It has been assumed that the windows to the café could be fully openable. In addition to the 35 covers internally, it has been assumed that there may be up to 17 customers talking at once in an outdoor seating area.

Sound pressure levels in the offices and meeting rooms will be much lower and will be attenuated by the glazing and building fabric. These are not expected to contribute significantly to the overall noise levels at the nearest NSR, and therefore this has not been included in the modelling.

The café is expected to operate until 17.00, and the operations side until 18:00, while functions in the Community and Education Building may extend until 21.00. Since the local authority specifies different criteria for daytime and evening periods, two scenarios have been modelled: first, with the café and function rooms operating at full capacity; second, with the function rooms only (at full capacity). These scenarios therefore represent a worst-case scenario in terms of activity noise emission from the site.

Below are shown the maximum L_{Aeq} results of the noise modelling.

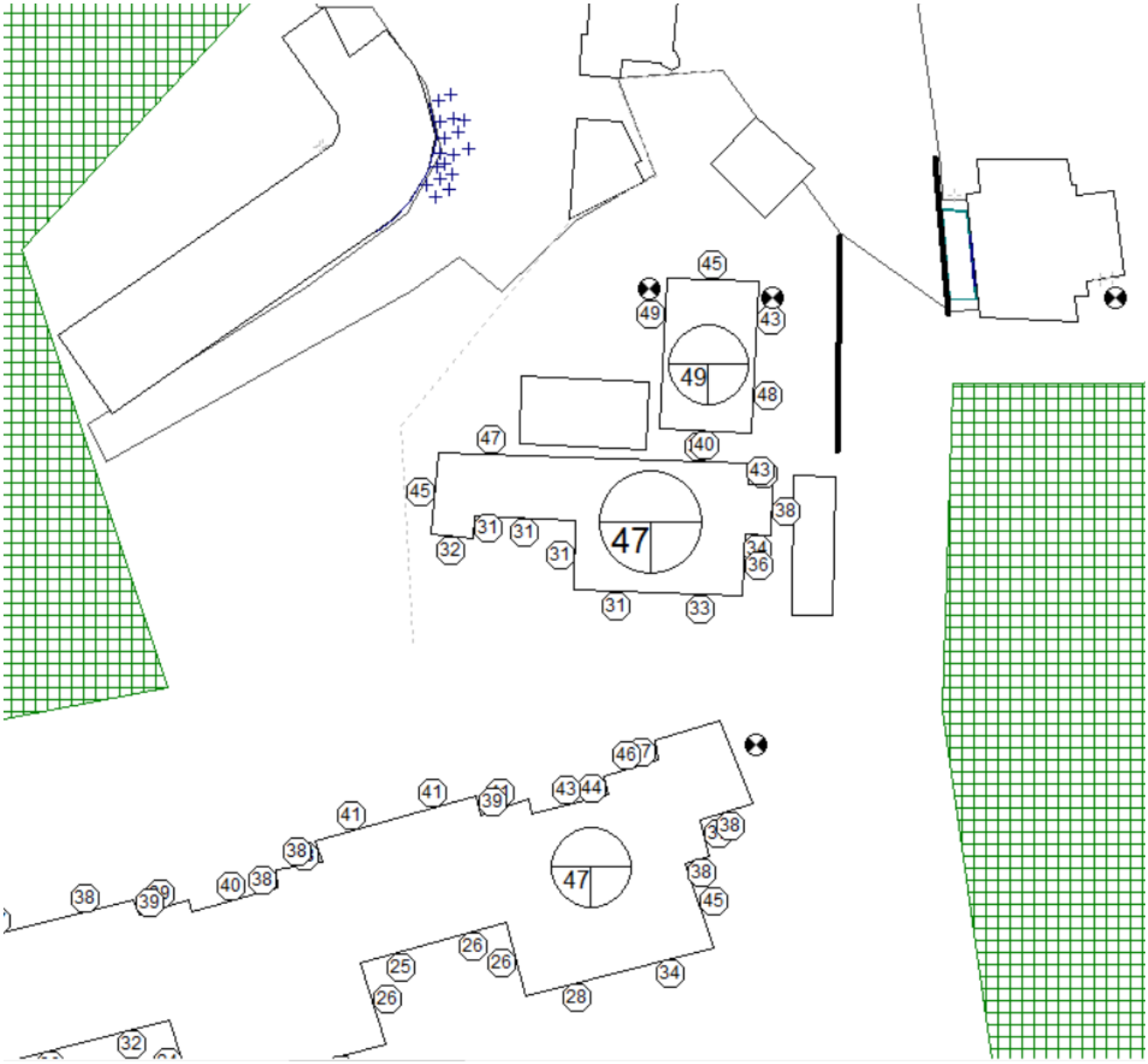


Figure 5: Noise map of daytime activity noise (L_{Aeq} dB)

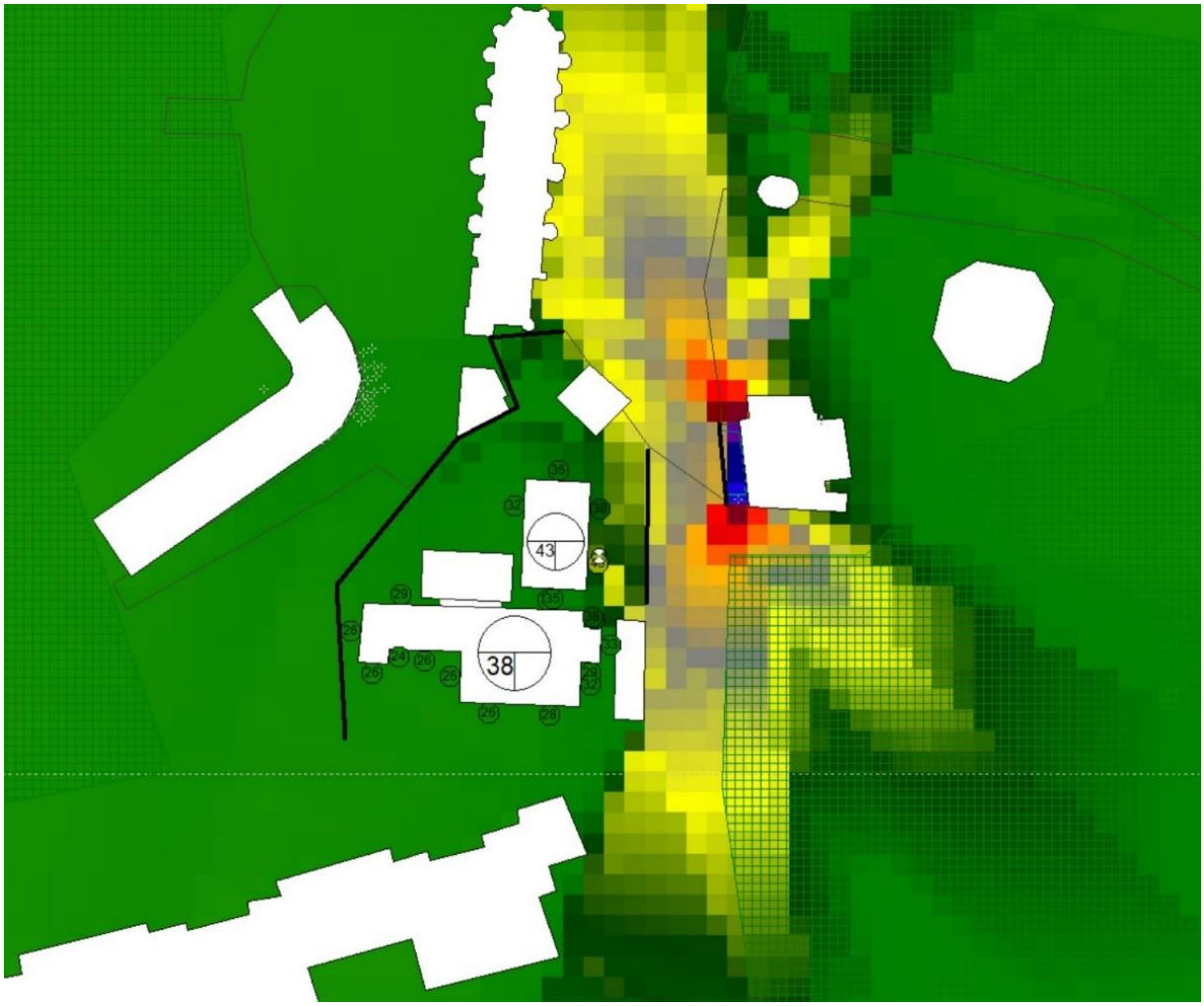


Figure 6: Noise map of evening activity noise (L_{Aeq} dB)

As per section 5.0 above, the local authority criteria are as follows.

Table 8: Local authority criteria for entertainment (customer) noise

Reference period	Criterion level
Daytime (07.00-19.00)	The higher of: • 55 dB(A); or • 10 dB below existing $L_{Aeq,5min}$ i.e. 37 dB(A)
Evening (19.00-23.00)	The higher of: • 50 dB(A); or • 10 dB below existing $L_{Aeq,5min}$ i.e. 28 dB(A)

The above figures show that the nearest NSR would be exposed to an activity noise level of up to 49 dB L_{Aeq} during the daytime, and up to 43 dB L_{Aeq} during the evening. As such, the criteria for activity noise limits specified by the local authority are met, and no further mitigation is required.

9.0 Uncertainty

The equipment was calibrated at the beginning and a reading taken at the end of both survey periods, and a maximum drift of 0.1 dB was noted. In the context of these environmental noise surveys, this level of drift is considered insignificant.

Weather conditions during both the long-term and short-term noise surveys were recorded. As described above, the wind speed did not exceed 1.4 m/s throughout (a maximum of 5 m/s is permissible). A few brief periods of rainfall were recorded, and the noise data captured during these times has been excluded from analysis. Otherwise, the weather conditions are considered conducive to acoustic measurements. Weather conditions were dry during the attended noise measurements.

Overall, the uncertainty within the survey procedure is deemed not to have significant influence on the outcome of the assessment.

The noise modelling software bases its calculations on the methodology of ISO 9613-2, 'Attenuation of sound during propagation outdoors'. In modelling the site, all appropriate precautions have been taken to ensure its integrity, and the model has been reviewed internally. As such, the uncertainty of the predicted levels at the NSRs has been minimised.

10.0 Conclusion

GSAD has undertaken a background noise survey at the site and the survey results are presented within this report, together with a noise impact assessment in accordance with BS 4142:2014+A1:2019 and The London Borough of Camden's noise policy. The assessment covers all proposed items of fixed plant, and accounts for a worst-case scenario based on the proposed operating times.

Representative background sound levels of 38 dB $L_{A90,1hr}$ during the daytime and 33 dB $L_{A90,15min}$ have been determined. Representative $L_{Aeq,5min}$ levels of 47 dB during the daytime and 38 dB during the evening have also been determined.

The plant noise impact assessment has determined that the cumulative rating level from the proposed plant units will be at least 14 dB $L_{Ar,Tr}$ below the representative background sound level during the daytime, and at least 10 dB $L_{Ar,Tr}$ below this level at night, including mitigation measures for the AHU exhaust as described in this report. This results demonstrate compliance The London Borough of Camden's adopted noise policy.

11.0 Statement of Competence

The assessment has been undertaken by the author of this report: Lucie Zalberg, BSc (Physics) MSc (Architectural Acoustics) MIOA. The author is a Director of Gillieron Scott Acoustic Design with 15+ years' experience since completing a degree at Pierre et Marie University in Paris and Bath University. Lucie has undertaken numerous noise assessments according to the 1997 revision of the British Standard and the most recent 2014 revision of the standard.

The assessment has been checked by: Tim Scott BSc (Hons.), MIOA a Director of Gillieron Scott Acoustic Design with 20+ years' experience since completing a degree in Audio Technology at the University of Salford in the late 1990's who has undertaken numerous assessments according to the 1997 revision of the British Standard and the most recent 2014 revision of the standard.

APPENDICES

Appendix A: Site Plans and Measurement Positions

Figure 7: Aerial site overview

The aerial view above shows the location of both the east and west compounds, and the positions of the nearest noise-sensitive receptors; these are as follows.

- NSR 1: No.81 John Winter's House
- NSR 2: Retcar Place / Lulot Gardens

Figure 8: Aerial view of west compound showing long-term monitoring position

Figure 9: Aerial view of east compound showing short-term measurement position

Appendix B: Long-term Measurement Time Series Graph

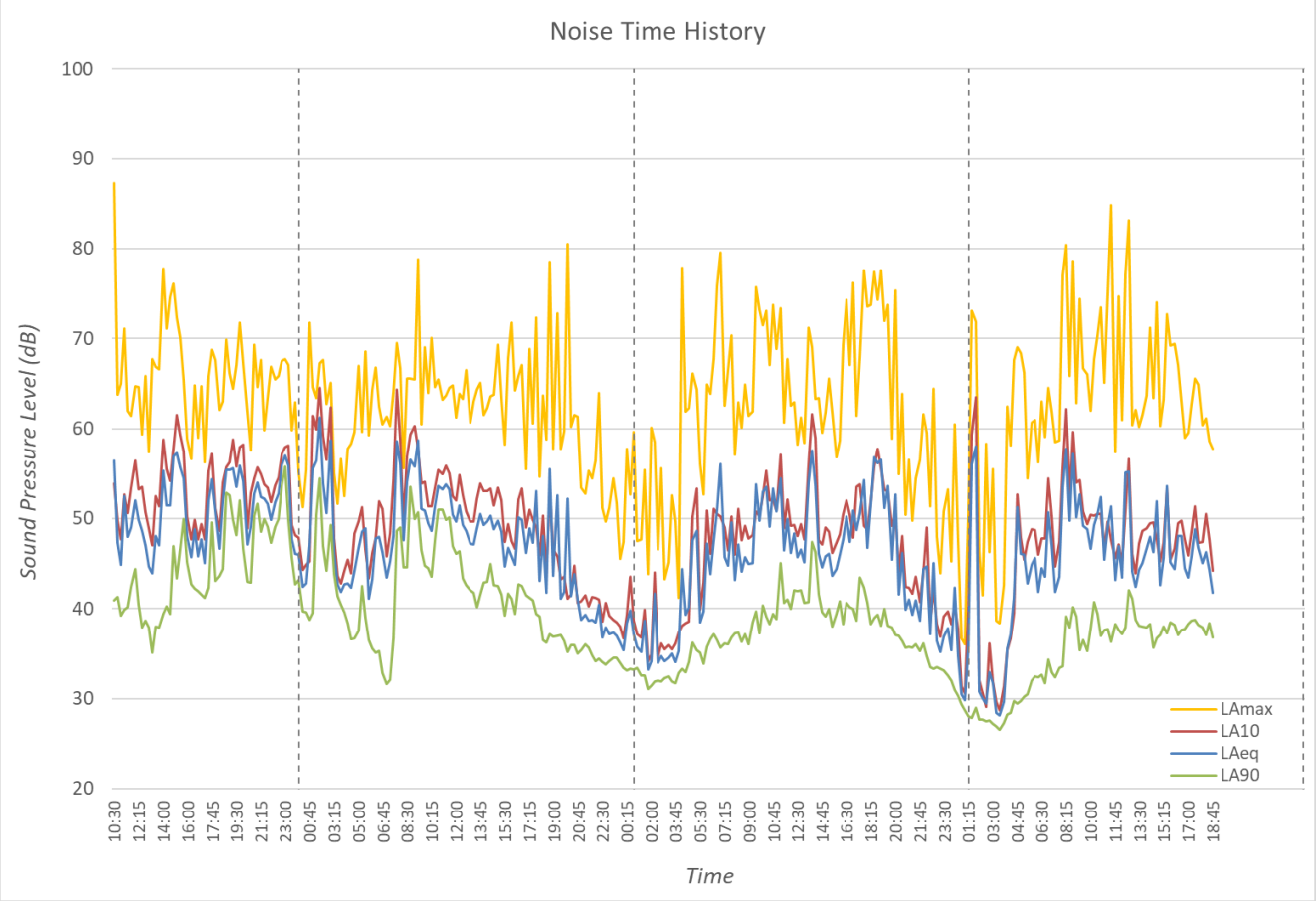
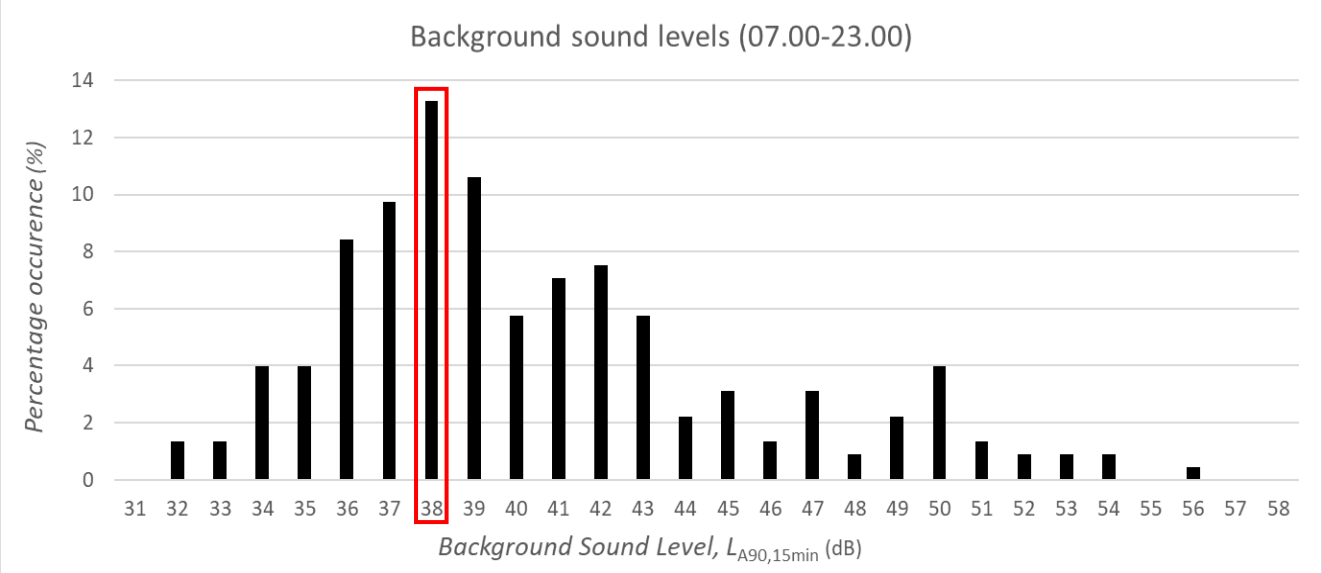
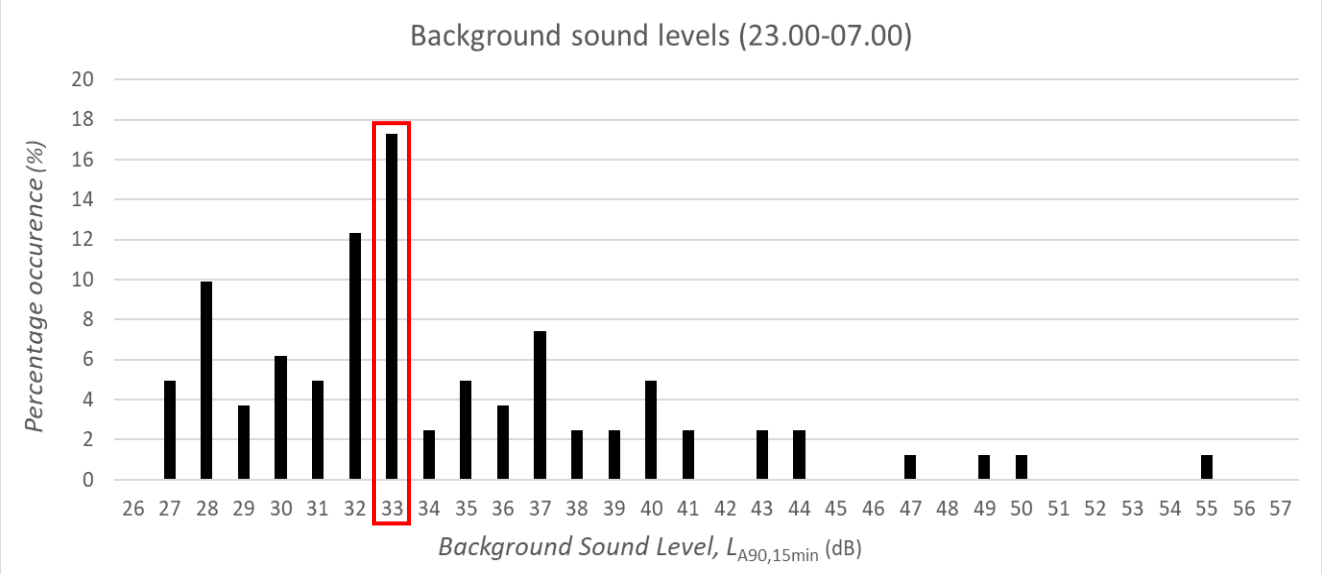


Figure 10: Time history trace from long-term environmental survey

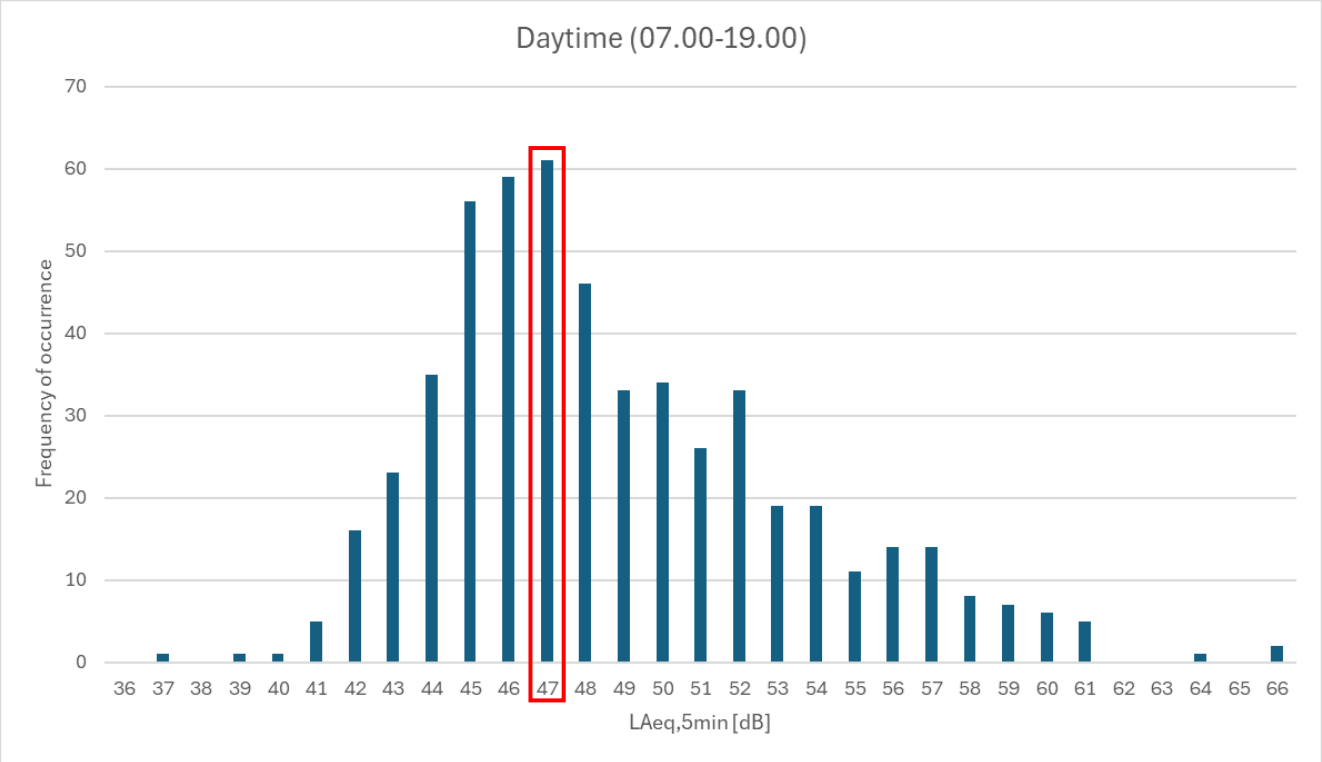
Appendix C: Histogram Plots

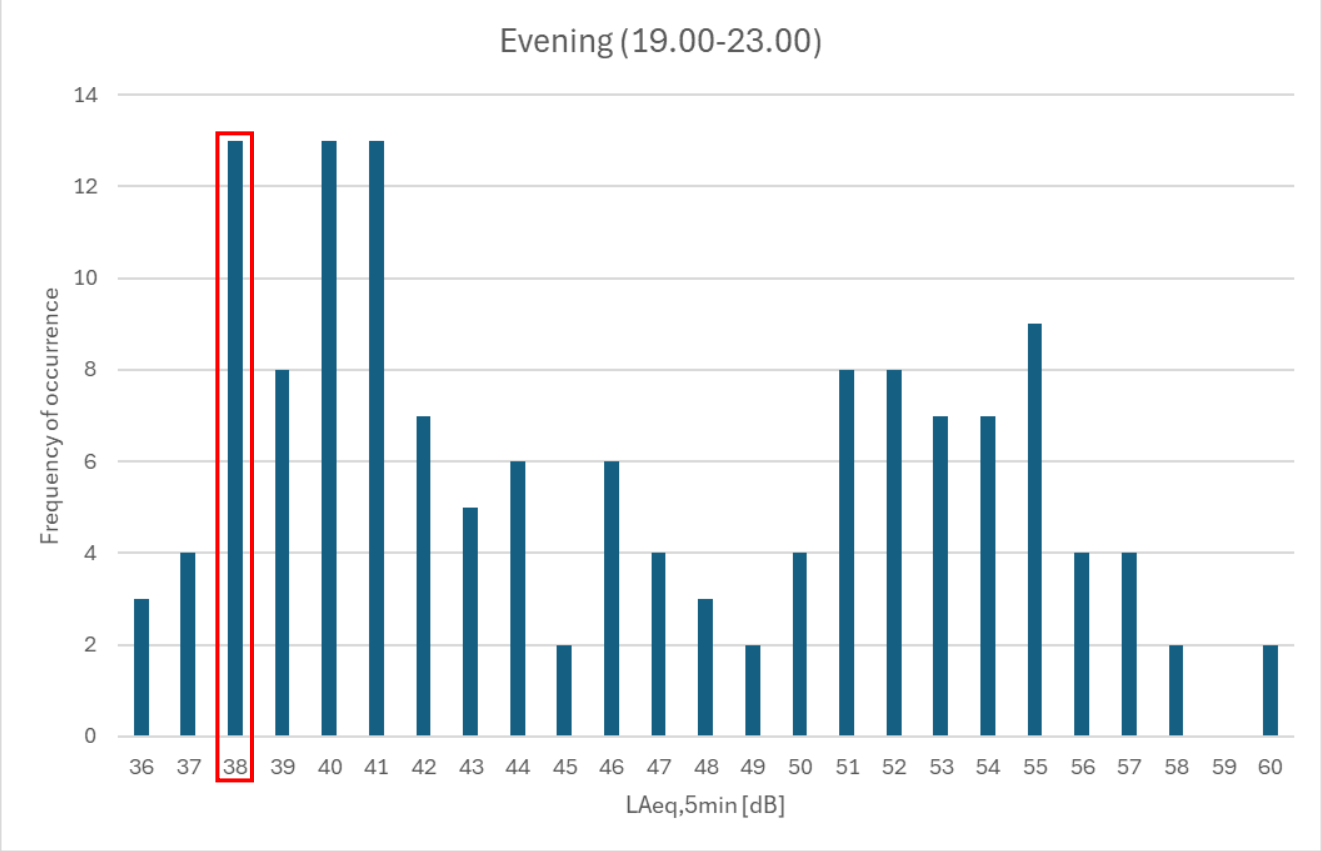
Representative Background Noise Level at NSR





Representative $L_{Aeq,5min}$





Appendix D: Proposed Site Layout and Plans

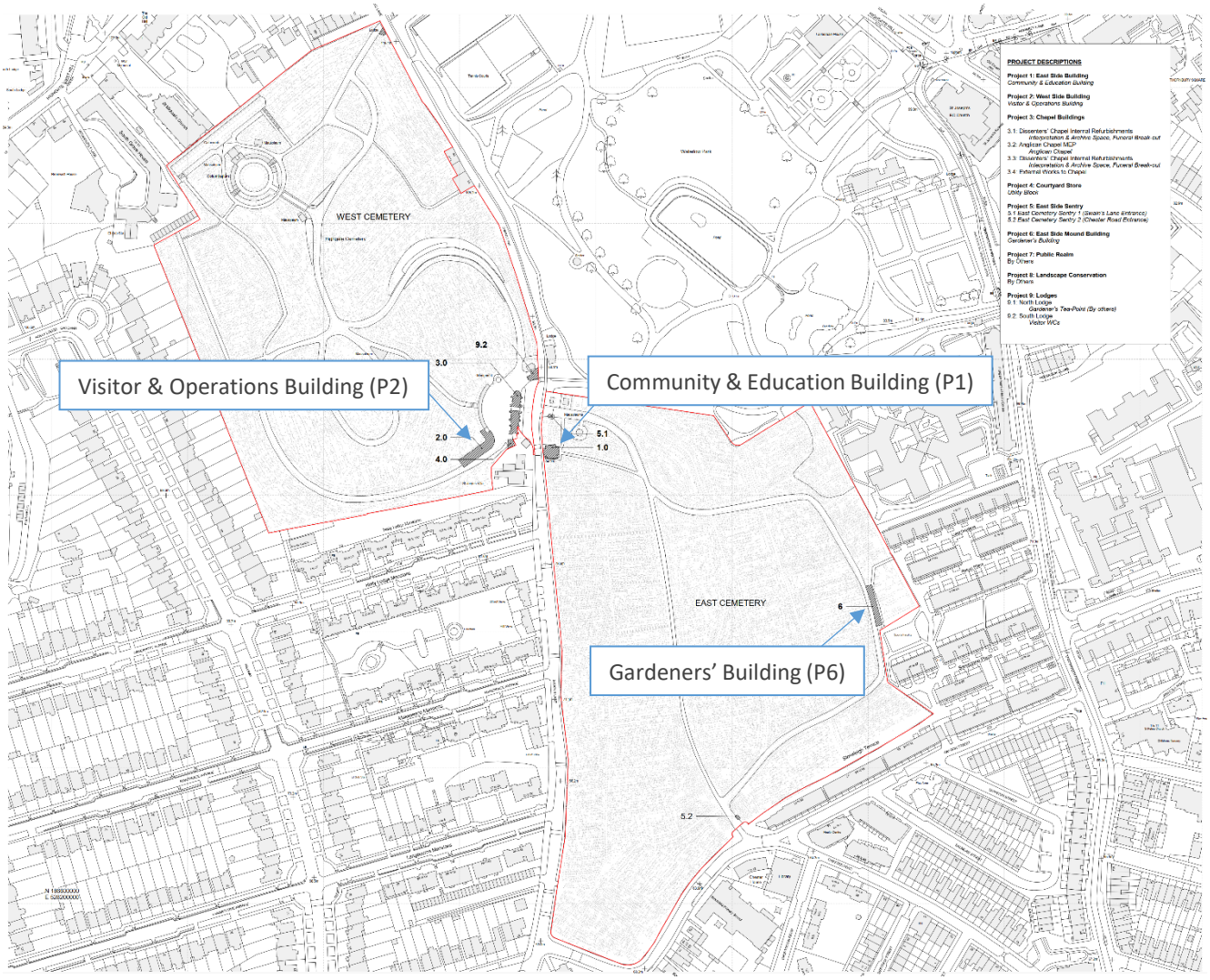


Figure 11: Proposed site plan overview

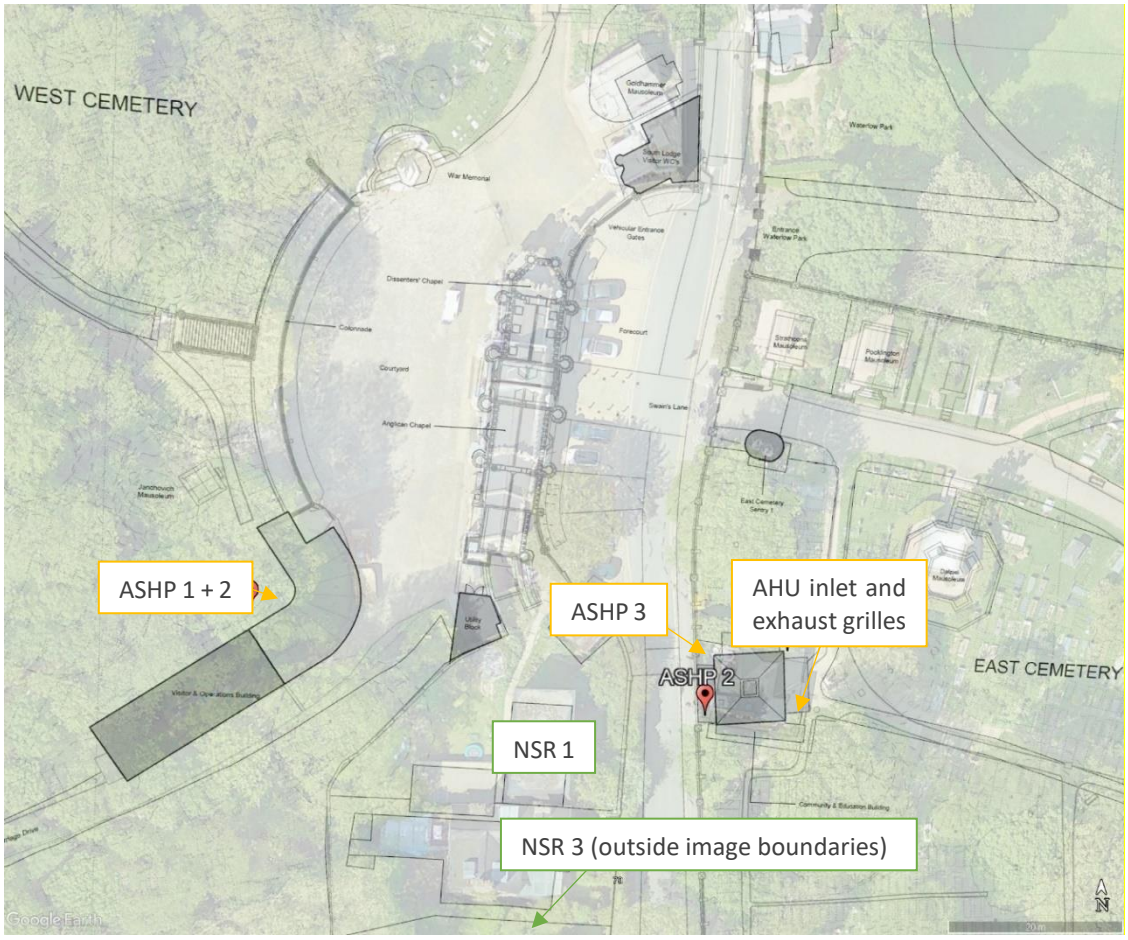


Figure 12: Aerial view with site plan overlay showing proposed locations of plant units to west side

Figure 13: Aerial view with site plan overlay showing proposed location of plant unit to east side

Appendix E: Full Survey Data

Long-term Measurement Data

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
05/07/2024	10:30	56.4	87.3	53.9	40.9
05/07/2024	10:45	47.3	63.8	49.8	41.3
05/07/2024	11:00	44.9	65.0	47.7	39.2
05/07/2024	11:15	52.5	71.1	52.7	39.9
05/07/2024	11:30	48.0	62.0	50.6	40.2
05/07/2024	11:45	49.0	61.4	53.4	42.4
05/07/2024	12:00	52.0	64.7	56.4	44.4
05/07/2024	12:15	49.9	64.6	53.2	40.5
05/07/2024	12:30	48.6	59.4	53.5	37.9
05/07/2024	12:45	47.0	65.8	50.7	38.7
05/07/2024	13:00	44.7	57.4	48.9	37.9
05/07/2024	13:15	43.9	67.7	47.0	35.1
05/07/2024	13:30	48.1	66.9	52.5	38.0
05/07/2024	13:45	47.0	66.6	51.4	37.9
05/07/2024	14:00	55.3	77.8	58.8	39.4
05/07/2024	14:15	51.5	71.1	55.5	40.3
05/07/2024	14:30	51.5	74.6	54.2	39.4
05/07/2024	15:00	56.9	76.1	57.8	46.9
05/07/2024	15:15	57.3	72.3	61.5	43.4
05/07/2024	15:30	55.7	70.1	59.3	46.7
05/07/2024	15:45	54.5	65.4	57.5	50.0
05/07/2024	16:00	48.1	58.9	50.2	45.2
05/07/2024	16:15	45.7	56.6	47.7	42.7
05/07/2024	16:30	48.8	64.8	49.9	42.2
05/07/2024	16:45	45.8	59.0	47.7	42.0
05/07/2024	17:00	47.7	64.7	49.4	41.6
05/07/2024	17:15	45.1	56.3	47.7	41.2
05/07/2024	17:30	52.0	65.8	55.3	42.3
05/07/2024	17:45	54.4	68.8	57.2	49.6
05/07/2024	18:00	50.8	67.6	51.2	43.1
05/07/2024	18:15	46.7	62.1	48.6	43.7
05/07/2024	18:30	51.9	63.0	54.0	44.4
05/07/2024	18:45	55.4	69.9	55.7	52.9
05/07/2024	19:00	55.4	66.1	56.3	52.6
05/07/2024	19:15	55.6	64.4	58.8	49.9
05/07/2024	19:30	53.5	67.1	55.8	48.2
05/07/2024	19:45	55.9	71.8	57.9	52.0
05/07/2024	20:00	54.2	67.3	58.2	46.7
05/07/2024	20:15	47.1	61.8	48.9	43.0
05/07/2024	20:30	49.1	57.6	52.9	42.9
05/07/2024	20:45	52.8	69.3	54.5	50.3

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
05/07/2024	21:00	54.0	64.6	55.7	51.6
05/07/2024	21:15	52.4	67.6	54.9	48.5
05/07/2024	21:30	52.2	59.8	53.8	50.0
05/07/2024	21:45	51.6	63.4	53.4	49.1
05/07/2024	22:00	49.9	66.9	51.8	47.3
05/07/2024	22:15	51.8	65.5	53.7	49.1
05/07/2024	22:30	52.8	65.8	54.6	50.0
05/07/2024	22:45	56.0	67.5	57.2	53.7
05/07/2024	23:00	57.0	67.7	57.9	55.8
05/07/2024	23:15	55.9	67.1	58.1	49.8
05/07/2024	23:30	47.7	59.8	49.3	45.6
05/07/2024	23:45	46.1	62.9	48.2	42.7
06/07/2024	00:00	46.0	55.2	47.9	43.2
06/07/2024	00:15	42.4	51.3	44.3	39.7
06/07/2024	00:30	42.8	55.4	44.9	39.6
06/07/2024	00:45	47.1	71.8	45.3	38.8
06/07/2024	01:00	55.6	64.6	61.4	39.5
06/07/2024	01:45	56.4	63.4	59.9	50.4
06/07/2024	02:00	61.2	67.3	64.5	54.5
06/07/2024	02:15	53.9	67.6	59.2	46.9
06/07/2024	02:30	50.6	62.7	56.5	44.2
06/07/2024	03:00	58.7	65.1	62.4	49.3
06/07/2024	03:15	46.1	55.0	47.8	43.8
06/07/2024	03:30	42.7	51.6	43.7	41.4
06/07/2024	03:45	41.9	56.6	42.8	40.5
06/07/2024	04:00	42.7	52.5	44.2	39.6
06/07/2024	04:15	42.8	57.8	45.4	38.4
06/07/2024	04:30	42.3	58.3	43.9	36.6
06/07/2024	04:45	44.2	59.6	48.4	36.7
06/07/2024	05:00	46.8	67.0	49.7	37.5
06/07/2024	05:15	48.5	59.6	51.3	42.5
06/07/2024	05:30	48.9	68.6	46.5	39.0
06/07/2024	05:45	41.1	59.3	43.4	36.5
06/07/2024	06:00	43.3	64.3	46.2	35.6
06/07/2024	06:15	47.8	66.8	47.8	35.1
06/07/2024	06:30	48.0	62.5	51.9	35.3
06/07/2024	06:45	46.3	60.5	51.1	32.8
06/07/2024	07:00	43.5	61.3	45.8	31.6
06/07/2024	07:15	45.3	60.3	48.4	32.1
06/07/2024	07:30	48.1	64.1	54.2	36.7
06/07/2024	07:45	58.6	69.5	64.3	48.6

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
06/07/2024	08:00	56.1	66.7	58.8	49.0
06/07/2024	08:15	47.6	55.6	49.7	44.6
06/07/2024	08:30	54.1	65.6	56.9	44.6
06/07/2024	08:45	56.5	65.6	59.4	53.5
06/07/2024	09:00	55.8	65.5	60.3	50.0
06/07/2024	09:15	58.7	78.8	57.8	50.7
06/07/2024	09:30	51.1	60.5	53.9	46.5
06/07/2024	09:45	50.9	69.0	54.1	44.8
06/07/2024	10:00	49.5	64.0	51.4	44.5
06/07/2024	10:15	48.6	70.1	51.4	43.6
06/07/2024	10:30	51.4	64.6	53.4	47.6
06/07/2024	10:45	53.6	65.5	55.4	51.0
06/07/2024	11:00	53.2	63.2	54.9	51.0
06/07/2024	11:15	53.8	63.7	55.9	49.9
06/07/2024	11:30	53.2	64.5	55.0	50.1
06/07/2024	11:45	50.4	64.8	52.5	46.9
06/07/2024	12:00	49.7	61.2	52.0	46.1
06/07/2024	12:15	51.5	63.9	54.8	46.4
06/07/2024	12:30	49.3	63.3	52.6	43.4
06/07/2024	12:45	48.6	66.5	50.8	42.6
06/07/2024	13:00	47.2	60.7	49.7	42.1
06/07/2024	13:15	47.1	63.0	49.7	41.8
06/07/2024	13:30	48.9	64.3	52.2	40.2
06/07/2024	13:45	50.5	65.1	53.9	41.6
06/07/2024	14:00	49.3	61.5	53.1	42.9
06/07/2024	14:15	49.7	62.3	53.1	43.0
06/07/2024	14:30	50.3	63.6	53.3	45.0
06/07/2024	14:45	48.8	63.8	51.5	42.6
06/07/2024	15:00	49.8	69.3	53.4	42.5
06/07/2024	15:15	48.5	63.3	52.0	41.6
06/07/2024	15:30	44.7	58.2	47.4	39.2
06/07/2024	15:45	46.8	67.8	49.4	41.7
06/07/2024	16:00	45.8	71.8	47.5	41.1
06/07/2024	16:15	44.9	64.2	46.7	39.4
06/07/2024	16:30	50.1	65.8	52.1	42.7
06/07/2024	16:45	49.9	67.1	53.3	42.5
06/07/2024	17:00	46.2	55.5	49.0	41.5
06/07/2024	17:15	48.9	68.9	51.0	41.2
06/07/2024	17:30	47.3	60.6	49.9	40.9
06/07/2024	17:45	53.1	72.3	49.0	39.4
06/07/2024	18:00	43.1	54.7	45.9	39.1
06/07/2024	18:15	48.1	63.7	50.3	36.5
06/07/2024	18:30	41.8	58.8	43.7	36.2
06/07/2024	18:45	55.5	78.5	53.0	37.2

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
06/07/2024	19:00	43.7	57.8	46.6	36.9
06/07/2024	19:15	52.6	72.8	45.8	37.0
06/07/2024	19:30	41.1	57.8	43.3	37.1
06/07/2024	19:45	41.9	59.7	43.6	36.4
06/07/2024	20:00	52.2	80.5	41.1	35.2
06/07/2024	20:15	41.4	60.2	41.6	35.9
06/07/2024	20:30	43.8	61.5	44.8	35.9
06/07/2024	20:45	41.0	61.3	40.6	35.0
06/07/2024	21:00	38.8	53.4	40.8	35.4
06/07/2024	21:15	39.3	52.8	41.5	36.0
06/07/2024	21:30	38.7	55.3	40.3	35.7
06/07/2024	21:45	38.8	54.5	41.3	34.8
06/07/2024	22:00	38.5	56.4	41.2	34.2
06/07/2024	22:15	40.5	64.0	41.0	34.4
06/07/2024	22:30	36.8	51.2	38.6	34.1
06/07/2024	22:45	37.9	49.7	40.6	33.8
06/07/2024	23:00	37.2	51.2	39.2	34.2
06/07/2024	23:15	37.4	54.5	38.8	34.5
06/07/2024	23:30	37.0	51.7	38.5	34.5
06/07/2024	23:45	36.2	45.5	38.0	34.0
07/07/2024	00:00	35.4	47.4	36.7	33.4
07/07/2024	00:15	38.4	57.8	39.3	33.1
07/07/2024	00:30	39.8	52.7	43.6	33.3
07/07/2024	00:45	37.2	59.6	38.7	33.2
07/07/2024	01:00	35.8	47.5	37.2	33.4
07/07/2024	01:15	35.2	47.7	36.8	32.6
07/07/2024	01:30	38.7	55.4	39.9	32.6
07/07/2024	01:45	33.2	43.8	34.2	31.1
07/07/2024	02:00	34.2	60.1	34.9	31.4
07/07/2024	02:15	41.7	58.5	44.0	31.9
07/07/2024	02:30	34.0	46.6	34.6	32.0
07/07/2024	02:45	34.7	55.6	36.1	31.9
07/07/2024	03:00	34.2	43.3	35.5	32.3
07/07/2024	03:15	34.5	45.2	35.9	32.5
07/07/2024	03:30	35.0	52.6	35.5	31.9
07/07/2024	03:45	34.1	49.7	36.1	31.7
07/07/2024	04:00	35.3	41.2	37.4	32.8
07/07/2024	04:15	44.4	77.9	38.1	33.3
07/07/2024	04:30	39.3	61.9	38.4	32.9
07/07/2024	04:45	40.2	62.3	38.6	34.1
07/07/2024	05:00	47.6	66.1	50.2	36.2
07/07/2024	05:15	48.6	64.3	53.3	35.4
07/07/2024	05:30	38.5	56.1	39.9	35.1
07/07/2024	05:45	39.7	52.7	42.9	33.9

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
07/07/2024	06:00	47.2	64.9	50.9	35.8
07/07/2024	06:15	43.8	63.9	46.1	36.6
07/07/2024	06:30	47.6	67.7	51.1	37.2
07/07/2024	06:45	51.0	75.8	50.5	36.5
07/07/2024	07:00	56.1	79.6	50.2	35.7
07/07/2024	07:15	45.7	62.6	49.0	36.1
07/07/2024	07:30	44.8	66.5	46.5	36.0
07/07/2024	07:45	49.6	70.4	50.2	36.8
07/07/2024	08:00	43.2	57.1	46.0	37.3
07/07/2024	08:15	47.1	62.9	51.1	37.4
07/07/2024	08:30	44.1	60.1	47.6	36.3
07/07/2024	08:45	45.7	64.9	49.2	37.2
07/07/2024	09:00	45.0	61.4	47.8	36.0
07/07/2024	09:15	45.1	61.9	48.2	38.5
07/07/2024	09:30	53.8	75.7	50.8	39.7
07/07/2024	09:45	49.8	73.2	50.3	37.3
07/07/2024	10:00	53.0	71.5	52.5	40.4
07/07/2024	10:15	53.5	73.1	55.3	39.1
07/07/2024	10:30	49.1	67.1	52.0	38.3
07/07/2024	10:45	53.3	73.7	52.1	39.4
07/07/2024	11:00	50.8	68.9	50.9	38.9
07/07/2024	11:15	54.5	73.4	57.1	45.1
07/07/2024	11:30	46.5	60.7	48.9	40.6
07/07/2024	11:45	50.0	67.7	52.1	41.0
07/07/2024	12:00	46.2	62.6	49.2	40.0
07/07/2024	12:15	48.4	62.9	49.3	42.1
07/07/2024	12:30	45.7	58.2	48.1	42.0
07/07/2024	12:45	46.6	61.2	49.4	42.1
07/07/2024	13:00	45.2	58.4	47.7	40.6
07/07/2024	13:15	54.0	71.2	56.1	40.7
07/07/2024	13:30	57.6	69.0	61.6	47.4
07/07/2024	14:15	53.7	63.3	59.0	46.3
07/07/2024	14:30	46.1	63.4	47.6	41.6
07/07/2024	14:45	44.6	59.5	47.1	39.6
07/07/2024	15:00	45.8	61.8	49.0	39.1
07/07/2024	15:15	46.1	65.6	48.5	40.0
07/07/2024	15:30	43.7	61.8	46.2	38.0
07/07/2024	15:45	44.4	56.8	47.3	39.4
07/07/2024	16:00	46.0	58.7	48.3	40.8
07/07/2024	16:15	47.7	69.3	50.5	38.3
07/07/2024	16:30	50.2	74.3	52.0	40.6
07/07/2024	16:45	47.4	67.1	50.4	40.2
07/07/2024	17:00	50.9	76.2	47.9	40.0
07/07/2024	17:15	48.7	61.4	53.5	38.7

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
07/07/2024	17:30	50.6	67.9	53.8	43.5
07/07/2024	17:45	54.3	77.6	49.2	42.3
07/07/2024	18:00	46.8	73.6	48.8	40.6
07/07/2024	18:15	51.6	73.7	51.9	38.3
07/07/2024	18:30	56.8	77.4	55.8	39.0
07/07/2024	18:45	56.2	74.3	57.8	39.3
07/07/2024	19:00	56.5	77.6	55.6	38.1
07/07/2024	19:15	51.2	72.0	53.2	40.0
07/07/2024	19:30	53.6	73.7	53.0	38.1
07/07/2024	19:45	45.4	58.9	49.2	37.9
07/07/2024	20:00	52.7	75.3	50.4	37.1
07/07/2024	20:15	41.6	54.9	44.1	37.0
07/07/2024	20:30	46.2	63.9	48.1	36.4
07/07/2024	20:45	39.9	50.4	42.4	35.7
07/07/2024	21:00	41.0	56.5	42.3	35.8
07/07/2024	21:15	39.3	49.8	41.7	35.7
07/07/2024	21:30	40.9	54.5	43.6	36.0
07/07/2024	21:45	38.7	56.5	40.7	35.3
07/07/2024	22:00	44.4	61.6	44.0	36.1
07/07/2024	22:15	44.7	59.5	49.0	34.7
07/07/2024	22:30	37.2	51.4	38.4	33.5
07/07/2024	22:45	45.1	64.4	42.2	33.3
07/07/2024	23:00	36.4	48.0	38.3	33.5
07/07/2024	23:15	35.2	43.9	36.9	33.3
07/07/2024	23:30	36.9	50.8	39.1	33.1
07/07/2024	23:45	37.8	53.2	39.7	32.6
08/07/2024	00:00	35.4	45.3	38.3	32.0
08/07/2024	00:15	42.3	60.5	40.3	31.0
08/07/2024	00:30	34.7	47.4	37.7	30.3
08/07/2024	00:45	30.5	36.7	31.3	29.4
08/07/2024	01:00	29.8	36.0	30.6	28.7
08/07/2024	01:15	35.8	50.4	39.6	28.0
08/07/2024	01:30	56.1	73.1	59.4	27.9
08/07/2024	01:45	58.0	71.9	63.5	29.0
08/07/2024	02:00	30.8	46.4	32.0	27.7
08/07/2024	02:15	30.0	41.5	30.6	27.7
08/07/2024	02:30	29.5	58.3	29.1	27.5
08/07/2024	02:45	32.9	46.3	36.1	27.6
08/07/2024	03:00	31.7	55.5	31.9	27.2
08/07/2024	03:15	28.4	38.7	29.6	26.9
08/07/2024	03:30	28.1	38.4	28.7	26.5
08/07/2024	03:45	29.6	42.6	31.3	27.3
08/07/2024	04:00	35.6	62.5	35.4	28.2
08/07/2024	04:15	37.2	58.1	36.7	28.4

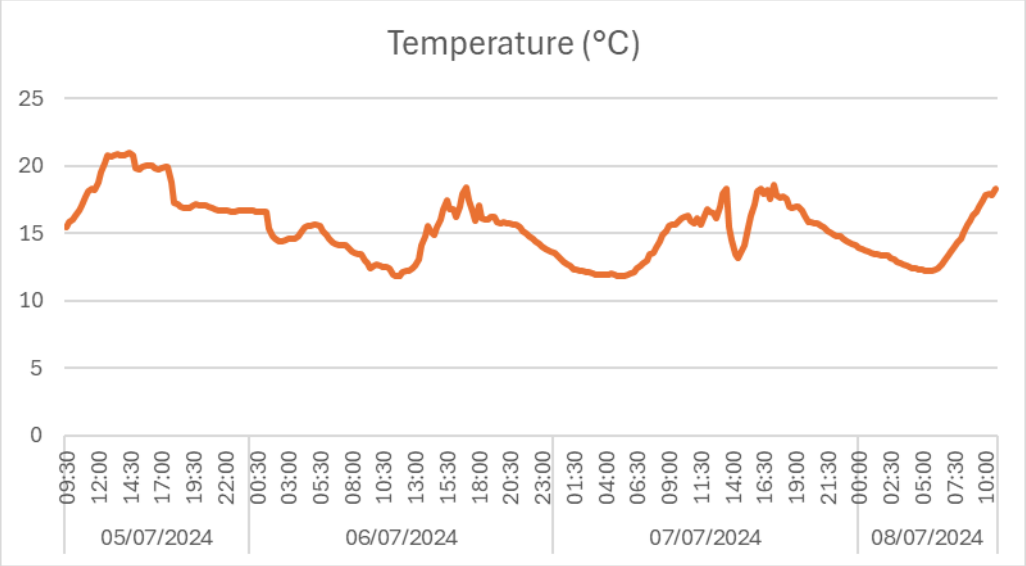
Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
08/07/2024	04:30	41.3	67.6	39.5	29.7
08/07/2024	04:45	51.3	69.0	52.7	29.5
08/07/2024	05:00	46.1	68.4	47.9	29.7
08/07/2024	05:15	46.0	66.2	45.4	30.2
08/07/2024	05:30	42.8	54.5	47.4	30.5
08/07/2024	05:45	44.9	60.7	48.8	32.0
08/07/2024	06:00	45.6	61.0	48.7	32.5
08/07/2024	06:15	41.9	56.3	46.0	32.4
08/07/2024	06:30	44.5	63.0	47.8	32.7
08/07/2024	06:45	43.6	59.1	47.8	31.7
08/07/2024	07:00	50.7	64.5	54.5	34.3
08/07/2024	07:15	47.0	61.9	50.2	32.9
08/07/2024	07:30	41.9	58.5	44.7	32.4
08/07/2024	07:45	43.6	58.7	47.4	33.4
08/07/2024	08:00	53.5	77.0	55.7	33.6
08/07/2024	08:15	57.8	80.4	62.2	39.1
08/07/2024	08:30	49.8	65.8	52.8	37.9
08/07/2024	08:45	57.2	78.6	59.6	40.2
08/07/2024	09:00	50.1	62.8	54.0	39.1
08/07/2024	09:15	52.7	74.4	54.3	35.4
08/07/2024	09:30	49.2	66.7	50.8	36.5
08/07/2024	09:45	48.8	66.0	49.4	35.3
08/07/2024	10:00	46.7	62.0	50.4	37.8
08/07/2024	10:15	49.3	67.7	50.3	40.7
08/07/2024	10:30	50.5	70.4	50.5	39.4
08/07/2024	10:45	52.4	73.5	50.5	37.0
08/07/2024	11:00	45.4	65.1	46.8	37.6
08/07/2024	11:15	49.2	75.1	49.7	37.7
08/07/2024	11:30	51.4	84.8	47.6	36.3

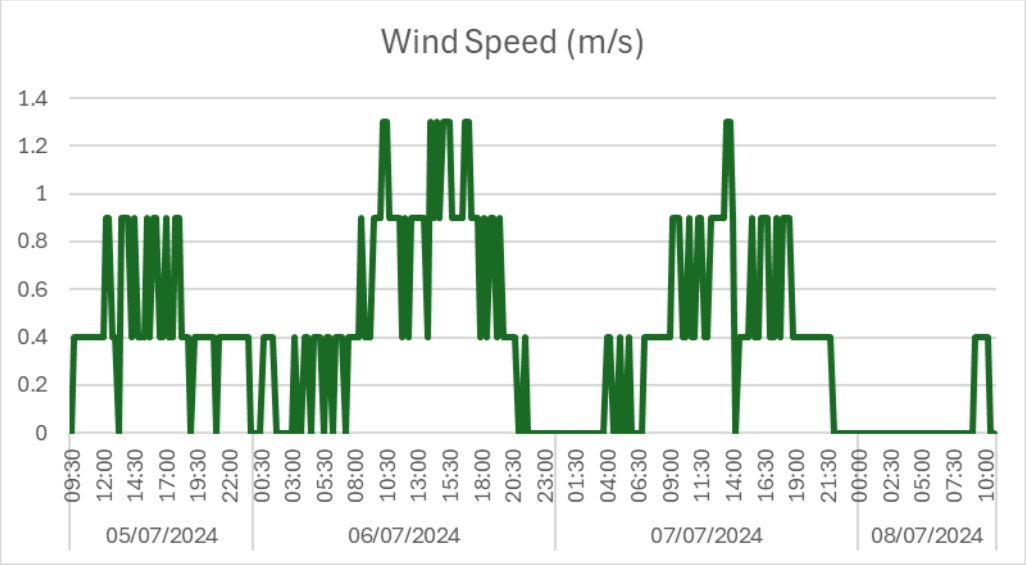
Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
08/07/2024	11:45	43.2	57.4	45.6	38.3
08/07/2024	12:00	46.9	74.7	47.1	37.6
08/07/2024	12:15	43.5	61.0	45.1	37.2
08/07/2024	12:30	55.1	77.1	50.9	37.9
08/07/2024	12:45	55.2	83.1	56.6	42.1
08/07/2024	13:00	44.1	60.4	46.1	41.1
08/07/2024	13:15	42.4	62.1	43.9	38.8
08/07/2024	13:30	44.3	60.2	47.2	38.1
08/07/2024	13:45	45.1	61.5	48.6	38.0
08/07/2024	14:00	46.7	63.7	48.9	37.9
08/07/2024	14:15	48.0	71.2	49.5	38.3
08/07/2024	14:30	46.3	63.4	49.6	35.7
08/07/2024	14:45	51.9	74.0	47.7	36.7
08/07/2024	15:00	42.6	60.3	45.3	37.1
08/07/2024	15:15	45.6	63.2	47.3	38.0
08/07/2024	15:30	53.6	72.7	53.4	37.3
08/07/2024	15:45	45.2	69.2	45.4	38.5
08/07/2024	16:00	44.4	69.4	46.7	38.2
08/07/2024	16:15	48.1	67.1	49.5	37.1
08/07/2024	16:30	48.1	63.0	49.8	37.6
08/07/2024	16:45	44.5	59.0	47.7	37.7
08/07/2024	17:00	43.5	59.5	45.9	38.3
08/07/2024	17:15	45.8	62.7	48.5	38.7
08/07/2024	17:30	48.8	65.6	51.4	38.8
08/07/2024	17:45	46.8	64.9	47.3	38.2
08/07/2024	18:00	45.1	60.4	47.4	37.9
08/07/2024	18:15	46.3	61.1	50.5	37.1
08/07/2024	18:30	44.3	58.6	47.7	38.4
08/07/2024	18:45	41.8	57.8	44.2	36.8

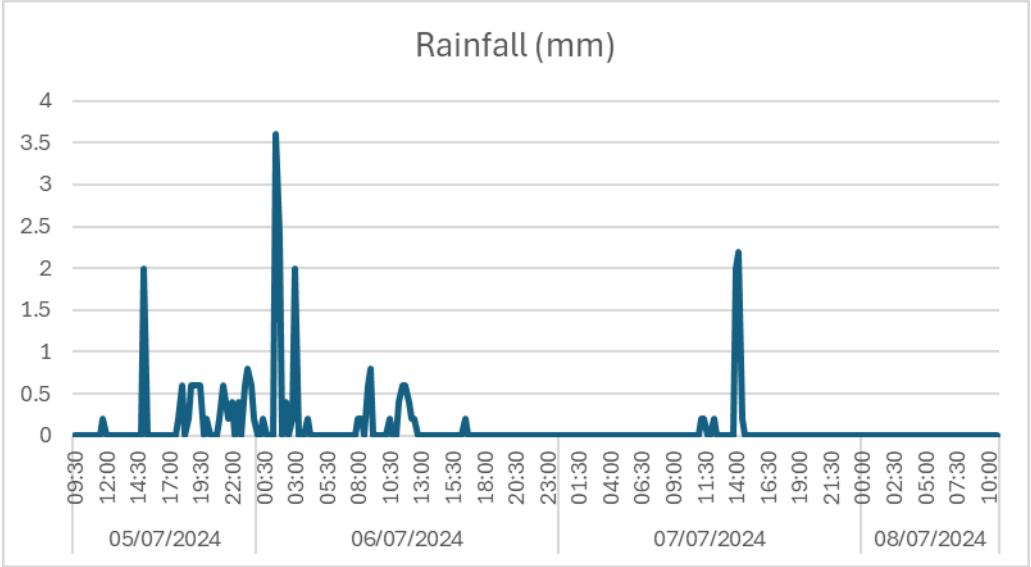
Short-term measurement data

Date	Time	L_{Aeq} [dB]	L_{Amax} [dB]	L_{A10} [dB]	L_{A90} [dB]
09/07/2024	08:33:28	48.7	70.3	50.6	42.1
09/07/2024	08:45:00	51.7	77.4	48.6	43.3
09/07/2024	09:00:00	44.8	61.1	45.8	42.7
09/07/2024	09:15:00	46.3	65.4	47.7	42.4
09/07/2024	09:30:00	51.0	73.8	51.9	42.7

Appendix F: Weather Data Summary







Appendix G: Equipment

- NTi XL2 Real Time Analyser
- Bruel & Kjaer 4231 Calibrator
- NTi outdoor kit
- Tripods
- Davis Vantage Vue Weather Station

All sound level meters are Class 1 and within 2 years of their most recent laboratory calibration. Calibration certificates are available on request.

Appendix H: Acoustic Feature Correction

Tonality
For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity
A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

I**ntermittency**
When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics
Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.

Although acoustic features are not predicted to be audible at the nearest noise sensitive receptor due to the distance, cautionary penalties have been applied in line with BS4142. For the cars and deliveries, a 3dB penalty has been applied for 'other sound characteristics' that may be distinctive against the environment. The ASHPs and Extracts have had a 2dB penalty applied for just perceptible tonality, as plant items sometimes show tonal characteristics.

Appendix I: Manufacturer Noise Data

Community and Education Building (P1) – Mitsubishi Electric PUZ-HWM140VHA(-BS)

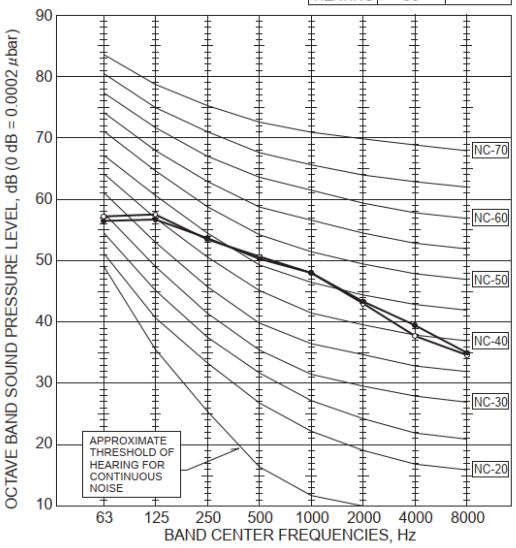
Heating | **Product Information**

PUZ-HWM140VHA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

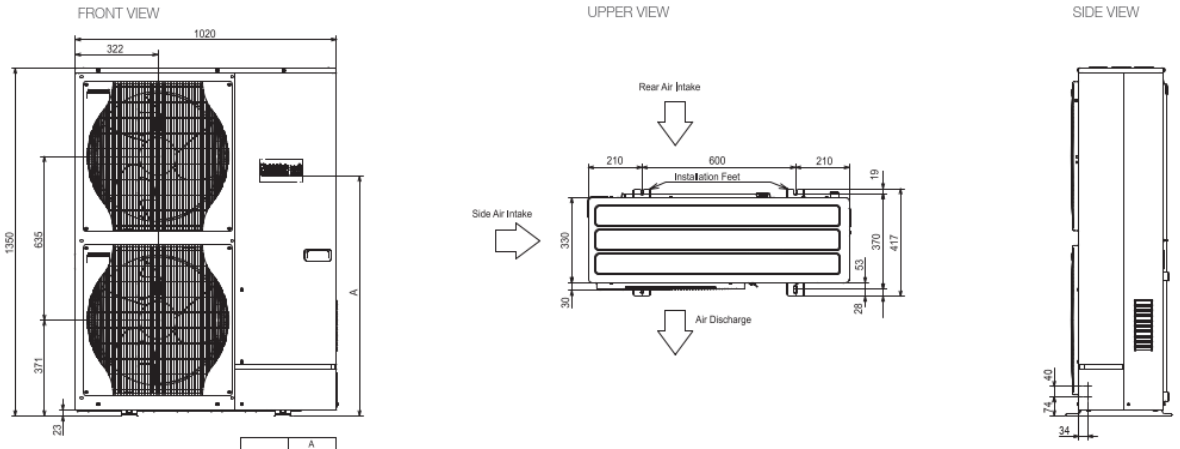
OUTDOOR UNIT		PUZ-HWM140VHA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	131%
	SCOP (MCS)	3.26
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	176%
	SCOP (MCS)	4.33
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	130%
HEATING*2 (A-7/W35)	Capacity (kW)	14
	Power Input (kW)	5.71
	COP	2.45
OPERATING AMBIENT TEMPERATURE (°C DB)		-28 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	53
	Power Level (dBA)*4	67
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	40.1
	Water Pressure Drop (kPa)	20
DIMENSIONS (mm)	Width	1020
	Depth	330 + 30*7
	Height	1350
WEIGHT (kg)		132
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	13.8 [35]
	Fuse Rating - MCB Sizes (A)*6	40
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	3.3

PUZ-HWM140VHA(-BS)
PUZ-HWM140YHA(-BS)

MODE	SPL(dB)	LINE
COOLING	53	
HEATING	53	



PUZ-HWM140VHA(-BS) DIMENSIONS



	A
VHA	1079
YHA	931

All dimensions (mm)

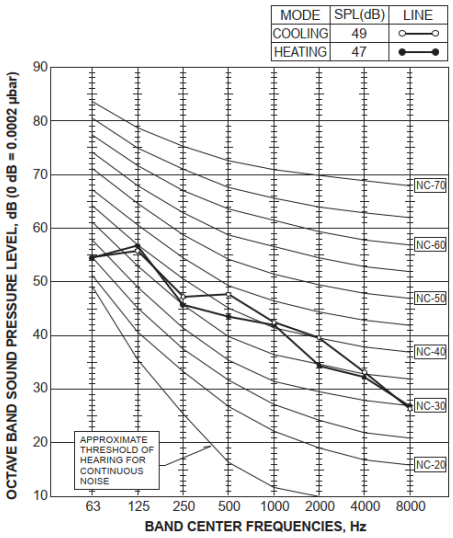
Visitor and Operations Building (P2) – 2 No. Mitsubishi Electric PUZ-WM112VAA(-BS)

Heating | **Product Information**

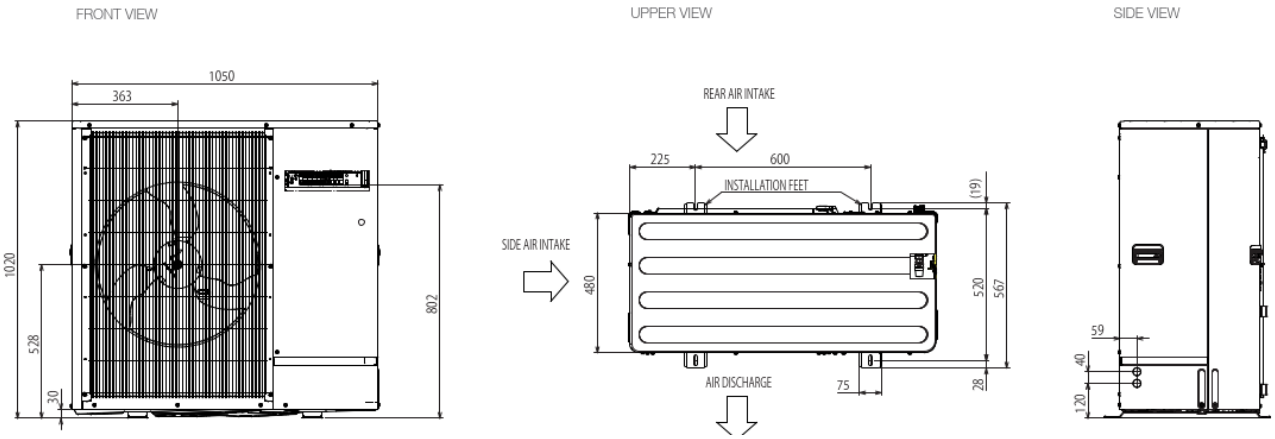
PUZ-WM112VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT		PUZ-WM112VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	134%
	SCOP (MCS)	3.34
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	191%
	SCOP (MCS)	4.74
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	148%
HEATING*2 (A-7/W35)	Capacity (kW)	11.2
	Power Input (kW)	3.73
	COP	3.00
OPERATING AMBIENT TEMPERATURE (°C DB)		-25 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	60
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	32
	Water Pressure Drop (kPa)	24.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		119
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	10.9 [28]
	Fuse Rating - MCB Sizes (A)*6	32
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	3.0 / 2.03

PUZ-WM112VAA.UK **PUZ-WM112VAA-BS.UK**
PUZ-WM112YAA.UK **PUZ-WM112YAA-BS.UK**



PUZ-WM112VAA(-BS) DIMENSIONS



Gardeners' Building (P2) – Mitsubishi Electric PUZ-WM85VAA(-BS)

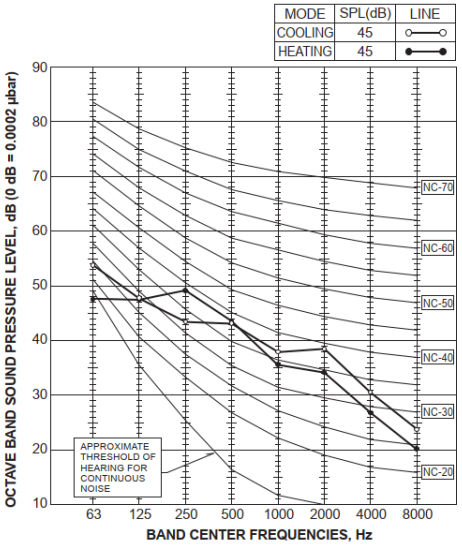
Heating | **Product Information**

PUZ-WM85VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT		PUZ-WM85VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	139%
	SCOP (MCS)	3.48
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	193%
	SCOP (MCS)	4.84
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	8.5
	Power Input (kW)	3.27
	COP	2.60
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	58
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	24
	Water Pressure Drop (kPa)	15.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		98
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	9.1 [22]
	Fuse Rating - MCB Sizes (A)*6	25
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

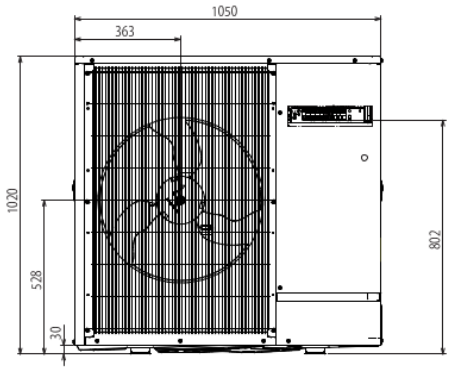
PUZ-WM60VAA.UK
PUZ-WM85VAA.UK
PUZ-WM85YAA.UK

PUZ-WM60VAA-BS.UK
PUZ-WM85VAA-BS.UK
PUZ-WM85YAA-BS.UK

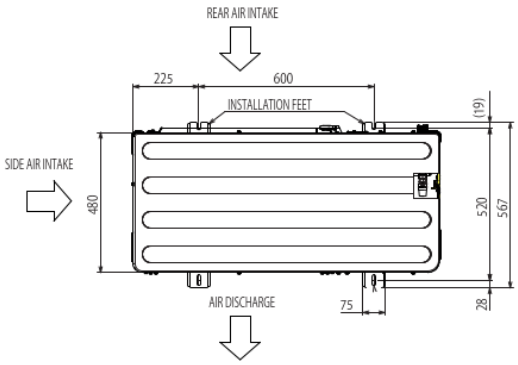


PUZ-WM85VAA(-BS) DIMENSIONS

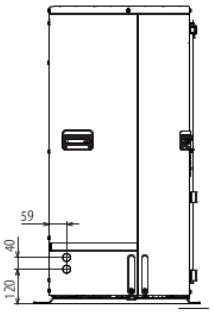
FRONT VIEW



UPPER VIEW



SIDE VIEW



Education and Community Building AHU – Systemair TR30-R-HWH-461834

systemair

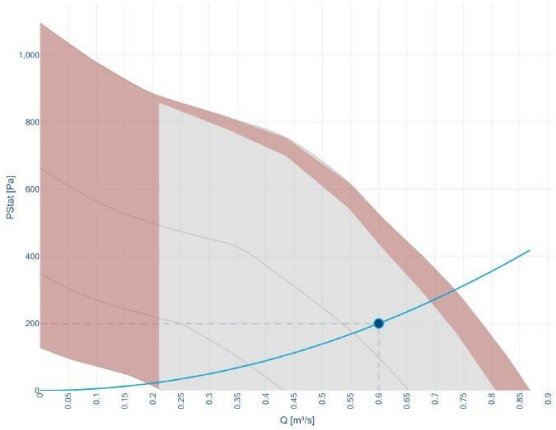
Share code 55qfc17v

Project name	Project	Unit no. 1
Project number		11/07/2024
Model name	Topvex TR30-R-HWH - 461834	Page 5 / 19

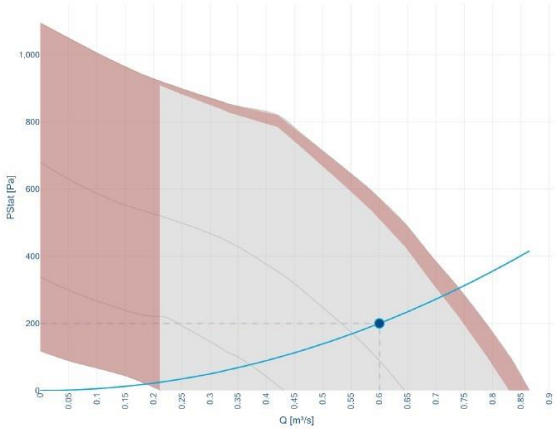
Air and sound

Winter & Summer

Supply



Extract



	Octave bands [Hz]								
Sound power level	63 [dB]	125 [dB]	250 [dB]	500 [dB]	1k [dB]	2k [dB]	4k [dB]	8k [dB]	Total dB [dB(A)]
Supply	82	68	72	68	69	65	60	58	73
Outdoor	77	67	69	57	55	47	42	41	63
Extract	81	70	70	60	56	47	39	31	65
Exhaust	80	70	73	71	70	64	54	46	73
Surrounding	70	57	66	48	49	46	39	34	59
Sound pressure at 3m									38

Sound results according to EN 13053.

Appendix J: Predicted Speech Noise Levels from Visitor's Café

17 people speaking at 'normal voice' level inside the café

Normal speech levels at 0 degrees directivity, taken from Monson et al (2012). *'Horizontal directivity of low- and high-frequency energy in speech and singing'* J. Acoust. Soc. Am., Vol. 132, No. 1, July 2012.

Source	Octave Band Sound Pressure Level, dB								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Normal Speech, 0 degrees directivity, 1 person talking at 1m	48*	50	56	57	55	51	46	44	62

*63Hz level assumed as not provided in the literature

The above level has been extrapolated to 17 people at each frequency, using the calculation:

$$SPL_{17people} = SPL_{1person} + 10\log(17/1)$$

$$62dB(A) + 10\log(17/1) = 72dB(A)$$

Appendix K: Glossary of Acoustic Terms

DECIBEL (dB) - A unit of sound pressure measurement
Sound Pressure Level in dB (*L*p) = 20 log (Measured sound pressure/Reference sound pressure = 20 µPa)

dB(A) - The A -weighted sound pressure level, the weighting network reduces low frequency sound in a similar way to the human ear.

REVERBERATION TIME (RT or *T*) – decay of sound in rooms
The time taken for a sound, once terminated, to fall through 60dB i.e. to one millionth of its original sound intensity. *T*30 – RT for first 30dB of decay. RT_{500} - Mid frequency RT.
HERTZ (Hz) - a unit of frequency measurement. The normal range of hearing is from 20Hz to about 15kHz.

ABSORPTION COEFFICIENT – degree to which a material absorbs sound.
The ratio of absorbed to incident sound energy (perfect absorber = 1)

SOUND REDUCTION INDEX *R* – quantity which describes a material's ability to reduce the sound pressure level across it (e.g. a wall or floor)

$R = L1 - L2 + 10\log (S/A)$

*L*1 - Average sound pressure level in source room (averaged from 100 Hz – 3150 Hz)
*L*2 - Average sound pressure level in receiving room (averaged from 100 Hz – 3150 Hz)
S – Wall Area (m^2)
A – Total absorption in receiving room (m^2 units)

*R*w – weighted sound reduction index

AVERAGE ROOM TO ROOM LEVEL DIFFERENCE – *D*, dB = *L*1 – *L*2, averaged 1/3 octave bands from 100Hz – 3150kHz.

*D*w – weighted value of D (usually 2 - 3dB higher)

*D*nT, w – *D*w corrected for reverberation time of receiving room

NOISE RATING CURVES (NR CURVES) – set of curves used to describe optimum background noise levels for different tasks.

*L*10/90 LEVEL (dB) - The level in dB of a time varying sound pressured level (e.g. traffic) exceeded for 10%/90% of the time of measurement.
*L*90 is usually called the BACKGROUND NOISE LEVEL.

*L*eq AVERAGE SOUND PRESSURE LEVEL – level dB of a time varying sound pressure level with equal amounts of energy above and below it, for the time of measurement.

TONAL NOISE – noise of a single frequency (or a narrow band of frequencies that can be perceived as a tone), audible above the broad band noise background. Noise which is at least 5dB above the average of the 1/3 octave band sound pressure levels immediately on either side of it.