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31 DALEHAM GARDENS

Noise Impact Assessment – Revision A

31 DALEHAM GARDENS
Noise Impact Assessment

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Revision and Date	Amendment Details	Revision Prepared By	Revision Approved By
Rev A 04.04.23	Plant Noise Assessment	BD	JDB

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by Mole Architects to undertake an environmental noise impact assessment to support the planning application for the proposed development at 31 Daleham Gardens, NW3 5BU.

1.2 The proposals were to provide 14 apartments, across 6 floors. The lower two floors are referred to as lower ground and ground, with associated amenity and parking. The existing site situation has been shown in the following figure:

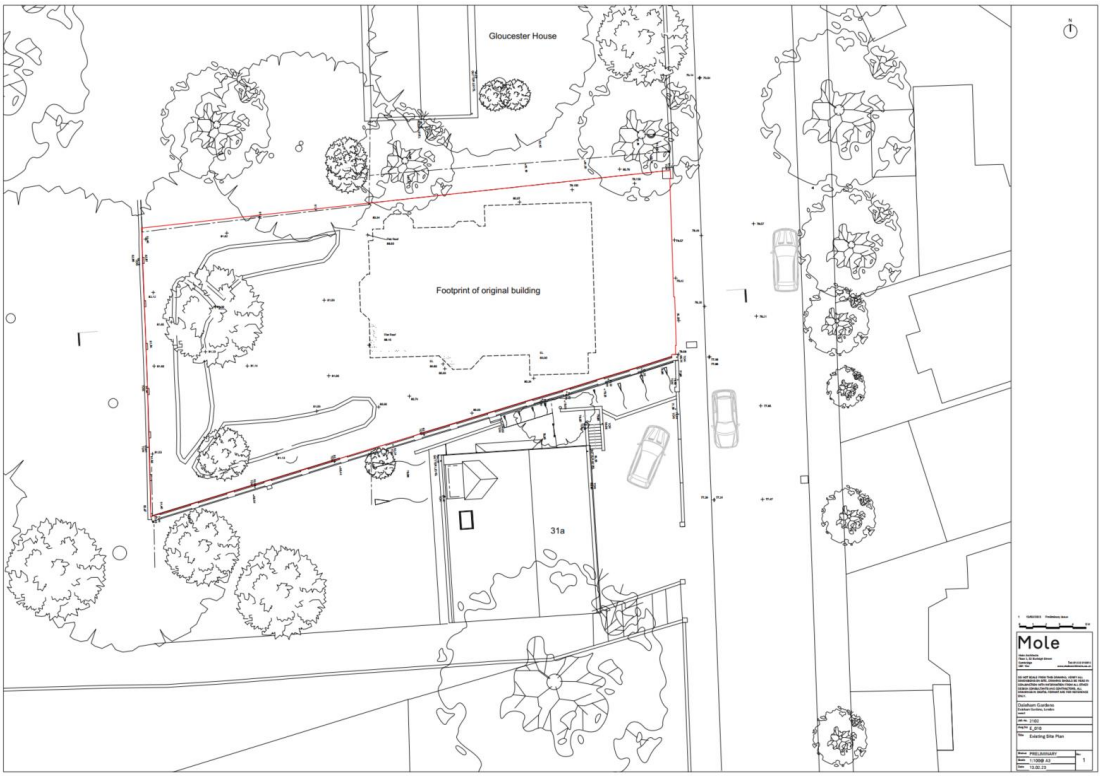


Figure 1.1: Site Plan *Excerpt from 2102_E_010_Existing Site plan [P01]*

1.3 During a site walkover, it was noted that sounds from the surrounding transport network remained dominant, with other incidental sounds such pedestrian movements. There was also a school building to the north which has been discussed later within this document.

1.4 To provide a representative and robust assessment, this report has examined the results of long term, unmanned monitoring undertaken at the site location, and will:

- Report the results of the unmanned, baseline survey;
- Provide critical assessment of these baseline sound levels;
- Assess the site in-line with the most applicable local, national and international guidance;
- Assess the proposed plans against the relevant criteria; and
- Make recommendations for improvement and mitigation where warranted.

2.0 LEGISLATION, POLICY AND GUIDANCE

National Planning Policy

2.1 A summary of the National Planning Policy Framework (NPPF), National Planning Practice Guidance and the Noise Policy Statement for England is provided in the Appendix of this report.

Local Policy

The London Plan: 2021

2.2 Under the legislation establishing the Greater London Authority (GLA), the Mayor is required to publish a Spatial Development Strategy (SDS) and keep it under review. The SDS is known as the London Plan. As the overall strategic plan for London, it sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years.

2.3 Whereas there are many policies pertinent to acoustics within the plan, the most applicable have been listed and described, as follows:

Policy D1 London's Form, Character and Capacity for Growth

Defining an area's character to understand its capacity for growth

A. Boroughs should undertake area assessments to define the characteristics, qualities and value of different places within the plan area to develop an understanding of different areas' capacity for growth. Area assessments should cover the elements listed below:

1. *demographic make-up and socio-economic data (such as Indices of Multiple Deprivation, health and wellbeing indicators, population density, employment data, educational qualifications, crime statistics)*
2. *housing types and tenure*
3. *urban form and structure (for example townscape, block pattern, urban grain, extent of frontages, building heights and density)*
4. *existing and planned transport networks (particularly walking and cycling networks) and public transport connectivity*
5. ***air quality and noise levels***
6. *open space networks, green infrastructure, and water bodies*
7. *historical evolution and heritage assets (including an assessment of their significance and contribution to local character)*
8. *topography and hydrology*
9. *land availability 1*

10. *existing and emerging Development Plan designations*
11. *land uses*
12. *views and landmarks.*

Policy D3 Optimising Site Capacity Through The Design-Led Approach

The design-led approach

A. *All development must make the best use of land by following a design-led approach that optimises the capacity of sites, including site allocations. Optimising site capacity means ensuring that development is of the most appropriate form and land use for the site. The design-led approach requires consideration of design options to determine the most appropriate form of development that responds to a site's context and capacity for growth, and existing and planned supporting infrastructure capacity (as set out in Policy D2 Infrastructure requirements for sustainable densities), and that best delivers the requirements set out in Part D.*

B. *Higher density developments should generally be promoted in locations that are well connected to jobs, services, infrastructure and amenities by public transport, walking and cycling, in accordance with Policy D2 Infrastructure requirements for sustainable densities. Where these locations have existing areas of high density buildings, expansion of the areas should be positively considered by Boroughs where appropriate. This could also include expanding Opportunity Area boundaries where appropriate.*

C. *In other areas, incremental densification should be actively encouraged by Boroughs to achieve a change in densities in the most appropriate way. This should be interpreted in the context of Policy H2 Small sites.*

D. *Development proposals should:*

Form and layout

1. *enhance local context by delivering buildings and spaces that positively respond to local distinctiveness through their layout, orientation, scale, appearance and shape, with due regard to existing and emerging street hierarchy, building types, forms and proportions;*
2. *encourage and facilitate active travel with convenient and inclusive pedestrian and cycling routes, crossing points, cycle parking, and legible entrances to buildings, that are aligned with peoples' movement patterns and desire lines in the area*
3. *be street-based with clearly defined public and private environments;*
4. *facilitate efficient servicing and maintenance of buildings and the public realm, as well as deliveries, that minimise negative impacts on the environment, public realm and vulnerable road users;*

Experience

5. *achieve safe, secure and inclusive environments;*
6. *provide active frontages and positive reciprocal relationships between what happens inside the buildings and outside in the public realm to generate liveliness and interest*
7. *deliver appropriate outlook, privacy and amenity;*
8. *provide conveniently located green and open spaces for social interaction, play, relaxation and physical activity;*
9. ***help prevent or mitigate the impacts of noise and poor air quality;***

[…]

Policy D14 Noise

A. *In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:*

1. *avoiding significant adverse noise impacts on health and quality of life;*
2. *reflecting the Agent of Change principle as set out in Policy D13 Agent of Change;*
3. *mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses;*
4. *improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquility);*
5. *separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation;*
6. *where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles;*
7. *promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.*

National Policy

ProPG: Planning & Noise (2017)

2.4 In May 2017 the Institute of Acoustics (IOA), Association of Noise Consultants (ANC) and the Chartered Institute of Environmental Health (CIEH) released this document which provides professional guidance on planning and noise, specifically relating to residential developments.

2.5 It was produced to provide practitioners with a guidance on a recommended approach to the management of noise within the planning system in England. It encourages good acoustic design, including site layouts, orientation of rooms within dwellings etc. Importantly, this document does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy on which users should take their own advice as appropriate.

2.6 ProPG risk assesses the noise levels in a graduating manner from Negligible Risk through to High Risk in the following manner. It also states that "an indication that there might be more than 10 noise events at night (23:00 – 07:00) with $L_{Amax,F}$ > 60 dB means the site should not be regarded as negligible risk."

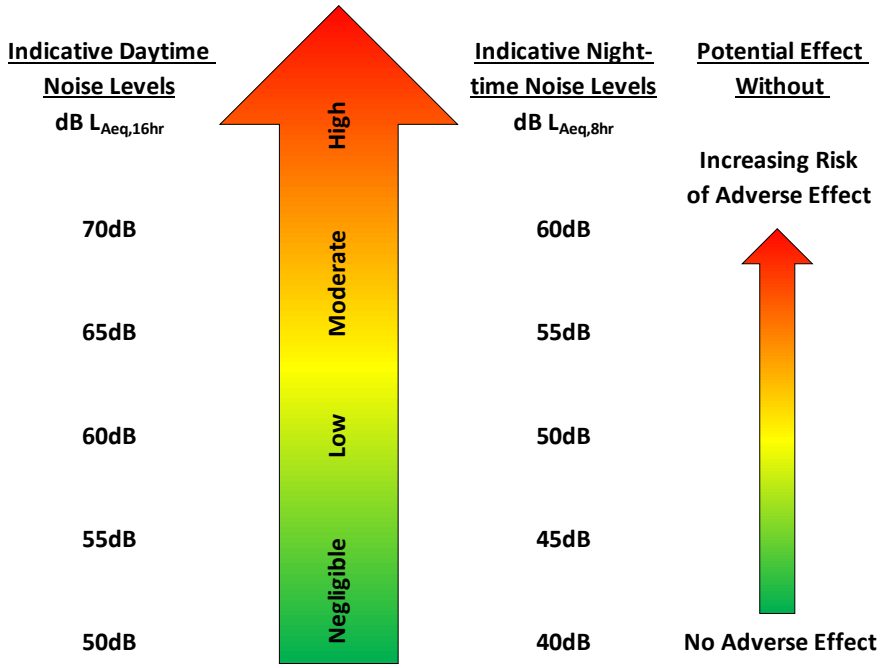


Figure 2.1: Initial Site Risk Assessment Using Fig. 1 of ProPG

3.0 ASSESSMENT METHODOLOGY AND CRITERIA

3.1 This section outlines the assessment methodology and criteria that have been used to assess the significance of risk associated with the development.

Data Sources

3.2 The key data sources reviewed as part of this study have been listed in Table 3.1 below.

Organisation	Document
British Standards Institute (BSI)	BSI (2014). BS 8223:2014 Guidance on sound insulation and noise reduction for buildings.
	BSI (2019) BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound
World Health Organisation (WHO)	WHO (2000). Guidelines for Community Noise
Department for Environment, Food and Rural Affairs (DEFRA)	Defra (2010). Noise Policy Statement for England
Institute of Environmental Management and Assessment (IEMA)	Guidelines for Environmental Noise Impact Assessment

Table 3.1: Key Information Sources

3.3 This assessment has considered the existing ambient noise levels and the likely significant effects on existing and proposed human receptors within the site and surrounding area in terms of:

- noise impacts expected during construction;
- existing baseline conditions and potential noise sources that may impact the proposed development;
- noise from changes in traffic attributed to the proposed development; and
- noise from building services plant associated with the proposed development.

3.4 The nature of the development has been noted to be residential on the first-floor, with commercial below. Therefore, an assessment has been undertaken of the suitability of the site for the proposed use and whether any mitigation measures are required in order to provide an adequate environment for future occupants.

Site Suitability – Internal and External Noise Levels [BS 8233:2014]

3.5 BS 8223:2014 and 1999 provide criteria for the assessment of noise affecting various uses, including residential dwellings.

3.6 WHO 'Guidelines for Community Noise' outlines criteria for the assessment of internal and external noise levels affecting various uses including residential dwellings.

3.7 BS 8223:2014 and 1999 state the recommendation of a single figure values that should be met in assessment of the property. These values can be seen in Table 3.2 below:

Activity	Location	Day-Time Period 07:00 – 23:00	Night-Time Period 23:00 – 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,16hour}$
NOTE 7 – Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved			

Table 3.2: BS8223:2014 Indoor Ambient Noise Levels

3.8 Design criteria for external amenities is also suggested within the document:

> *'For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments'*

Acoustics and Overheating: Residential Design Guide (2020)

3.9 Ventilation requirements for dwellings are covered under the Building Regulations Approved Document F (ADF).

3.10 ADF describes three types of ventilation provision and associated ventilation rates for dwellings. These four 'systems' are summarised in table 3.3 below:

Ventilation System	Provision with ADF system / purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 1: Background Ventilators and Intermittent Extract Fans	Background Ventilators (Trickle Vents)	Intermittent Extract Fans	Typically Provided by Opening Windows
System 2: Passive Stack ("Natural")	Background Ventilators (Trickle Vents) and Passive Stack Ventilation	Continuous Via Passive Stack	Typically Provided by Opening Windows
System 3: Continuous Mechanical Extract (MEV)	Continuous Mechanical Extract - Minimum Low Rate Trickle Vents Provide Inlet Air	Continuous Mechanical Extract - Minimum High Rate Trickle Vents Provide Inlet Air	Typically Provided by Opening Windows
System 4: Continuously Mechanical Supply and Extract with Heat Recovery (MVHR)	Continuous Mechanical Supply and Extract - Minimum Low Rate	Continuous Mechanical Supply and Extract - Minimum High Rate	Typically Provided by Opening Windows

Table 3.3: Table 2-2 from the Acoustics and Overheating: Residential Design Guide – January 2020

3.11 The ventilation strategy for each development has a significant impact on the design and subsequent internal ambient noise levels within habitable spaces.

Approved Document F – Ventilation (2013)

3.12 Approved document F outlines provisions to control the noise that is associated with the installation of ventilation systems.

3.13 It recommends that in noisy areas, in order to reduce the amount of noise entering the building through the ventilation system it may be appropriate to use sound-attenuating products such as silencers or attenuators. This is dependent on the noise levels and planning conditions.

BS 4142:2014+A1:2019

3.14 This British Standard has been reviewed and updated since the previous version in 2014. The biggest change however occurred in the 2014 amendments when the method for applying acoustical characteristics was dramatically changed. Another key area which was amended related to the determination of the appropriate background sound level.

3.15 Acoustical characteristics are applied cumulatively for the following characters;

Acoustic Character	Subjective Level	Correction
Tonality	Just perceptible	+2 dB
	Clearly perceptible	+4 dB
	Highly Perceptible	+6 dB
Impulsivity	Just perceptible	+3 dB
	Clearly perceptible	+6 dB
	Highly Perceptible	+9 dB
Intermittency	Readily distinctive	+3 dB
Other sound characteristics	Readily distinctive	+3 dB

Table 3.4: Acoustical Characteristics For Determining the Rated Sound Level

3.16 The above correction values are based on the subjective nature of the sound, however BS 4142 also provides detailed guidance on objectively calculating the correction factors, which are included within Annexes C, D and E of the British Standard.

3.17 This latest version of the British Standard states that the most relevant background sound level should be applied for the most relevant time period and should reflect the period which is being assessed. This could include the use of statistical analysis or averaging to calculate the most applicable background sound level.

WHO Guidelines for Community Noise (1999)

3.18 The WHO Guidelines for Community Noise state the following guideline values for noise in specific environments, as can be seen in table 3.5.

Specific Environment	Critical Health Effects	$L_{Aeq,T}$ (dB)	$L_{AMAX,fast}$ (dB)
Dwelling, indoors	Speech intelligibility and moderate annoyance	35	-
Inside bedrooms	Sleep disturbance, night-time	30	45
Outdoor living area	Serious annoyance, daytime and evening	55	-
	Moderate annoyance, daytime and evening	50	-

Table 3.5: WHO Guideline Values for Community Noise

3.19 The document also states:

> **'**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 & Varnet, 1991).'

Proposed Criteria

3.20 On the basis of the guidance listed above, we would propose the following internal noise levels be adopted as a minimum design target for the proposed residential dwellings:

Period	Duration	Noise (1) (2) (dB)
Day	07:00 -23:00	35 $L_{Aeq,16hr}$
Night	23:00 – 07:00	30 $L_{Aeq,16hr}$
		45 $L_{AF,MAX}$
Notes: (1) From BS8223:2014 and WHO Guidelines (2) The design targets relate to internal noise levels. With respect to outdoor living areas, a target of 55dB $L_{Aeq,T}$ should avoid serious annoyance during the day or evening		

Table 3.6: Proposed Indoor Criteria

Institute of Environmental Management and Assessment (IEMA) Guidelines: Guidelines for Environmental Noise Impact Assessment

3.21 There is currently no specific guidance on how to undertake a noise impact assessment, and, although standards and guidance about noise are available.

3.22 The purpose of the document is to address the key principles of a noise impact assessment, and state the importance of contextual assessment, by informing the practitioner:

- how to scope a noise assessment;
- issues to be considered when defining the baseline noise environment;

- prediction of changes in noise levels as a result of implementing development proposals; and
- definition and evaluation of the significance of the effect of changes in noise levels (for use only where the assessment is undertaken within an EIA).

3.23 The guidance states the practitioner must consider the most applicable and relevant indices for assessing the impact of noise, by considering not only the diurnal times, overall levels and location, but the characteristics and type of noise.

4.0 ACOUSTIC SURVEY PROCEDURE

Unmanned Measurement Procedure

4.1 Long-term environmental sound monitoring was undertaken by Mr Sam Ward, AMIoA of Create Consulting Engineers, from the 20th – 23rd February 2023.

Unmanned Measurement Procedure

4.2 The monitor was fixed to the site hoarding and was intended to be directly representative of the road, which was noted to be the dominant noise source.

4.3 The location of the monitor has been shown in the following figure:

Figure 4.1: Monitor Location

Manned Measurement Procedure

4.4 Short-term monitoring was undertaken on the day of installation within the site area to check sound propagation across the site. The following figure shows these locations. It should be noted that the pre-existing building was no longer there, however the satellite image has not been updated to reflect this.

Figure 4.2: All Monitor Locations

Acoustic Survey Specifics

4.5 The microphone at MP1 was affixed at high level at approximately 2.5m high, to remain free from surface reflections and to provide added security.

4.6 The weather was monitored throughout the period, and there were no periods of inclement weather that warranted the exclusion of sound levels from the assessment. The temperature ranged from 12.9 to 6.4°c and windspeeds did not exceed 1.5m/s. There were 3 periods of rainfall recorded during the survey which have been omitted from assessment as a matter of course.

4.7 The sound level meters and acoustic calibrator detailed below were Class 1 standard in accordance with the British Standards 60942 and 61672. They were all within the laboratory calibration time-frame of two years during the period of measurement and the laboratory calibration time of 1 year for the calibrator.

4.8 The sound level meters were calibrated to the manufacturer's specific requirements before and after the measurement period and no significant drift in calibration was noted. Full survey equipment specifics have been included in the appendix.

4.9 Calibration certificates have not been included within this report but are available upon request.

5.0 ACOUSTIC SURVEY RESULTS AND DATA ANALYSIS

Unmanned Survey Results

5.1 The assessed results from the unattended measurement positions have been shown in the following table. Full analysis has been appended, which include the methods for identifying all representative levels used in this assessment:

Period	Internal Noise Level Limit	Partially open window reduction	Maximum level at façade	Measured	Excess over Target
Daytime	35 dB	15 dB	50 dB	56 dB	6 dB
Night-time	30 dB	15 dB	45 dB	47 dB	2 dB
Max	45 dB	15 dB	60 dB	69 dB	9 dB

Table 5.1: Assessment Sound Levels

Attended Survey Results

5.2 The following table shows the time-aligned level comparison between MP1 and the short-term (ST) measurement positions (locations shown in Figure 4.2).

5.3 The calculation steps have assumed the road source as dominant and, has back calculated the level at MP1 to the ST locations:

Date		20/02/2023			
Start Time		11:32:23	11:47:49	12:03:28	12:18:53
ST	Location	1	2	3	4
	dB $L_{Aeq,15min}$	48	47	47.5	47
MP1 dB $L_{Aeq,15min}$		54.6	53	52.9	55.2
Difference dB		6.6	6	5.4	8.2
r_1 MP1 to Centre of Road (mtrs)		5	5	5	5
r_2 MP1 to ST (mtrs)		22	16	18	12
MP1+10*log(r_1/r_2) dB		48	48	47	51
Difference dB		0	1	0	4

Table 5.2: Time-aligned Level Comparison

5.4 The results show a strong correlation between the time aligned measurements, which indicate the road source remained dominant throughout. The level at ST4 was markedly decreased, which has been attributed to the locations proximity to the hoarding, which would have provided screening from the road noise.

6.0 ACHIEVABLE SOUND LEVELS THROUGH NOISE MITIGATION

Internal Noise Levels

6.1 This section has assessed the acoustical viability of the site for residential development.

6.2 The 16hr daytime, 8hr night-time and representative night-time max levels have been assessed (see Table 5.1 for full results).

6.3 If constructed using common construction methods, the internal noise levels would be met with windows closed using standard double glazing.

6.4 With windows open, it is generally accepted that a partially open window reduces a façade's sound insulation to a maximum of approximately 15 dB, depending on the open area. Given the levels measured, it would indicate that additional measures of mitigation would be required if natural ventilation was desired for this development:

Period	Internal Noise Level Limit	Partially open window reduction	Maximum level at façade	Measured	Excess over Target
Daytime	35 dB	15 dB	50 dB	53 dB	3 dB
Night-time	30 dB	15 dB	45 dB	44 dB	-1 dB
Max	45 dB	15 dB	60 dB	69 dB	6 dB

Table 6.1: Viability of Natural Ventilation *(Corrected for 5mtr distance from MP1 to facade)*

6.5 Given the excess over the internal noise levels targets (specifically the max levels), this preliminary level of assessment would indicate that a ventilation system, reliant on openable windows alone would be unsuitable from a noise perspective.

6.6 Following construction, the buildings would offer screening at locations further away from the road source. This would result in the viability of alternate ventilation at certain locations.

6.7 This has been more closely examined in the following chapter of this report.

External Noise Levels

6.8 As previously stated in section 3 of this report, external amenity areas should ideally not exceed the range of 50-55 dB $L_{Aeq,16hr}$, however these values may not be achievable in all circumstances where development is considered 'desirable'.

6.9 As can be seen in table 5.1, the measured levels exceed this design range by 1 dB. A difference of 1 dB is considered negligible in most instances. MP1 was at the site boundary, in order to be free from screening form the site hoarding. The proposed amenity spaces are set further back, which would result in >1 dB drop in sound levels. This would be considered suitable form a planning perspective.

7.0 3D NOISE MODEL

7.1 Construction of a 3D noise propagation model has allowed for more detailed analysis, to assist designers with decisions on:

- Orientation of site buildings/structures;
- Orientation of internal spaces (habitable rooms);
- Alternate methods of ventilation;
- Suitability of private external amenity spaces in locations (such as balconies/gardens); and
- Suitable locations for shared external amenity spaces.

Construction and Calibration

7.2 The model was constructed using the supplied plans (Mole Architect's DWGs: 2102_A_999 to 2102_A_1004). Building heights were provided and the road which was noted to be the dominant noise source was introduced into the model. Topography was introduced using 21-010-1-Existing Topographical Survey (sec).

7.3 For calibration purposes, the proposed buildings were switched to 'off' and all the existing buildings were switched to 'on'. The model was then calibrated with the measurement locations to be within 1 dB of the measured levels.

Assessment

7.4 The model results show the predicted sound levels at each façade of the development and can therefore be used to inform orientation of internal spaces, façade constructions and ventilation strategies at each specific location. This is especially useful in circumstances where a building's façade overlooks a potentially significant noise source.

7.5 As it is generally accepted that a partially open window can afford up to a 15 dB reduction from external noise sources (depending on the open area), the following sections have compared the daytime and night-time internal noise level targets against the level outside – 15 dB:

Period	Internal Noise Level Limit	Reduction for a partially opened window	Maximum level at façade
Daytime	35 dB	15 dB	50 dB
Night-time	30 dB	15 dB	45 dB

Table 7.1: Qualification for Openable Windows

Acoustic Design Principles

7.6 Good acoustic design principles should be incorporated throughout the design stages. These would commonly include:

- Increasing distances between source and receiver (from the road to the building);
- Reorientation of habitable spaces (no living spaces on the noisy elevations);
- Introduction of screening (arranging site buildings/obstacles to screen residential units from the roads).

7.7 Following implementation of the principles listed above, if there are still predicted exceedances that would otherwise result in costly and less sustainable methods of mitigation (such as mechanical ventilation), it may be considered feasible to relax internal noise levels.

7.8 As quoted in Table 3.2 of this report, BS8233 states: *Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.*

7.9 in instances where the maximum level at the façade is exceeded by up to 5 dB (>55 dB daytime and >50 dB night-time), a discussion between the developer and local authority is encouraged to determine the viability relaxing internal noise levels targets for the most at risk parts of the development.

Model Results – Day and Night-time ambient sound levels

7.10 The following figures show the maximum predicted levels at the façade. The levels shown are both the day and night-time sound levels.

Site Area 1

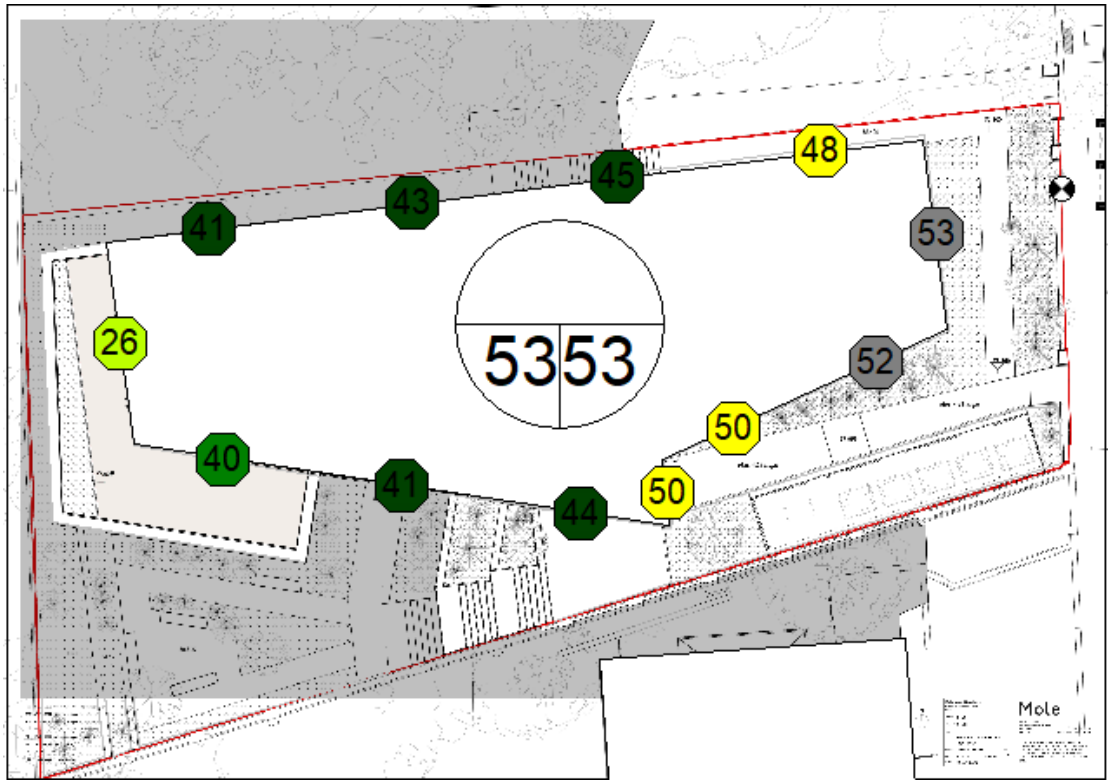


Figure 7.1: Day (≤ 50 dB) *[55 dB BS8233 Table 3.2]*

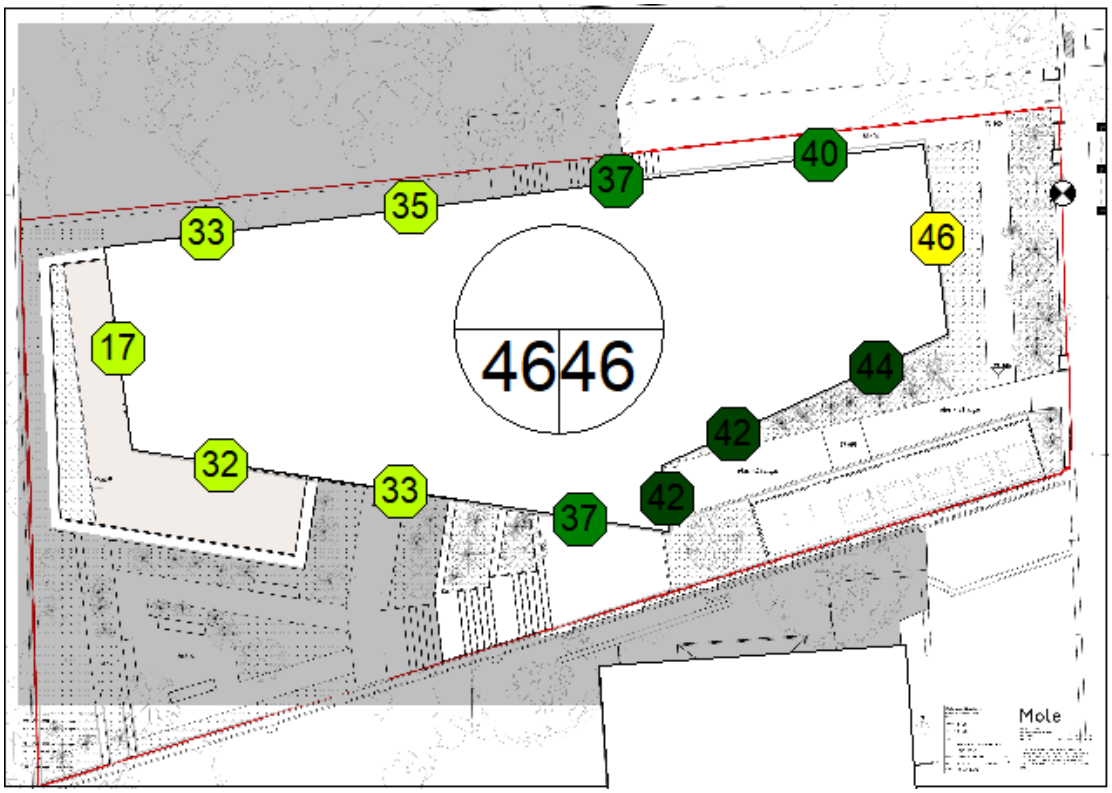


Figure 7.2: Night (≤ 45 dB) *[50 dB BS8233 Table 3.2]*

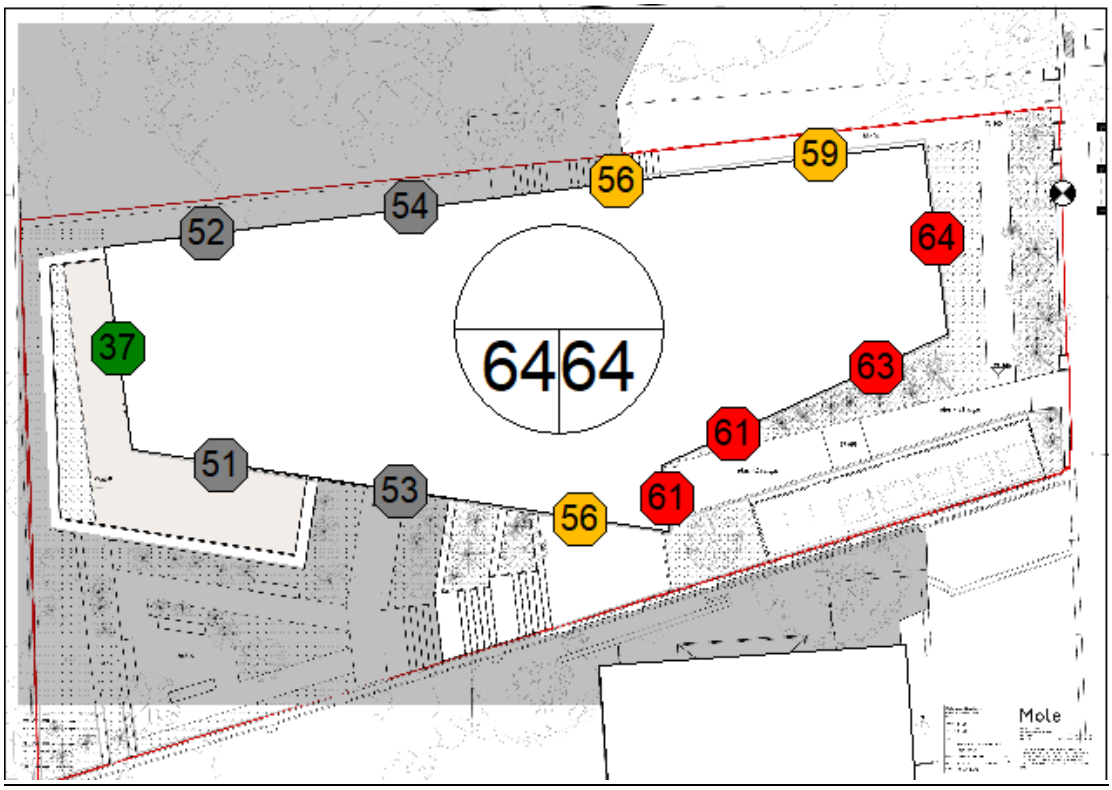


Figure 7.3: Night-time Max (≤ 60 dB) *[65 dB BS8233 Table 3.2]*

Façade Levels: Summary

7.11 Without relaxation of the criteria, the current plans show that a good internal acoustic environment can be achieved through a mix of forced and natural ventilation. The flat types have been shown to be identical through the floors, and so alternate ventilation would only need to be implemented for the flat overlooking the road. An example has been shown in the following figure, where flat 14 faces the road:

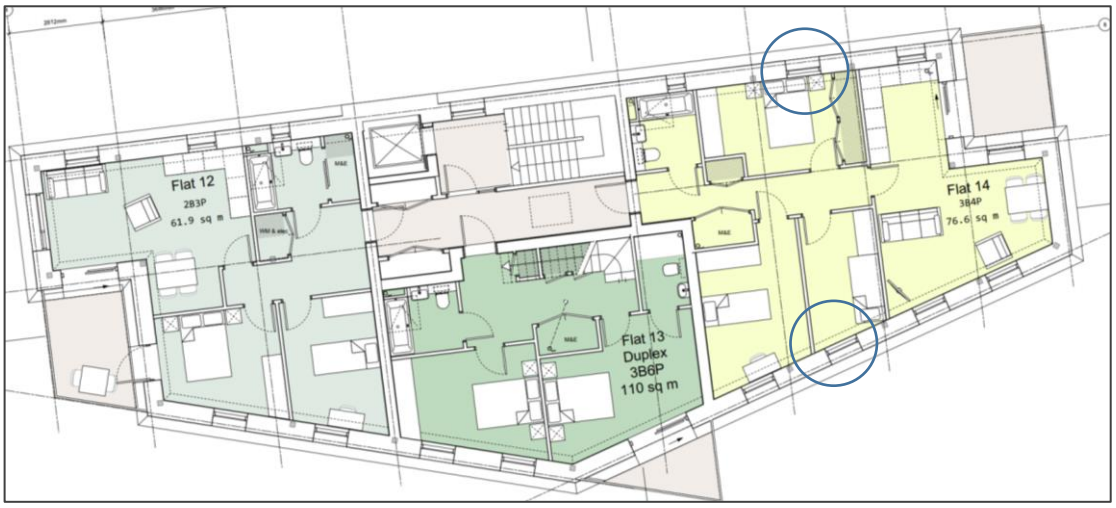


Figure 7.4: Example of Floor Plan

7.12 The most adversely affected room would be the living room of flat 14. The highest level of design exceedance was noted to be the night-time Max criteria (Figure 7.3). The night-time max criteria's purpose is for sleep disturbance, which has been modelled to be in 1 dB excess of the targets at the closest bedroom.

7.13 With consideration to the point above, and given the guidance provided in BS8233 and the marginal exceedance of the criteria, it may be considered feasible to relax the internal levels to reduce the need for less sustainable ventilation methods (such as MVHR).

7.14 The designs appear to show a good balance between acoustic design and use of space. The only openable aperture on the worst affected façade is to the living room, which is shown to be set back within a balcony, which in turn would provide additional screening from the road should a solid balustrade be installed (see Table 7.2).

7.15 Should the LPA and planners decide that forced ventilation is required, the resident should still be able to open their windows for purge ventilation at their discretion.

7.16 Should it be decided that the criteria can be relaxed to allow for natural ventilation, it is recommended that the windows on the worst affected façade hinge towards the road, to provide another degree of screening when in the open position.

Balcony and Apartment External Amenity Spaces (1st floor and above)

7.17 The levels at the facades provide a good indication of viability of uncovered private balconies. As the dominant noise sources was demonstrated to be the road, solid balustrades that break the line of sight between the source and receiver will afford a minimum of 5 dB reduction. The levels at the facades can therefore be interpreted as such:

Period	Amenity Space Noise Limits	Reduction for an obstructed line of sight (balustrade)	Maximum level at façade
Daytime	50-55 dB	5 dB	55-60 dB

Table 7.2: Qualification for Uncovered Balconies

7.18 Considering the highest predicted level at a façade with an inset balcony was 53 dB (daytime), this would be considered suitable for use as an external amenity space.

8.0 EXTERNAL PLANT NOISE

8.1 This section has provided the rated plant noise level for all external plant items associated within the development, that may impact upon the proposed or existing residences (for example, air source heat pumps).

Rating Level

8.2 The rating level is the specific sound level (the sound level of the source) plus any adjustment for the characteristic features of the sound at the assessment location (NSR), which include:

- Tonality
- Impulsivity
- Intermittency
- Other Sound Characteristics

Proposed Development: Rating Level

8.3 The rating level provided is the design threshold for all building services plant associated with the development.

8.4 It has been proposed that the rated level for residential dwellings be defined by the noise levels measured at MP1, which would be **37 dB $L_{Ar,Tr}$ Daytime and 32 dB $L_{Ar,Tr}$ Night-time** (Table 5.1). These are the levels not to be exceeded at any noise sensitive receptor, inclusive of any adjustments for characteristic features as listed above.

Plant Noise Assessment

8.5 The client has indicated that the only externally mounted plant equipment within the development area would be the 4 Air Source Heat Pumps (ASHP) mounted on the 4th floor roof:

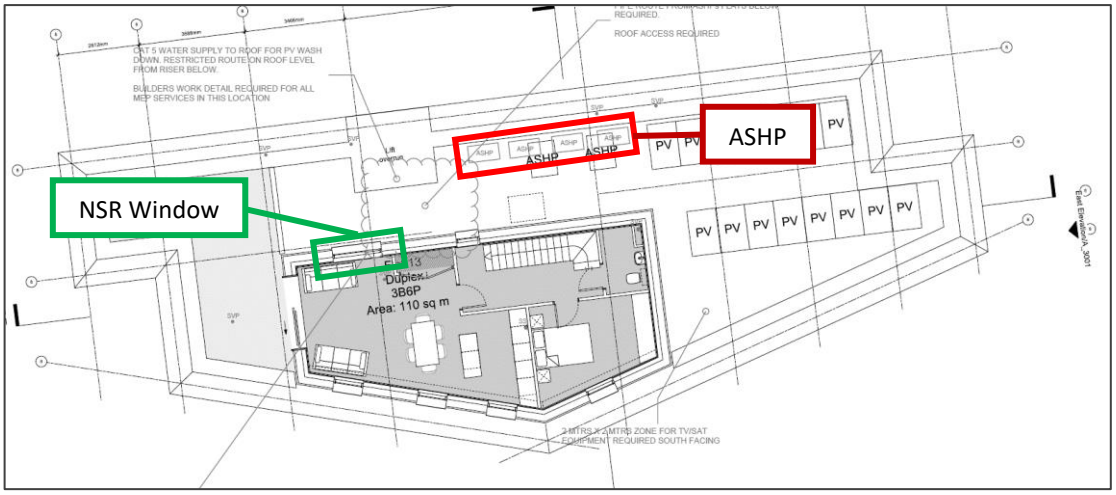


Figure 8.1: ASHP Locations

8.6 The proposed units were the MHI Ecodan PUZ-WM60VAA(-BS). The manufacturer's stated sound power level of these units was 58 dB L_{WA} with a sound pressure level of 45 dB L_{PA} at 1mtr (manufacturer data has been appended).

8.7 The units were introduced into the 3D noise model at the proposed locations shown on the drawing.

8.8 Without any mitigation, the resultant level at the NSR within the development (North window, living room, Flat 13 duplex) was noted to be 38 dB $L_{Aeq,T}$, which is 6 dB in excess over the night time rated sound level.

8.9 The units themselves would be sited behind the parapet wall, so would provide an element of acoustic screening to the school building to the north. The predicted sound level at the school building, the closest receptor to the north of the proposed development, would be 14 dB $L_{Aeq,T}$.

8.10 The client was consulted an agreed a noise barrier would be feasible, between the ASHP and the receptor. An L-Shaped barrier was introduced into the model, at a height of 1.8mtr.

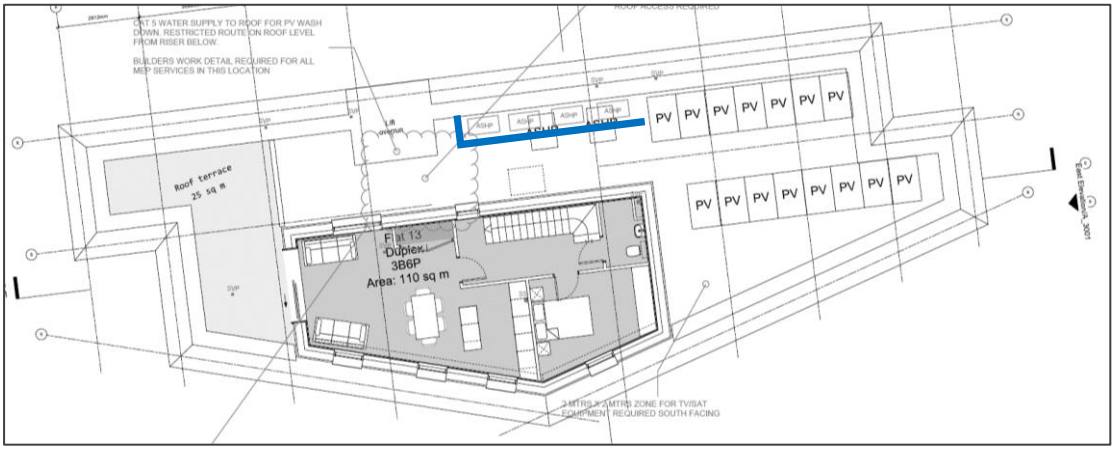


Figure 8.2: Barrier Location

8.11 With this, the level at the duplex unit was modelled to be 29.7 dB $L_{Aeq,T}$, which is 2.3 dB below the Rated level.

8.12 As ASHPs are inherently intermittent in their operation, a +3 dB correction should be applied, which would result in a specific level of 32.7 dB $L_{Aeq,T}$ at the north window of the duplex unit. This is a 0.7 dB increase over the residual background sound level, which would be considered negligible in subjective terms. BS4142:2014+A1:2019 states:

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

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

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

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. […]

8.13 With consideration to the above, the potential for adverse impact at the proposed development would be low. Should the developer wish to reduce the level of the ASHPs to below the existing background sound level, then an increase in the height of the barrier, to 2.0mtr would achieve this additional mitigation.

ASHP Barrier

8.14 The barrier should be full height, from roof floor to a minimum of 1.8mtr high and break the line of site to the assessment location (Duplex Flat 13 Living room Window).

8.15 It should be solid, and imperforate with a mass >12 kg/m^3. If possible, it should adjoin the parapet wall on the 'dog-leg' portion to limit sound diffraction to the top of the barrier, only.

8.16 Should the ASHP be mounted at distances of less than 1mtr from the parapet wall, the parapet's inner wall should be lined with acoustically absorbent media to reduce acoustic reflections which would otherwise have the potential to increase the sound levels at the Duplex unit.

9.0 SCHOOL

9.1 It has been noted that the neighbour to the north of the site, was Gloucester House School, which is a special education needs (SEN) school. The location has been shown in the following figure:

Figure 9.1: Gloucester House School

9.2 Over the survey period, it was noted that there were 3 hour periods which exceed 60 dB $L_{Aeq,1hr}$. Although these correlate to the school times (opening, lunch and closing), the audio recorded during these time periods appear to be people accessing the applicant's site and undertaking works.

Day/Date	Time	dB $L_{Aeq,T}$	dB $L_{A10,T}$	dB $L_{A90,T}$	dB L_{AFmax}
Wednesday 22/02/2023	08:00	62.4	65.1	49.5	93.9
	09:00	57.1	60.7	44.6	85
	10:00	55.4	57.7	44.6	76.8
	11:00	56.6	58.4	47	83.3
	12:00	66.9	69.5	49.6	94.6
	13:00	59.5	58.2	42.7	91.9
	14:00	54.3	57.1	46.8	76.4
	15:00	68.8	66.8	52.9	96
	16:00	58.8	63	45.8	79.7

Figure 9.2: Elevated Sound Levels

9.3 These higher levels were not present for Monday, Tuesday or Thursday, which further suggests that these increases were not related to the school.

9.4 As such, the survey data does not appear to show any significant contribution form this school, however there may be potential disturbances during the warmer months, should students spend more time outside/in the play area.

9.5 The plans don't show any private external amenity areas overlooking the school grounds, which is conducive to good acoustic design. There may still however be instances where children are heard internally should the occupants have their windows open, however in a built-up area, there is a certain amount of daytime noise that would be reasonably expected.

10.0 UNCERTAINTY

10.1 Every effort to minimise uncertainty has been made throughout this assessment, however certain factors of uncertainty inherent to environmental noise monitoring.

10.2 The location selected was both within the proposed site, and representative of the existing residential receptors.

10.3 Nearfield measurements were undertaken to determine how sound propagates throughout the site.

10.4 CadnaA noise modelling was used to minimise uncertainty further, which once calibrated was within 1 dB of the actual levels measured.

10.5 Manufacturer's data has been relied upon for the acoustic assessment of the plant noise from the ASHPs. Although it is preferred practice to use physical measurements of actual noise sources, this was not possible as these have not yet been installed. The manufacturer's data suggests that all sound measurements were conducted at a distance of 1m from the front of the unit at a height of 1.5m and that the sound power levels were determined in line with BS EN ISO 12102-1. Through the use of this British Standard, the uncertainty should be reduced.

11.0 CONCLUSIONS

11.1 Create Consulting Engineers Ltd has undertaken a baseline noise survey and outline assessment for the proposed development located at 31 Daleham Gardens.

11.2 A baseline sound survey was undertaken from 20th to 23rd February 2023

11.3 Based on the survey data, internal noise levels can be achieved with windows closed using standard construction techniques and double glazing. The maximum performances have been provided.

11.4 Most of the development area was suitable for natural ventilation. These areas can be increased through good acoustic design. Guidance on which has been provided in Chapter 8.

11.5 As this project is still outline, it is recommended that designers, the LPA and a suitably qualified acoustician discuss mitigative measures to improve the acoustic conditions on site post construction, and reduce the need for less sustainable mitigative strategies.

11.6 External amenity areas have been preliminarily assessed and shown to be within the design targets of BS 8233 with some conscientious design and mitigation.

11.7 A rated level for all plant equipment located on the proposed site has been provided and is 37 dB $L_{Ar,Tr}$ for daytime and 32 dB $L_{Ar,Tr}$ for the night-time periods.

11.8 The proposed plant equipment has been assessed and has been found to have a negligible potential for adverse impact. The level at the closest existing receptor was calculated to be 18 dB below the residual background.

11.9 The site has been demonstrated as suitable for residential development.

11.10 Construction noise and vibration should be considered prior to undertaking the works given the close proximity to the school and other residential properties. However, this is not relevant to this noise impact assessment.

11.11 The NPPF has been satisfied in so much as the development would avoid noise from giving rise to adverse impacts on health and quality of life. The NPSE also requires that effective management of noise should be used to promote good health and a good quality of life.

11.12 On the basis of this assessment and the proposed acoustic strategy for the scheme, we are of the opinion that the scheme design should not impede any decision to grant permission for the development of this project, from an acoustical perspective.

12.0 DISCLAIMER

12.1 Create Consulting disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report.

12.2 The copyright of this report is vested in Create Consulting Engineers Ltd and Mole Architects. The Client, or his appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or Mole Architects.

12.3 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

APPENDICES

APPENDIX A

Glossary of Acoustic Terminology

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter can be used to duplicate the ear's variable sensitivity to sound across a spectrum of frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the average ear. This is called an "A-weighting filter". Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

$L_{eq,T}$

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period (T).

$L_{10,T}$

This is the minimum level exceeded for not more than 10% of the time period (T). This parameter is often used as a "not to exceed" criterion for noise.

$L_{90,T}$

This is the minimum level exceeded for not more than 90% of the time period (T). This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{fmax}

This is the maximum sound pressure level that has been measured over a period using a fast time constant.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combine, on a logarithmic scale, to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 3 identical sources produce a 5dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g., stream of cars) drops off by 3dB for each doubling of distance.

Sound Exposure Level (SEL)

This is the level at the reception point which, if maintained constant for a period of 1 second, would cause the same A weighted sound energy to be received as is actually received from a given noise event. The SEL is used to categorise and quantify the noise generated by individual railway vehicles and individual trains. As such, it serves as a "building block" to determine the L_{Aeq} for the total flow of trains over a given time period.

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.

APPENDIX B

National Planning Policy

National Planning Policy

National Planning Policy Framework (July 2021)

The National Planning Policy Framework (NPPF) replaces the previous version of the NPPF and the Planning Policy Statements (PPS) and Planning Policy Guidance (PPG), including the Department of the Environment's Planning Policy Guidance Note 24: 'Planning and Noise' (PPG 24), which was published in 1994. The main reference to noise within the latest version of the NPPF is at Paragraphs 174 (e) and 185:

'Para.174 (e). "Planning policies and decisions should contribute to and enhance the natural and local environment by:

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability."

'Para.185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

(a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life65;

(b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.; and

(c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.'

The reference number 65 cross references the National Policy Statement for England (NPSE)

Explanatory Note. Although some qualitative guidance on noise has been provided in the web-based Planning Practice Guidance document, there has been no alternative quantitative guidance proposed by the Government as a direct replacement for PPG24. This was due to the recognition that every site is different and that there is no single acceptable noise level, suitable for all applications.

National Planning Policy Guidance (2019)

On 6th March 2014, the Department for Communities and Local Government (DCLG) launched the National Planning Practice Guidance (NPPG) web-based resource to supersede previous planning guidance documents including PPG24 and provide clarification over all disciplinary sectors in the delivery of the design quality aspirations of the NPPF. This has been updated in July 2019.

The NPPG-Noise provides guidance on the assessment of noise, the needs to be considered when new developments may create additional noise and when developments would be sensitive to the prevailing acoustic environment.

The acoustic environment should be taken into account in the planning of new development and decision making should take the following into consideration:

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

It then cross-references the Noise Policy Statement for England (2010) for further clarification on how to assess the overall effect of noise exposure.

The Noise Policy Statement for England (2010)

The Noise Policy Statement for England (NPSE) was published in March 2010 and is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long-term vision of Government noise policy which is to:

> 'Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.'

The vision is supported by the following aims which are reflected in paragraph 1.7 of the Noise Policy Statement for England:

'Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *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 improvement of health and quality of life.'*

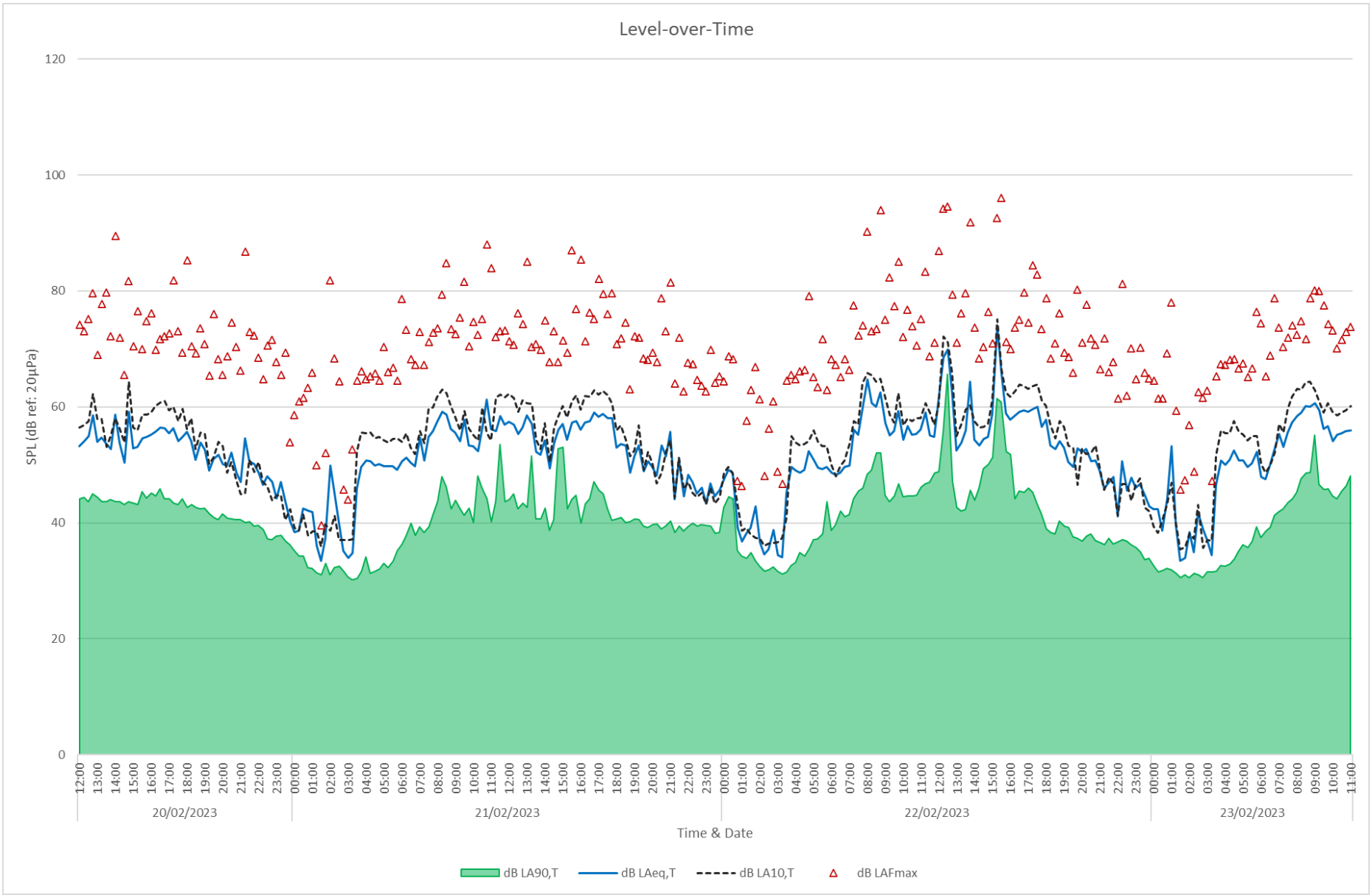
The Explanatory Note to the NPSE introduces three concepts to the assessment of the potential effects of noise:

- *'NOEL – No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
- *LOAEL – Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected.*
- *SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.'*

Unlike the now redundant PPG24, the three levels are not defined numerically in the NPSE, and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent a SOAEL for noise is acknowledged and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

APPENDIX C

Survey Results


Level-over-Time
120
100
80
60
40
20
0
SPL (dB ref: 20µPa)
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
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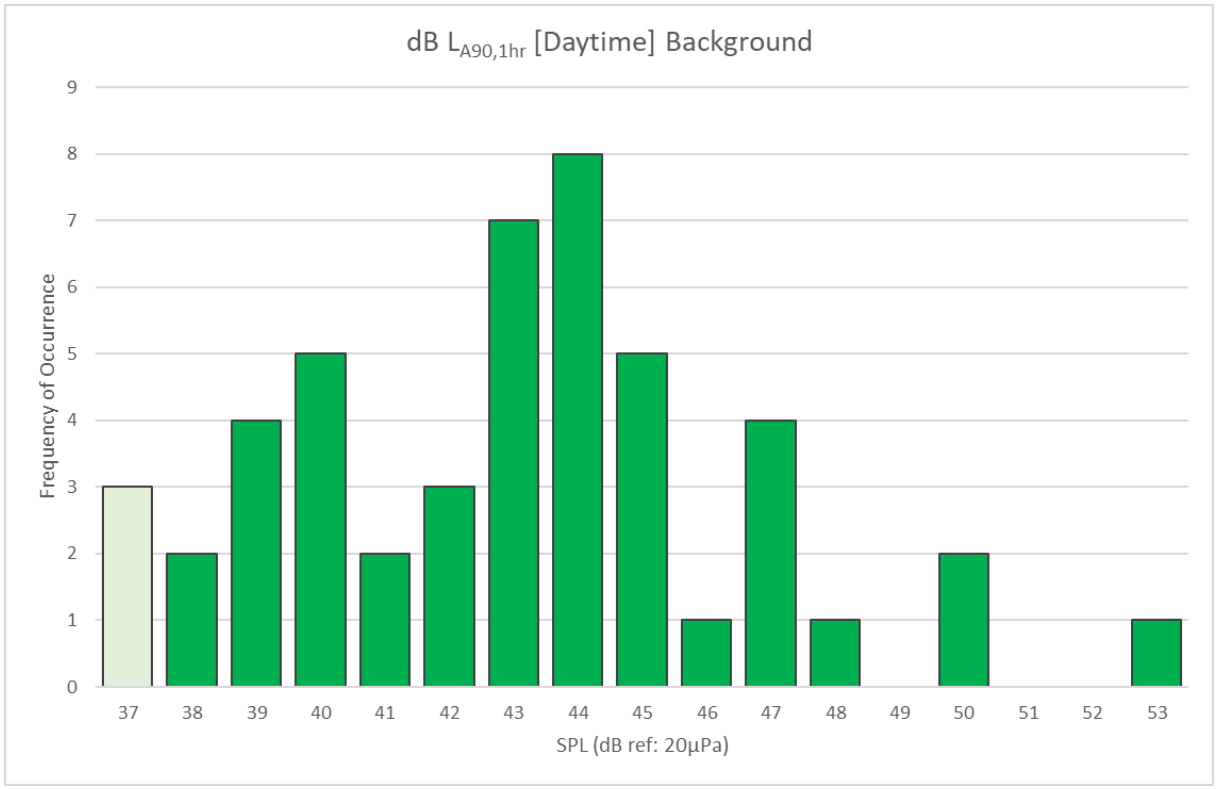
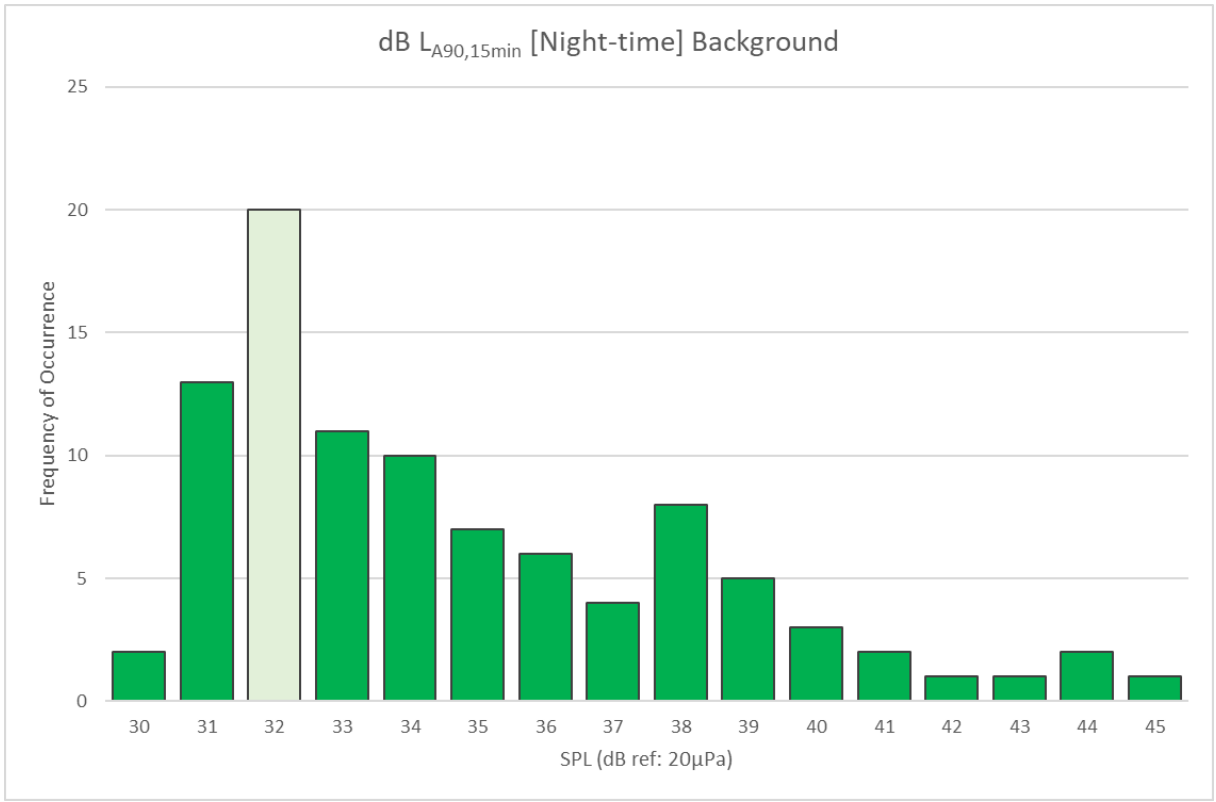
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
20/02/2023
21/02/2023
22/02/2023
23/02/2023
Time & Date
dB LA90,T
dB LAeq,T
dB LA10,T
dB LAFmax

APPENDIX D

Analysis of Survey Results


dB $L_{A90,1hr}$ [Daytime] Background
Frequency of Occurrence
0
1
2
3
4
5
6
7
8
9
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
SPL (dB ref: 20µPa)

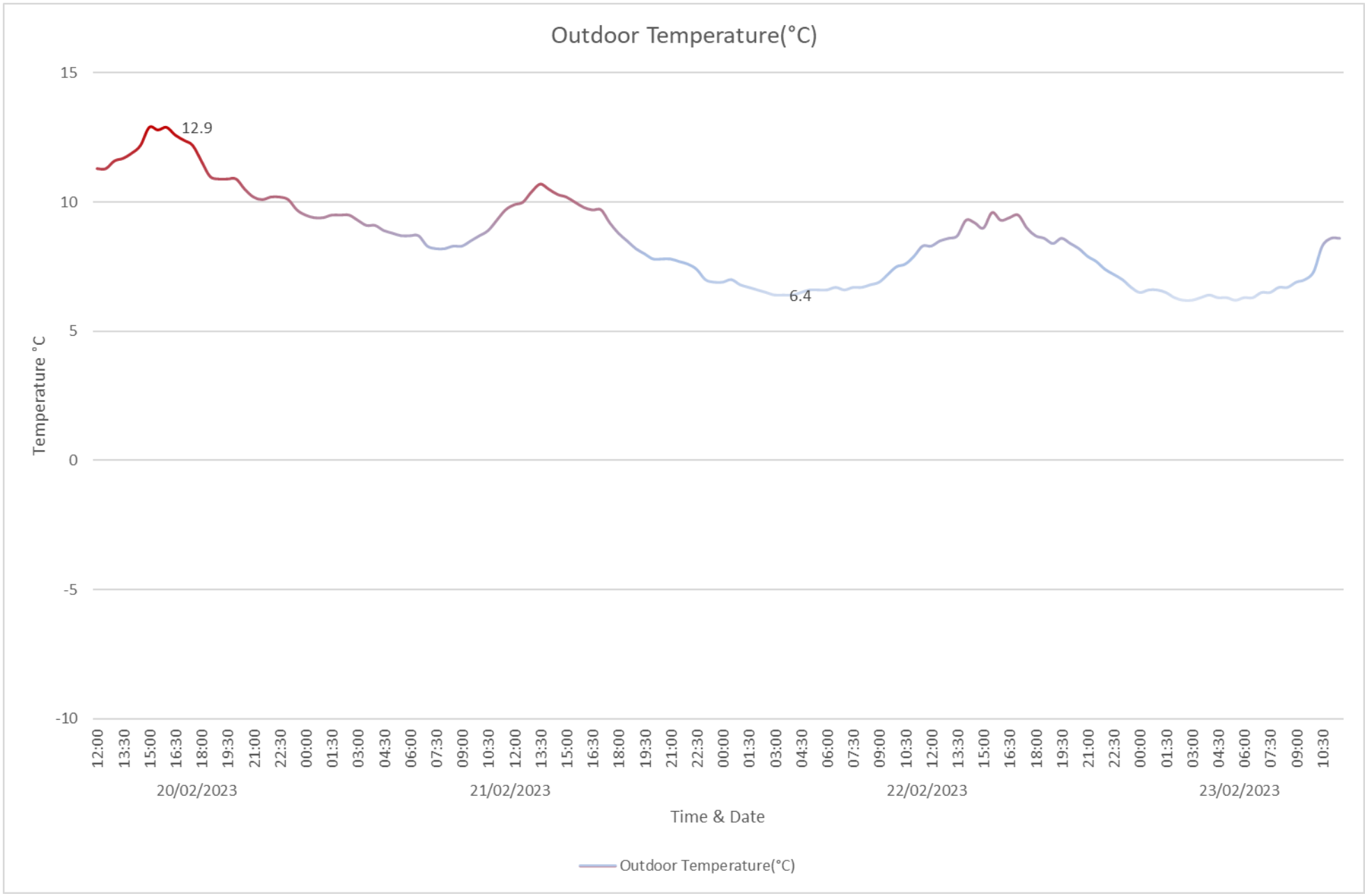

dB $L_{A90,15min}$ [Night-time] Background
Frequency of Occurrence
0
5
10
15
20
25
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
SPL (dB ref: 20µPa)

Order	20-21/02/2023		21-22/02/2024		22-23/02/2025	
	dB L_{AFmax}	Time of Max	dB L_{AFmax}	Time of Max	dB L_{AFmax}	Time of Max
1st	81.9	02:13:39	79.1	04:57:18	78.8	06:50:40
2nd	78.6	06:01:32	71.7	05:31:57	78	01:14:12
3rd	73.3	06:20:20	69.8	23:24:19	76.4	05:46:19
4th	70.4	05:08:44	68.8	00:23:44	74.4	06:11:17
5th	69.3	23:39:34	68.6	23:22:42	72.4	01:12:37
6th	68.4	02:19:55	68.3	00:44:00	70.2	23:20:57
7th	68.3	06:41:32	68.2	06:13:13	70.1	06:58:39
8th	67.9	06:28:47	68.2	06:53:20	69.6	01:07:38
9th	67.8	23:14:54	67.4	06:47:49	69.2	00:50:48
10th	67.2	06:50:52	67.3	06:22:03	68.9	06:40:34
11th	67	06:08:20	67.2	06:15:02	68.3	04:39:16
12th	66.8	05:37:42	66.9	01:45:57	68.1	04:21:22
13th	66.6	06:46:02	66.8	00:43:59	68.1	04:36:11
14th	66.2	03:59:03	66.4	04:41:43	68.1	05:56:20
15th	66.2	06:16:06	66.1	04:28:38	68	06:13:59
16th	66	03:57:35	66.1	05:38:48	67.9	05:58:12
17th	66	05:21:29	65.5	03:47:56	67.9	06:14:00
18th	65.9	01:11:07	65.4	04:42:31	67.5	05:10:18
19th	65.9	05:38:19	65.3	23:55:05	67.5	05:51:56
20th	65.8	04:37:10	65.2	05:41:49	67.4	03:49:10

Day/Date	Time	dB $L_{Aeq,T}$	dB $L_{A10,T}$	dB $L_{A90,T}$	dB L_{AFmax}
Monday 20/02/2023	12:00	55.7	59.5	44.1	79.6
	13:00	53.9	56.3	43.8	79.7
	14:00	56.8	58.9	43.5	89.5
	15:00	54	57.8	43.7	76.5
	16:00	56	60.2	44.8	76.1
Tuesday 21/02/2023	08:00	58	62.1	44.5	84.8
	09:00	55.5	57.6	42.5	81.6
	10:00	57.4	56.2	43.5	88
	11:00	57	61.2	42.3	83.9
	12:00	56.6	61.4	43.5	76.1
	13:00	55.9	59	41.9	85.1
	14:00	54	57	40.1	74.9
	15:00	56.7	60.6	44.1	87
	16:00	57.6	61.9	43.1	85.4
Wednesday 22/02/2023	08:00	62.4	65.1	49.5	93.9
	09:00	57.1	60.7	44.6	85
	10:00	55.4	57.7	44.6	76.8
	11:00	56.6	58.4	47	83.3
	12:00	66.9	69.5	49.6	94.6
	13:00	59.5	58.2	42.7	91.9
	14:00	54.3	57.1	46.8	76.4
	15:00	68.8	66.8	52.9	96
	16:00	58.8	63	45.8	79.7
Thursday 23/02/2023	08:00	59.4	63.7	47.3	78.7
	09:00	58.7	61.3	46.5	80.1
	10:00	55.2	59	45	73.2
	11:00	56	60.1	48.1	73.8

APPENDIX E

Weather Results


Outdoor Temperature(°C)
15
10
5
0
-5
-10
Temperature °C
12.9
6.4
12:00
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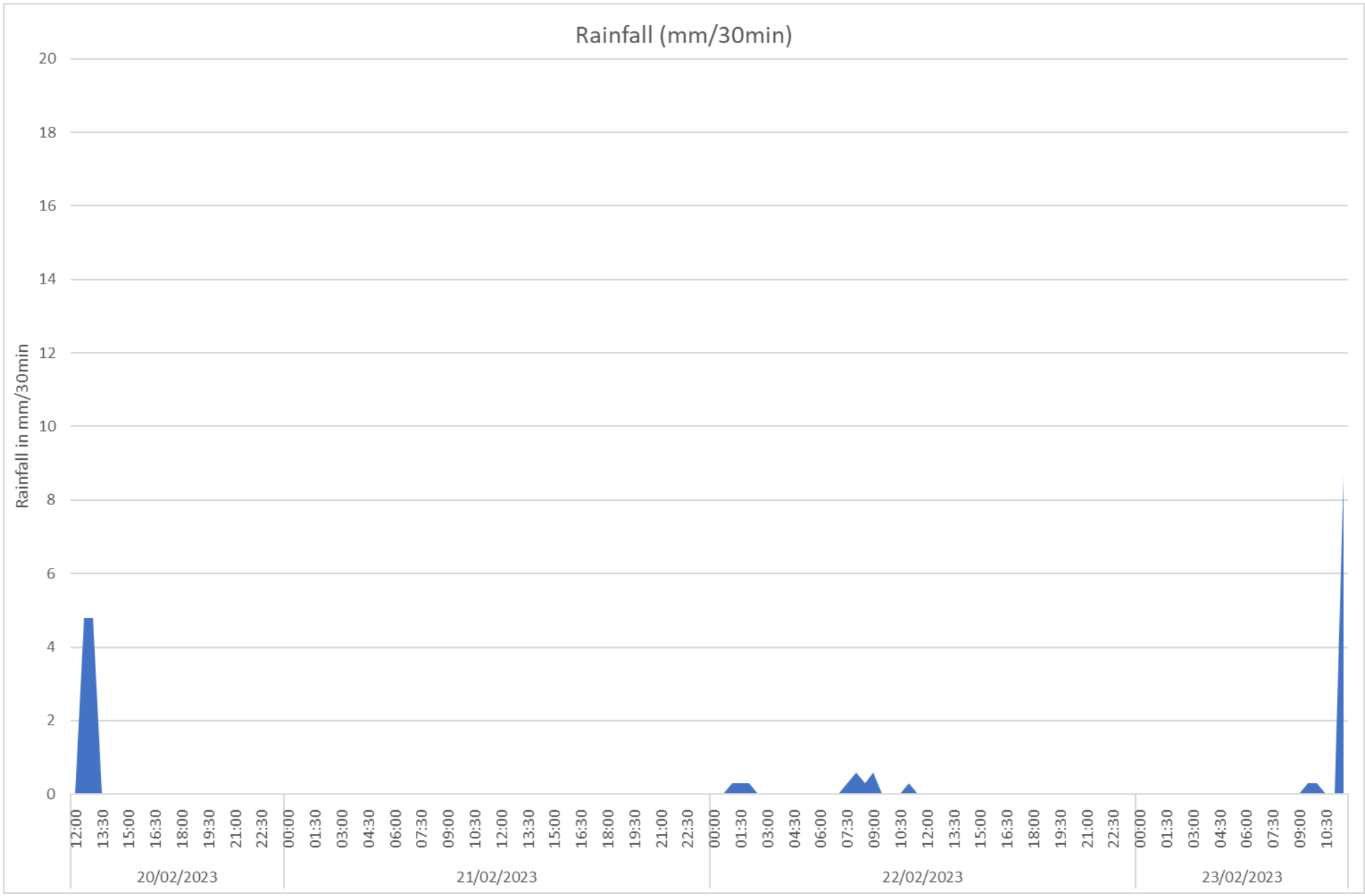
19:30
21:00
22:30
00:00
01:30
03:00
04:30
06:00
07:30
09:00
10:30
20/02/2023
21/02/2023
22/02/2023
23/02/2023
Time & Date
Outdoor Temperature(°C)


Rainfall (mm/30min)
Rainfall in mm/30min
20
18
16
14
12
10
8
6
4
2
0
12:00
13:30
15:00
16:30
18:00
19:30
21:00
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01:30
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19:30
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01:30
03:00
04:30
06:00
07:30
09:00
10:30
20/02/2023
21/02/2023
22/02/2023
23/02/2023

APPENDIX F

Survey Equipment Details

Equipment No.	Equipment	Make/Model	Certification	
45 (MP1)	Class 1 Sound Level Meter	Norsonic 140 RTA	Serial Number	
			1403342	
			Cert No.	
			U38304	
			Calibration Date	
			01/07/2021	
	Preamplifier	Gras 26AK	Serial Number	
			79811	
			Cert No.	
			82555	
			Calibration Date	
			29/07/2021	
	Microphone	Gras-40AS	Serial Number	
			1255.96162	
			Cert No.	
			79811	
			Calibration Date	
			29/07/2021	
	Calibrated Level Before:	**113.9**	**Sens**	-
	Calibrated Level After:	114.5	**Sens**	-

APPENDIX G

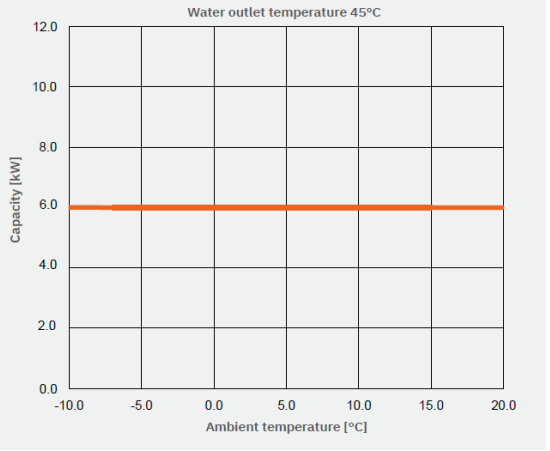
Manufacturer Data

Heating | **Product Information**

PUZ-WM60VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT		PUZ-WM60VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	142%
	SCOP (MCS)	3.57
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	190%
	SCOP (MCS)	4.81
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	6.0
	Power Input (kW)	1.88
	COP	3.20
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)	22
	Flow Rate (l/min)	17
	Water Pressure Drop (kPa)	8.0
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	5.68 [13]
	Fuse Rating - MCB Sizes (A)*6	16
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

NOMINAL HEATING CAPACITY



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

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

PUZ-WM112VAA.UK
PUZ-WM112YAA.UK

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