
Noise Impact Assessment

Proposed Residential Development – Dye House, Prescott

Client: Group D Developments Limited

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EXECUTIVE SUMMARY

This Assessment has shown that noise levels in garden areas do not exceed 55dB $L_{Aeq,16hr}$ following installation of an acoustic barrier on the Site boundary with the A58 and Liverpool Rd at varying height, combined with acoustic barriers between individual gardens.

This Assessment has shown that standard thermal double glazing will be adequate for all living rooms and bedroom across the Development in order to meet the internal target noise criteria levels. With an open window however, various living room and bedroom plots exceed the internal target noise criteria and so alternative ventilation has been recommended. In addition, this Assessment has recommended that any bedroom window located within a certain distance of Liverpool Road and the A58, with either full or partial line of sight to the roads, is fitted with alternative ventilation in order to control maximum noise levels produced by road traffic movements.

This Assessment has set mechanical and electrical plant noise emission limits for the proposed pumping station. The noise limits should not be exceeded at the closest proposed residential dwellings.

Should the recommended noise mitigation measures be implemented in order to control external noise levels for gardens and internal noise levels in habitable rooms, then the sound climate which future occupiers of the Development will be exposed to will accord with the 'No Observed Adverse Effect Level' as detailed in the PPG and as such, noise should not be deemed to be a determining factor in the granting of planning permission for this Site.

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1 INTRODUCTION

1.1 Appointment

1.1.1 Professional Consult Limited was instructed by Group D Developments Limited ('the Applicant'), to prepare a Noise Impact Assessment ('the Assessment') for a proposed residential development ('the Development') on a parcel of land located at Dye House on Liverpool Road in Prescot, Merseyside, L34 3LX to be referred to hereafter as 'the Site'.

1.2 The Development

1.2.1 It is understood that proposals include for the development of 45 residential dwellings and associated works including a pumping station.

1.3 Site & Locality

1.3.1 To the north and east of the Site lies a new residential development currently under construction and to the south and west lies Liverpool Road and the A58 respectively.

1.3.2 The sound climate across the Site is comprised largely of noise from road traffic using Liverpool Road and the A58. During the course of the noise survey there was intermittent noise associated with the residential development to the north and east however noise measurements for the Development have been completed in such a way that construction noise has not interfered with the measured noise levels.

1.4 Purpose of Assessment

1.4.1 This Assessment has been undertaken to identify the key sources of noise surrounding the Site which may adversely impact upon the proposed residential amenity. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.

1.4.2 All acronyms used within this report are defined in the Glossary presented in Appendix 2.

1.5 Limitations

1.5.1 The limitations of this report are presented in Appendix 1.

1.6 Confidentiality

1.6.1 Professional Consult has prepared this report solely for the use of the Client. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Professional Consult; a charge may be levied against such approval.

2 POLICY & GUIDANCE

2.1 National Planning Policy Framework & National Planning Practice Guidance

- 2.1.1 The Government updated the National Planning Policy Framework (NPPF) on 19th February 2019 and its associated National Planning Practice Guidance (NPPG) on 22nd July 2019. Together, the NPPF and NPPG set out what the Government expects of local authorities. The overall aim is to ensure the planning system allows land to be used for new homes and jobs, while protecting valuable natural and historic environments.
- 2.1.2 The NPPG adds further context to the NPPF and it is intended that the two documents should be read together.
- 2.1.3 Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.
- 2.1.4 Local planning authorities' plan-making and decision making should take account of the acoustic environment and in doing so consider:
- ② Whether or not a significant adverse effect is occurring or likely to occur;
 - ② Whether or not an adverse effect is occurring or likely to occur; and
 - ② Whether or not a good standard of amenity can be achieved.
- 2.1.5 In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.
- 2.1.6 The Observed Effect Levels are as follows:
- ② Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
 - ② Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
 - ② No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.
- 2.1.7 Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1. Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
<i>Lowest Observed Adverse Effect Level</i>			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
<i>Significant Observed Adverse Effect Level</i>			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.1.8 The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

2.1.9 These factors include:

- ② The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day - this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- ② For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- ② the spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

2.1.10 More specific factors to consider when relevant:

- ② where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- ② Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on

windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations; and

- ② If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’

Noise Criteria Limits

- 2.2.1 The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.
- 2.2.2 The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 2.

Table 2. BS8233:2014 Internal Target Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom*	30

*For a Reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not exceed 45dB L_{max}

- 2.2.3 BS8233 goes on to recommend noise levels for gardens as follows:

“It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted”.

- 2.2.4 BS8233 goes on to say:

“In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited”.

- 2.2.5 With regards to external noise within balcony areas, BS8233: 2014 provides the following advice:

“Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels”

Ventilation Requirements

- 2.2.6 Where a partially open window cannot be relied upon to provide an adequate level of facade sound insulation performance, it is necessary to consider alternative ventilation for habitable rooms. Section 8.4.5.4 within BS8233 states:

“The Building Regulations’ supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice.

Alternatively, acoustic ventilation units (see 7.7.2 below) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans.”

Section 7.7.2 states:

“NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.”

2.3 Knowsley Metropolitan Borough Council’s Environmental Health Department

- 2.3.1 Professional Consult issued the following consultation to Knowsley Metropolitan Brough Council on 18th May 2021:

We have been appointed by a client to complete a Noise Impact Assessment for a proposed residential development on the parcel of land currently occupied by Dye House on Liverpool Road in Prescott, Merseyside L34 3LX. The Site is bound by Liverpool Rd to the south, the A58 to the west with the M57 beyond and new residential development being constructed to the north and west.

Professional Consult have completed a road traffic noise survey on the Site, in line with the procedure detailed in Calculation of Road Traffic Noise, for Liverpool Road which was the dominant noise source adjacent to the Site boundary.

Professional Consult will complete the following assessment:

Road Traffic Noise: An assessment will be completed in line with the guidance presented in BS8233:2014 whereby internal noise level in living rooms will not exceed 35dB LAeq,16hr and in bedrooms will not exceed 30dB LAeq,8hr / 45dB LAmx,fast. With regards to any outdoor amenity areas (gardens), it is proposed that noise levels will achieve the lowest practicable levels as detailed at section 7.7.3.2 of BS8233:2014, which is applicable to development in areas lying adjacent to strategic transport networks in urban areas. Nevertheless, noise mitigation will be put in place wherever possible with a view to achieving 55dB LAeq,16hr which is the same approach employed for the Whitefield Drive project.

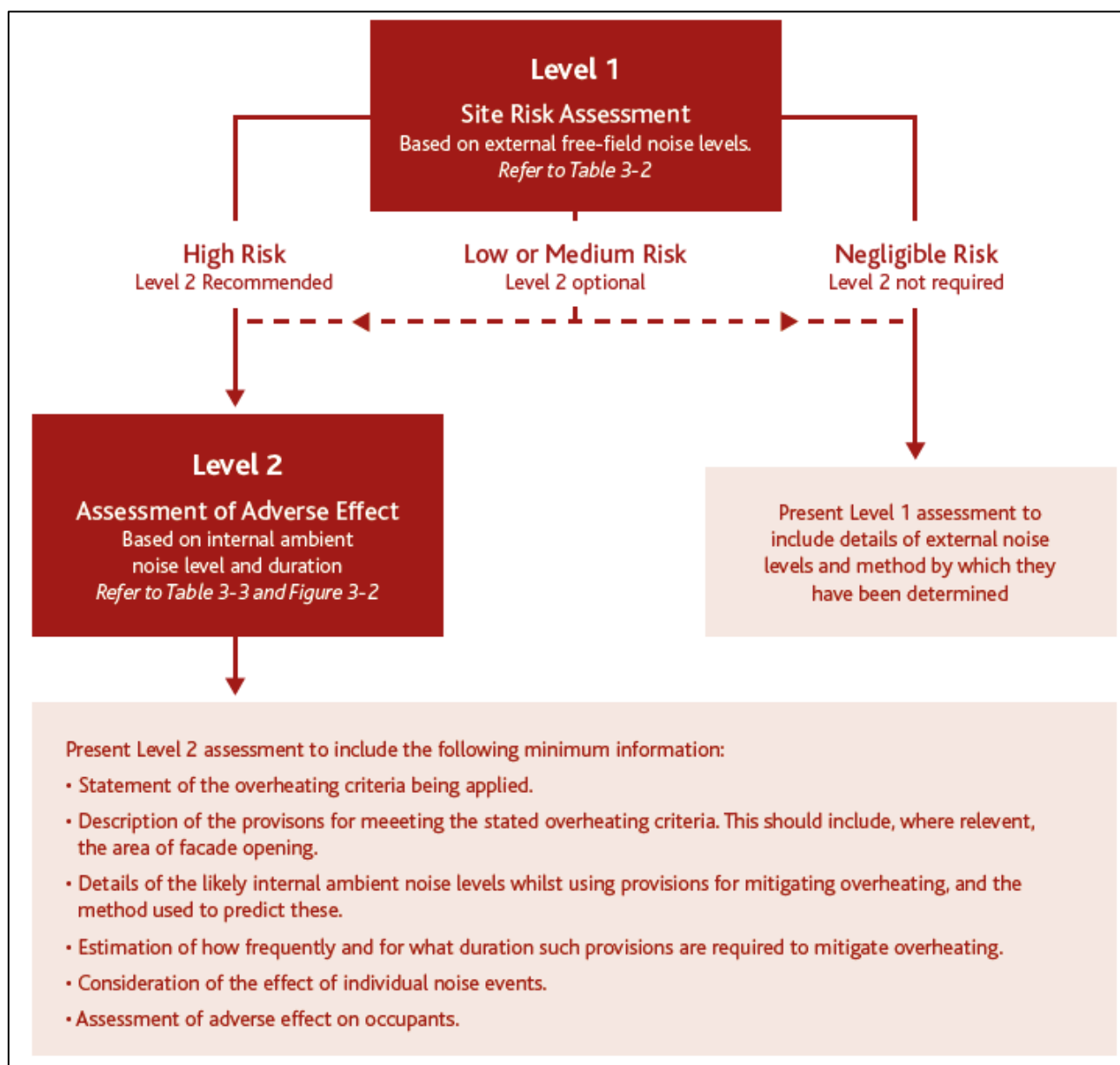
We will issue to the client a Noise Impact Assessment suitable for submission alongside the scheme planning application.

Please advise if you have any specific noise criteria that you wish for us to adhere to.

- 2.3.2 At the time of issuing this report, no response had been received.

2.4 INSTITUTE OF ACOUSTICS AND ASSOCIATION OF NOISE CONSULTANTS (2020) ACOUSTICS VENTILATION & OVERHEATING: RESIDENTIAL DESIGN GUIDE

2.4.1 The Acoustics Ventilation and Overheating (AVO) Residential Design Guide provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed. The AVO Guide aims to assist designers to adopt an integrated approach to the acoustic design within the context of the ventilation and thermal comfort requirements. The AVO Guide provides a method for assessing the impact of opening windows and providing whole house ventilation due to the impact of noise via a two-level noise assessment procedure, as below:



2.4.2 A level 1 risk assessment is based on external free-field noise levels with the assumption of a partially opened window in use for mitigation of overheating. A level 1 assessment is appropriate for scenarios where the risk to a development is deemed 'Negligible'. 'Low' and 'Medium' risk sites only require a level 2 assessment on an optional basis in order to give further confidence in the suitability of internal noise conditions.

2.4.3 The noise levels suggested in Tables 3 and 4 assume steady road traffic noise source but can be adapted for other transport sources.

Table 3. Guidance for Level 1 Site Risk Assessment for Transportation Noise Sources Relating to Overheating Condition

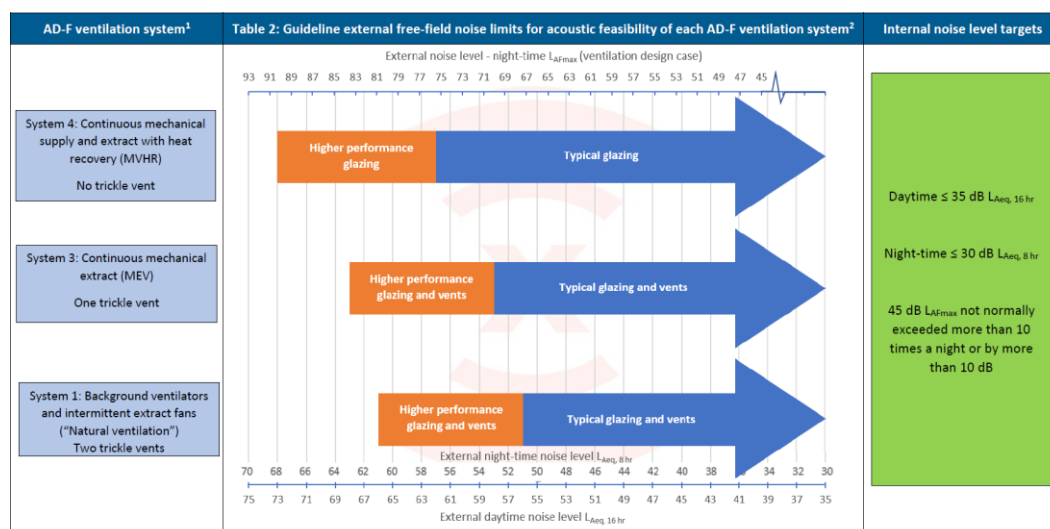
Risk Category for Level 1 Assessment - External		Risk Level	Potential Effect Without Mitigation	Recommendation for Level 2 Assessment
Daytime Noise Level, $L_{Aeq,t}$ (07:00 – 23:00)	Night-time Noise Level, $L_{Aeq,t}$ (23:00 – 07:00)			
≥ 65 dB	≥ 55 dB	High	Increasing risk of adverse effect	Recommended
> 55 dB & < 63 dB	> 45 & < 55 dB	Medium		Optional
> 50 dB & < 55 dB		Low		
≤ 50 dB	≤ 45 dB	Negligible	Use of opening windows as means of mitigating overheating is not likely to result in in adverse effect	Not required

2.4.4 A level 2 assessment will be carried out when the risk of adverse effect is 'High' or it is deemed appropriate for a 'low' or 'medium' risk site. An increase in internal ambient noise level can cause a change in human behaviour. At high levels this creates situations where occupants can no longer open windows for ventilation due to high external noise levels. A level 2 assessment identifies these situations and allows for appropriate alternative ventilation systems to be recommended.

Table 4. Guidance for Level 2 Assessment of Noise from Transport Noise Sources Relating to Overheating Condition

Internal Ambient Noise Level			Example of Outcome
Daytime $L_{Aeq,t}$ (07:00 – 23:00)	Night-time $L_{Aeq,t}$ (23:00 – 07:00)	Individual Noise Events During 23:00 – 07:00	
> 50 dB	> 42 dB	Normally exceeds 65dB $L_{A,f,max}$	Noise causes a material change in behaviour eg. having to keep windows closed most of the time
Increasing noise level			Increasing the likelihood of impact on reliable speech communication during the daytime or sleep disturbance at night

2.4.5 The Table below details guideline external free-field noise limits and determines the appropriate AD-F ventilation system (Systems 1 – 4).



2.4.6 This approved document supports Part O of Schedule 1 to the Building Regulations 2010 and took effect on 15th June 2022 for use in England.

2.4.7 Section 3 of the approved document details the requirements for noise ingress into a bedroom and states the following:

'In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. 40dB $L_{Aeq,T}$ averaged over 8 hours (between 11pm and 7am); and*
- b. 55dB L_{AFmax} more than 10 times a night (between 11pm and 7am).'*

2.4.8 The above internal noise criteria levels are higher than those presented in BS8233:2014 and so the trigger point for alternative ventilation for bedrooms, where required, will be dictated primarily by the assessment which considers compliance with the BS8233:2014 internal noise criteria levels. Nevertheless, compliance with the above noise criteria levels will be observed where the internal average and maximum noise levels with a partially open window, or where recommended appropriate alternative ventilation for the bedroom, results in noise levels not exceeding the above noise criteria levels.

2.4.9 The 'night-time façade noise levels' presented in the rear of this Assessment includes an assessment confirming whether compliance is achieved with the above average noise criteria level presented in the approved document. The 'Mitigation' section of this Assessment considers the maximum noise levels and whether compliance is achieved.

3 NOISE SURVEYS

3.1 Survey Information

3.1.1 A road traffic noise survey has been completed for Liverpool Road however it was not possible to complete a road traffic noise survey for the A58 due to the presence of a piling rig on the adjacent residential development to the north. The piling rig was generating high levels of intermittent noise which would have interfered with the road traffic noise measurement. It should be noted the piling rig was not audible at the microphone location for the Liverpool Road noise measurement. As such, this Assessment has relied upon a Noise Impact Assessment prepared by Hepworth Acoustics for an adjacent residential development (Application reference: 19/00684/FUL - ERECTION OF 227 NO. DWELLINGS).

3.1.2 A background sound survey has been completed in the centre of the Site and noise from the drilling rig on the adjacent site was audible during the daytime period with operations ceasing at 16:30. As such, the background sound level for the evening period has been taken as the daytime background sound level and the night-time background sound level is taken as-is.

3.2 Road Traffic Noise Survey – Liverpool Road

3.2.1 Professional Consult has completed noise measurements as follows:

② Noise Measurement Position 1: Located 5m from the nearside kerbstone of Liverpool Road in free-field conditions. Noise sources at the measurement position comprised of road traffic movements along Liverpool Road.

3.2.2 Table 5 summarises the measured road traffic noise levels at the microphone location.

Table 5. Summary of Measured Road Traffic Noise Levels

Table 3: Summary of Measured Road Traffic Noise Levels				
Measurement Position	Period	Measured Sound Pressure Level (dB)		
		L _{Aeq,1hr}	L _{A10,1hr}	L _{Amax,fast} *
1	12/05/2021 10:10	68.1	71.7	79.8
	12/05/2021 11:10	68.1	72.1	
	12/05/2021 12:10	68.4	71.8	
*10 th highest L _{Amax,fast}				

3.3 Background Sound Survey

3.3.1 Professional Consult has completed a background sound survey as follows:

② Measurement Position 2: Located in the centre of the Site in free-field conditions. Noise sources at the measurement position comprised of road traffic movements along Liverpool Road and intermittent noise from a drilling rig on an adjacent site during the daytime period.

3.3.2 Table 6 summarises the measured background sound levels at the microphone location.

Table 6. Summary of Measured Background Sound Levels

Measurement Position	Period	Range of Measured Background Sound Levels, $L_{A90,15\text{mins}}$ (dB)	Calculated Typical (Mode) Background Sound Level, $L_{A90,15\text{mins}}$ (dB)
NMP2	Daytime (07:00 – 23:00)*	45 - 58	55
	Night-time (23:00 – 07:00)	35 - 54	40
*Evening period used (19:00 – 23:00)			

3.3.3 The full measured background sound levels are presented in Appendix 9.

3.4 Noise Survey Equipment

3.4.1 The following equipment was used for the noise surveys.

Table 7. Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No	Serial No.	Calibration Due Date
NMP1	Sound Level Meter	01dB Fusion	12038	25 March 2023
	Pre-amplifier	01dB PRE22	1805093	
	Microphone	GRAS 40CE	330801	
	Calibrator	01dB CAL-31	87280	2 July 2021
NMP2	Sound Level Meter	01dB Fusion	11755	3 July 2022
	Pre-amplifier	01dB PRE22	1707173	
	Microphone	GRAS 40CE	291693	
	Calibrator	01dB CAL-31	84086	2 July 2021

3.4.2 The sound level meters were field calibrated prior to and following the noise surveys and there was no drift beyond the allowable limit of 1dB.

3.4.3 Table 8 indicates a summary of the measured weather conditions.

Table 8. Range of Measured Wind Speeds

Period	Range of Measured Wind Speeds (m/s)	Rainfall Recorded?
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All periods	0 – 3.8	No
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4 NOISE IMPACT ASSESSMENT

4.1 Assessment Information & Approach

- 4.1.1 Given the proximity of adjacent main roads to the Site, Professional Consult advised the client on the principles of good acoustic design for the evolving masterplan and as such, the masterplan presented has been designed with these principles in mind.
- 4.1.2 This Assessment has considered road traffic noise impacts from Liverpool Road and the A58 upon the proposed residential dwellings. This Assessment has also set mechanical and electrical plant noise emission limits for the proposed pumping station based on the measured background sound levels.
- 4.1.3 As previously discussed, it was not possible to complete an accurate and reliable noise measurement for the A58 due to noise generated by construction activities at the adjacent residential development, and so this Assessment has relied upon recently measured road traffic noise levels for the A58 by Hepworth Acoustics in support of the proposed adjacent residential scheme. Table 9 details the calculated road traffic noise levels for the A58 from the Hepworth Acoustics report.

Table 9. Third Party Noise Levels – A58

Measurement Position	Period	Calculated $L_{Aeq,t}$ (dB)	Highest Measured $L_{Amax,fast}$ (dB)	Distance to Nearside Kerbstone (m)
N/A	Daytime (07:00 – 23:00)	59	-	31*
	Night-time (23:00 – 07:00)	52	72	

*Hepworth Acoustics' noise measurement location was 25m for the site boundary with the A58 which, according to available satellite photography, equates to 31m from the nearside kerbstone of the A58.

- 4.1.4 The Hepworth Acoustics report details the highest measured maximum noise level during the night-time period from the A58, but not the 10th highest maximum noise level and so relying on this maximum noise level is likely to result in over specification of any upgraded glazing or alternative ventilation that maybe required for bedrooms. As such, this Assessment has adopted the measured maximum noise levels from the Liverpool Road traffic noise measurement. Nevertheless, this Assessment will adopt the calculated daytime and night-time average noise levels presented in the Hepworth Acoustics report.
- 4.1.5 The Assessment has also included for noise from the distant M57 motorway which lies in-cutting to the west of the Site. Professional Consult completed a noise survey for this road for another project back in 2019 and so the measured noise level data is still considered valid for use to inform this Assessment. Table 10 details the measured average road traffic noise level.

Table 10. Historic Noise Levels for M57 Motorway

Measurement Position	Period	Calculated $L_{Aeq,t}$ (dB)	Highest Measured $L_{Amax,fast}$ (dB)	Distance to Centre of Road (m)
N/A	Daytime (07:00 – 23:00)	83.6	-	18
	Night-time (23:00 – 07:00)	76.6	N/A*	

*It is not considered necessary to assess the maximum noise level over such a large distance.

4.1.6 In calculating road traffic noise impacts across the Development, existing features around the Site have been retained such as the 1.2m high stone wall (relative to the road-side) which lies on the boundary of the Site with Liverpool Road as this will act as a partial acoustic barrier for the Development.

4.2 Road Traffic Noise

4.2.1 For the purposes of this assessment, the wider daytime and night-time average ($L_{Aeq,T}$) noise levels for Liverpool Road have been calculated based on the shortened measurement procedure detailed in CRTN. The respective daytime and night-time noise levels have been derived using the following calculations:

② Calculation of the $L_{A10,18hr}$ noise level by using the following formula:

$$L_{10,18hr} = L_{10,3hr} - 1dB$$

② Calculation of the $L_{Aeq,16hr}$ noise level by using the following formula:

$$L_{eq,16hr} = L_{10,18hr} - 2dB$$

② Calculation of the night-time $L_{Aeq,8hr}$ noise level by using the following formula:

$$L_{night} (L_{eq,8hr}) = 0.90 \times L_{10,18hr} - 3.77dB$$

4.2.2 Table 11 calculates the daytime and night-time noise levels for Liverpool Road. The measurement distance was 5m from the nearside kerbstone of Liverpool Road which equates to 8.5 m from the centre of the road.

Table 11. Calculation of Road Traffic Noise Levels

Measurement Position	Period	Calculated $L_{Aeq,t}$ (dB)	10 th Highest Measured $L_{Amax,fast}$ (dB)	Distance from Centre of Road (m)
NMP1	Daytime (07:00 – 23:00)	68.9	-	8.5
	Night-time (23:00 – 07:00)	60.0	79.8	

4.2.3 For the purposes of this assessment, Professional Consult has used noise modelling software CadnaA to determine the impact of noise from Liverpool Road and the A58 at the proposed residential dwellings. A noise model has therefore been constructed in order to calculate façade noise levels and external noise levels in amenity areas.

4.2.4 The following inputs have been included in the model:

- ② Proposed Scheme Layout for the Site;
- ② Part of the Proposed Scheme Layout for the adjacent residential development using their approved masterplan '*Whittakers Garden Centre Prescot Planning Layout*' dated 21/3/19. This layout has been included as it may afford partial noise attenuation across the Site from the A58;
- ② Site elevations have been taken as existing using 1m contours;
- ② Noise Measurement Position 1 has been used in order to calibrate the noise model;

- ② A floor height of 2.5m has been assumed for all proposed dwellings which is a standard separation distance between ground and first floors in a typical dwelling;
- ② A reflection order of 2 has been used in all calculations;
- ② All dwellings have been included in the noise model as per the storey heights shown on the proposed site plan;
- ② Noise levels generated using ISO 9613-1 and ISO 9613-2 “Acoustics – Attenuation of sound during propagation outdoors” as incorporated into CadnaA software.

External Noise Impact in Garden Areas of Proposed Dwellings

- 4.2.5 In order to assess noise levels in external amenity areas across the Site, a grid noise map was calculated in the noise model. The grid noise map (Figure 1 of Appendix 4) shows a number of garden areas in the noise contour band 60dB to 65dB $L_{Aeq,16hr}$ and so the following section considers noise mitigation measures in to reduce the noise levels to the lowest practicable.

Internal Noise Impact for Proposed Dwellings

- 4.2.6 With regards internal noise levels, BS8233:2014 suggests that standard thermal double glazing will afford 33dB R_w of sound reduction, however this is for the pink noise spectrum and the same configuration will afford 30dB $R_w + C_{tr}$ for average noise levels from road traffic noise and so this value has been used to calculate internal noise levels. With regard to the maximum noise level ($L_{Amax,fast}$), the value of 33dB R_w has been used. BS8233:2014 also goes on to recommend that a partially open window provides approximately 15dB of attenuation.
- 4.2.7 Professional Consult uses a library database of glazing configurations issued by Saint Gobain and the glazing configuration 6mm glass / 12mm air space / 6mm glass affords 30dB $R_w + C_{tr}$ and 33dB R_w respectively.
- 4.2.8 Appendix 7 calculates the average daytime noise levels at the various facades of the plots and determines the requirement for upgraded glazing or alternative ventilation for living rooms. Appendix 7 indicates that standard thermal double glazing will be adequate in controlling external noise to meet the internal noise criteria limits however with a partially open window, the internal noise criteria limit for living rooms will be exceeded in various Plots and so the following section considers appropriate noise mitigation.
- 4.2.9 Appendix 8 calculates the average night-time noise levels at the various facades of the plots and determines the requirement for upgraded glazing or alternative ventilation for bedrooms. Appendix 8 indicates that standard thermal double glazing will be adequate in controlling external noise to meet the internal noise criteria limits however with a partially open window, the internal noise criteria limit for bedrooms will be exceeded in various Plots and so the following section considers appropriate noise mitigation.
- 4.2.10 In addition to the average noise levels, it is also necessary to consider maximum noise levels for the night-time period in addition to the average noise levels. With regards to road traffic movements along Liverpool Road the measured 10th highest maximum noise level was 78.5dB at 8.5m and the closest proposed dwelling lies at 16m from the centre of the road which gives a maximum noise level of 74.3dB $L_{Amax,fast}$. Allowing 33dB for a closed bedroom window gives an internal noise level of 41.3dB which falls below the internal noise criteria of 45dB $L_{Amax,fast}$ and so standard thermal glazing will be adequate in controlling maximum noise levels in bedrooms. Allowing 15dB for a partially open window will result in a maximum internal noise level of 59.3dB and so the following section considers appropriate noise mitigation for bedrooms.
- 4.2.11 The maximum noise levels discussed above were measured at Liverpool Road and they have also been adopted for the A58.

4.3 Mechanical & Electrical Plant Noise Limits – Pumping Station

- 4.3.1 At the time of issuing this report, no details for any proposed operating hours or details of any mechanical and electrical plant for the pumping station were known and so Table 12 has calculated maximum mechanical and electrical plant noise emission limits based on the existing background sound climate.

Table 12. Calculation of Noise Emission Limits

Period	Measured Background Sound Level, $L_{A90,t}$ (dB)	Criteria (dB)	Highest Permitted Cumulative Rated Level of Noise at Closest Proposed Receptor, $L_{A,r}$ (dB)
Day (07:00 – 19:00)	55	$L_{A,r} = L_{A90,t}$	55
Evening (19:00 – 23:00)	55		55
Night-time (23:00 – 07:00)	40		40

- 4.3.2 Table 12 indicates the maximum rated level of noise for each period when mechanical and electrical plant may be able to operate. The rated level of noise is relative to the closest existing and/or proposed residential dwelling. It should be noted that the rated noise levels may contain acoustic character corrections for tonality, impulsivity or intermittency and so the actual (specific) level of noise measurable at the receptor may need to be lower than the above values.

5 MITIGATION

5.1 Road Traffic Noise

External Noise Impact in Garden Areas of Proposed Dwellings

- 5.1.1 The previous section has shown that noise levels in the garden areas closest to Liverpool Road are in the noise contour band 60dB to 65dB $L_{Aeq,16hr}$ with no noise mitigation in place and so this section will consider the effectiveness of an acoustic barrier for the affected gardens.
- 5.1.2 In order to achieve a maximum average sound level in gardens no higher than 55dB $L_{Aeq,16hr}$, a noise barrier has been installed along part of the Site boundary with the A58 and Liverpool Rd which varies in height between 6m and 3.7m. The location of the noise barrier can be seen in Appendix 6.
- 5.1.3 In addition to the noise barrier on the boundary with the A58 and Liverpool Rd, noise barriers between gardens have also been included at a height of 2m, as shown in Appendix 6.

Internal Noise Impact for Habitable Rooms

- 5.1.4 The previous section has shown that standard thermal double glazing will be adequate in controlling the average external noise levels for living rooms and bedrooms, however with a partially open window, various habitable rooms will experience exceedances of the average internal noise levels and Appendices 8 and 9 detail the affected Plots.
- 5.1.5 Where System 1 or 2 alternative ventilation is required for habitable rooms, then ventilation can be achieved by using a window-frame mounted acoustic trickle ventilator as follows:
- ② Greenwoods EAQ42W (affords up to 42dB $D_{n,e,w} + C_{tr}$).
- 5.1.6 Where System 3 has been recommended for habitable rooms, the above acoustic trickle ventilator should be combined with a suitable Mechanical Extract Ventilation System.
- 5.1.7 With regards to maximum noise levels generated by vehicles using Liverpool Road and the A58, the previous section has indicated that certain bedrooms during the night-time period with a partially open window will exceed the internal noise criteria limit of 45dB $L_{Amax,fast}$. Further calculation indicates that any bedroom window located within 84m of Liverpool Road and the A58 with either full or partial line of sight to these roads will require the above trickle ventilator installing in the window frame.

6 CONCLUSION

- 6.1.1 Professional Consult Limited was instructed by Group D Developments Limited to prepare a Noise Impact Assessment for a proposed residential development on a parcel of land located at Dye House on Liverpool Road in Prescot, Merseyside, L34 3LX.
- 6.1.2 It is understood that proposals include for the development of 45 residential dwellings and associated works including a pumping station.
- 6.1.3 To the north and east of the Site lies a new residential development currently under construction and to the south and west lies Liverpool Road and the A58 respectively.
- 6.1.4 The sound climate across the Site is comprised largely of noise from road traffic using Liverpool Road and the A58. During the course of the noise survey there was intermittent noise associated with the residential development to the north and east however noise measurements for the Development have been completed in such a way that construction noise has not interfered with the measured noise levels.
- 6.1.5 This Assessment has been undertaken to identify the key sources of noise surrounding the Site which may adversely impact upon the proposed residential amenity. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.
- 6.1.6 This Assessment has shown that noise levels in garden areas do not exceed 55dB $L_{Aeq,16hr}$ following installation of an acoustic barrier on the Site boundary with the A58 and Liverpool Rd at varying height, combined with acoustic barriers between individual gardens.
- 6.1.7 This Assessment has shown that standard thermal double glazing will be adequate for all living rooms and bedroom across the Development in order to meet the internal target noise criteria levels. With an open window however, various living room and bedroom plots exceed the internal target noise criteria and so alternative ventilation has been recommended. In addition, this Assessment has recommended that any bedroom window located within a certain distance of Liverpool Road and the A58, with either full or partial line of sight to the roads, is fitted with alternative ventilation in order to control maximum noise levels produced by road traffic movements.
- 6.1.8 This Assessment has set mechanical and electrical plant noise emission limits for the proposed pumping station. The noise limits should not be exceeded at the closest proposed residential dwellings.
- 6.1.9 Should the recommended noise mitigation measures be implemented in order to control external noise levels for gardens and internal noise levels in habitable rooms, then the sound climate which future occupiers of the Development will be exposed to will accord with the 'No Observed Adverse Effect Level' as detailed in the PPG and as such, noise should not be deemed to be a determining factor in the granting of planning permission for this Site.

APPENDIX 1: LIMITATIONS

This report and its findings should be considered in relation to the terms of reference and objectives agreed between Professional Consult Limited and the Client.

The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

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APPENDIX 2: GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

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

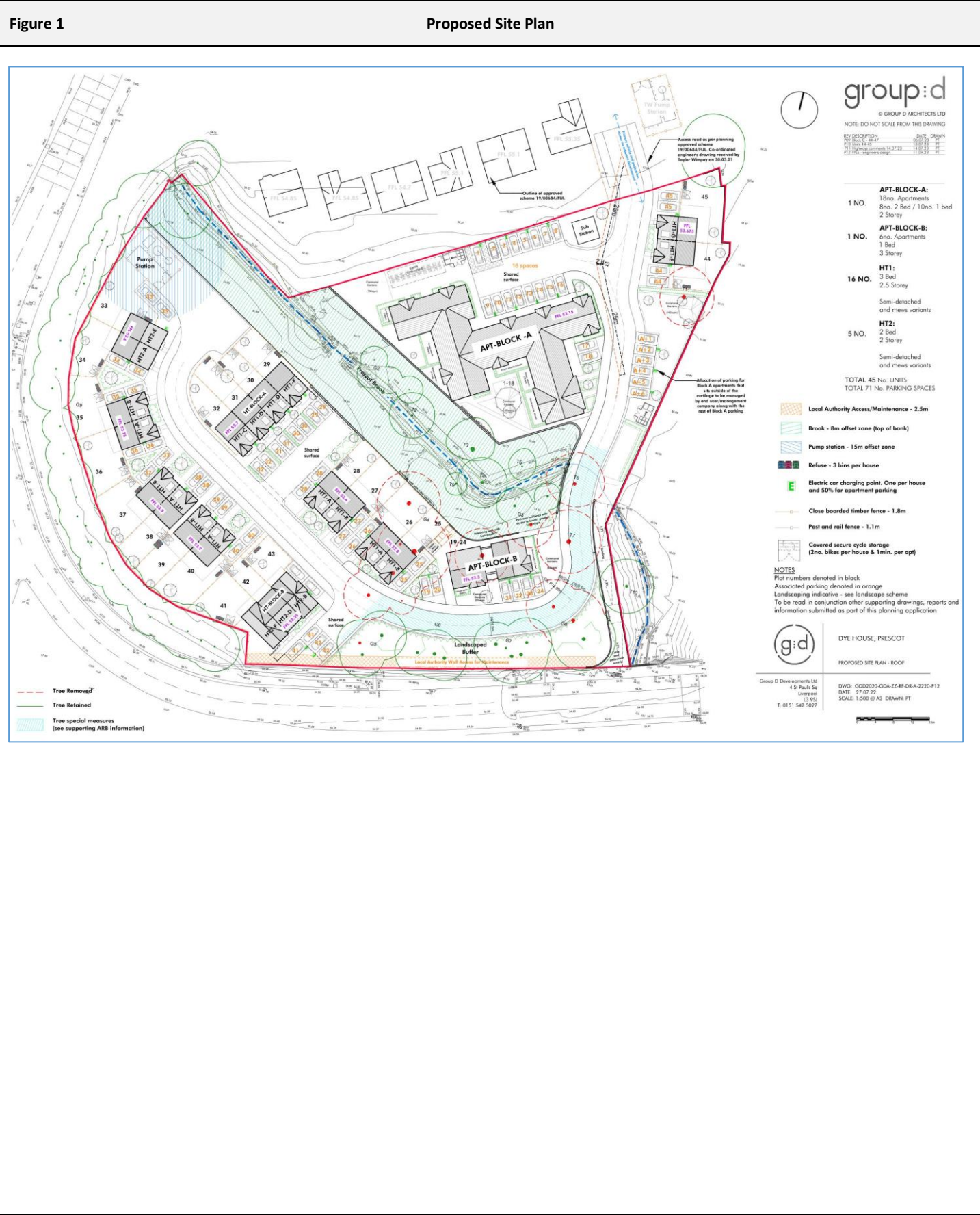
Table 1: Typical Sound Pressure Levels

Sound Pressure Level (dB)	Location/Example
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

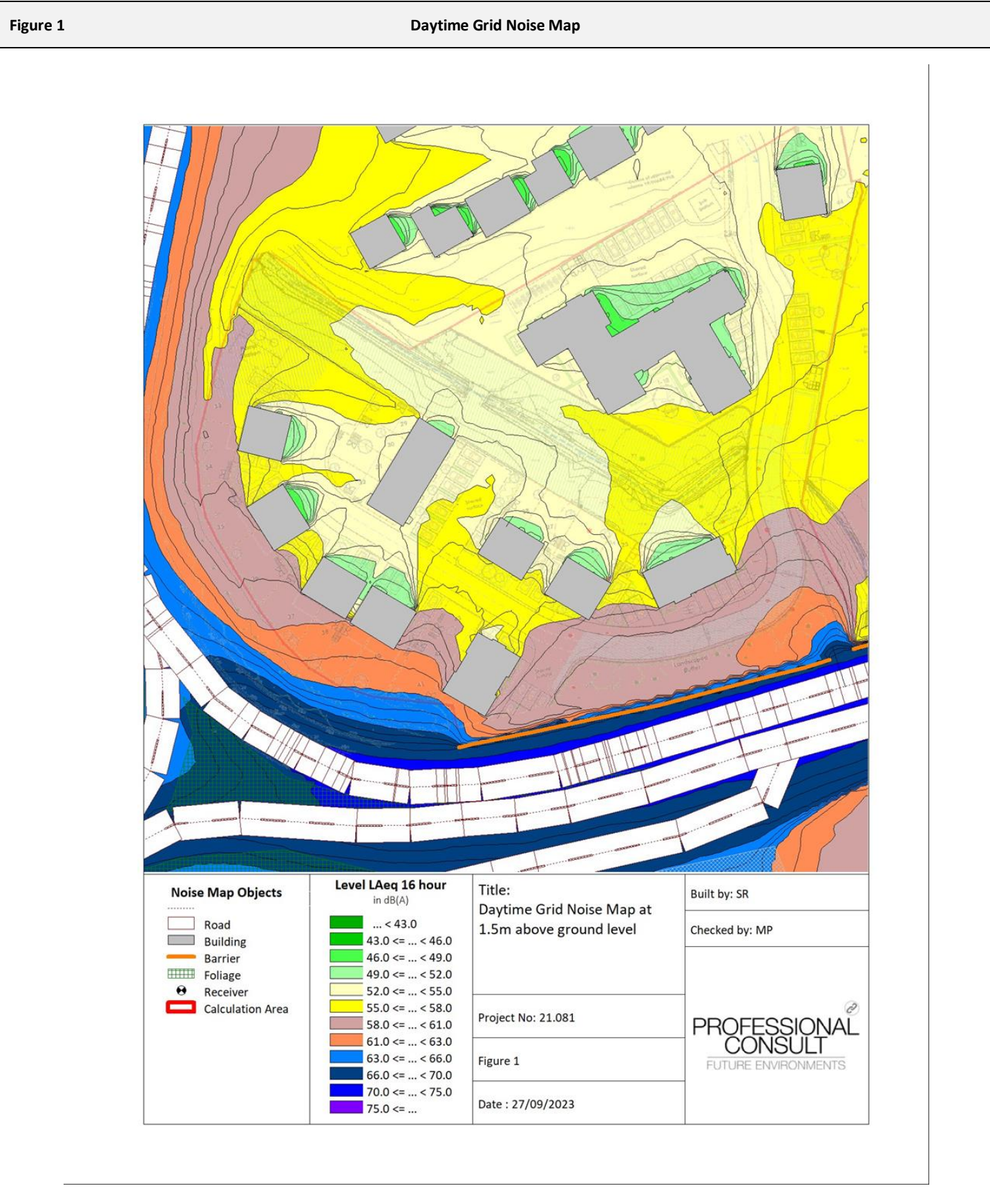
Table 2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 ⁻⁵ Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L _{Aeq, T}	L _{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L _{Amax}	L _{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L _{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L ₁₀ & L ₉₀	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L ₁₀ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L ₉₀ is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L ₁₀ index to describe traffic noise.
Free-field Level	2A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX 3: PROPOSED SITE PLAN & NOISE MEASUREMENT POSITION



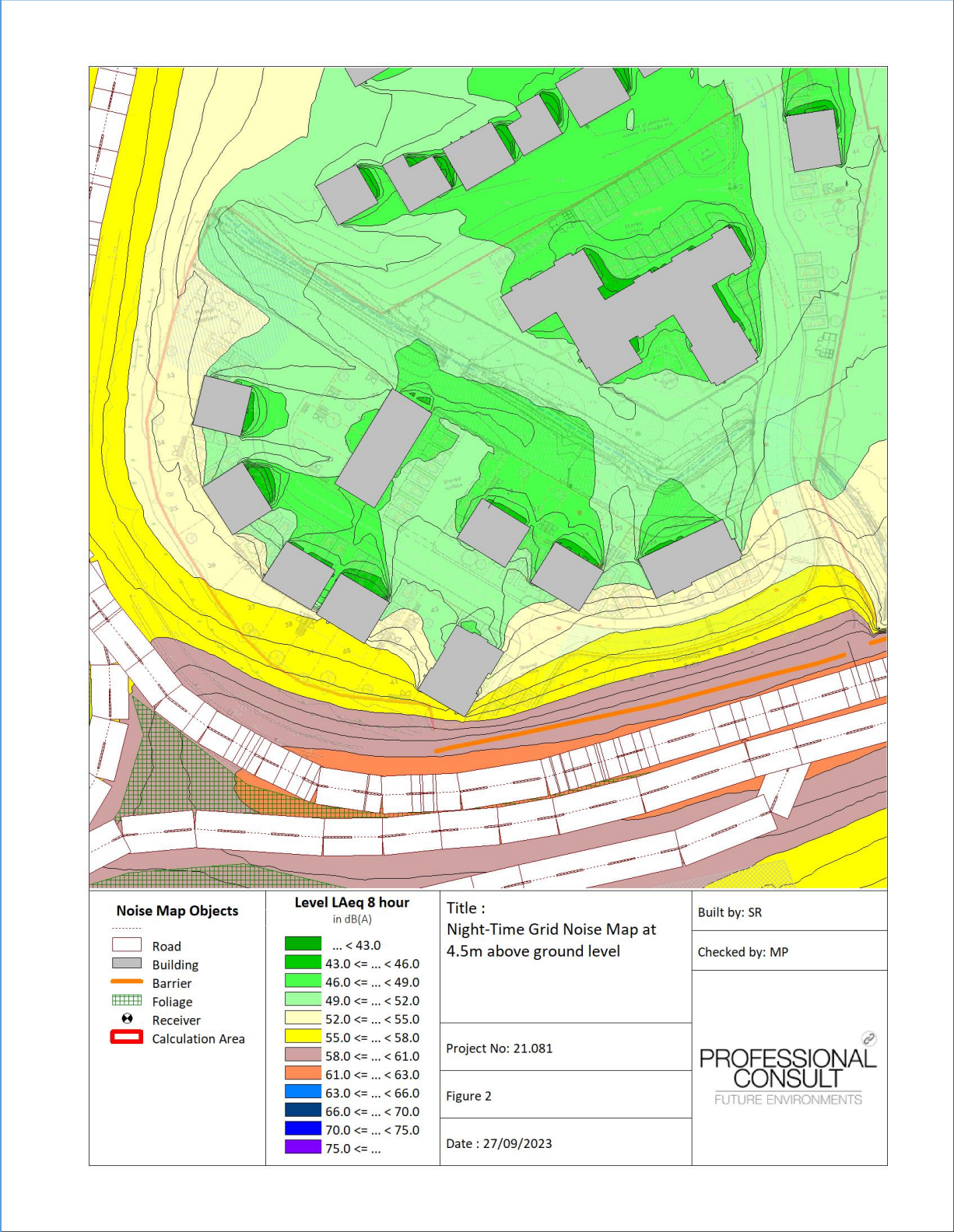
APPENDIX 4: DAYTIME GRID NOISE MAP



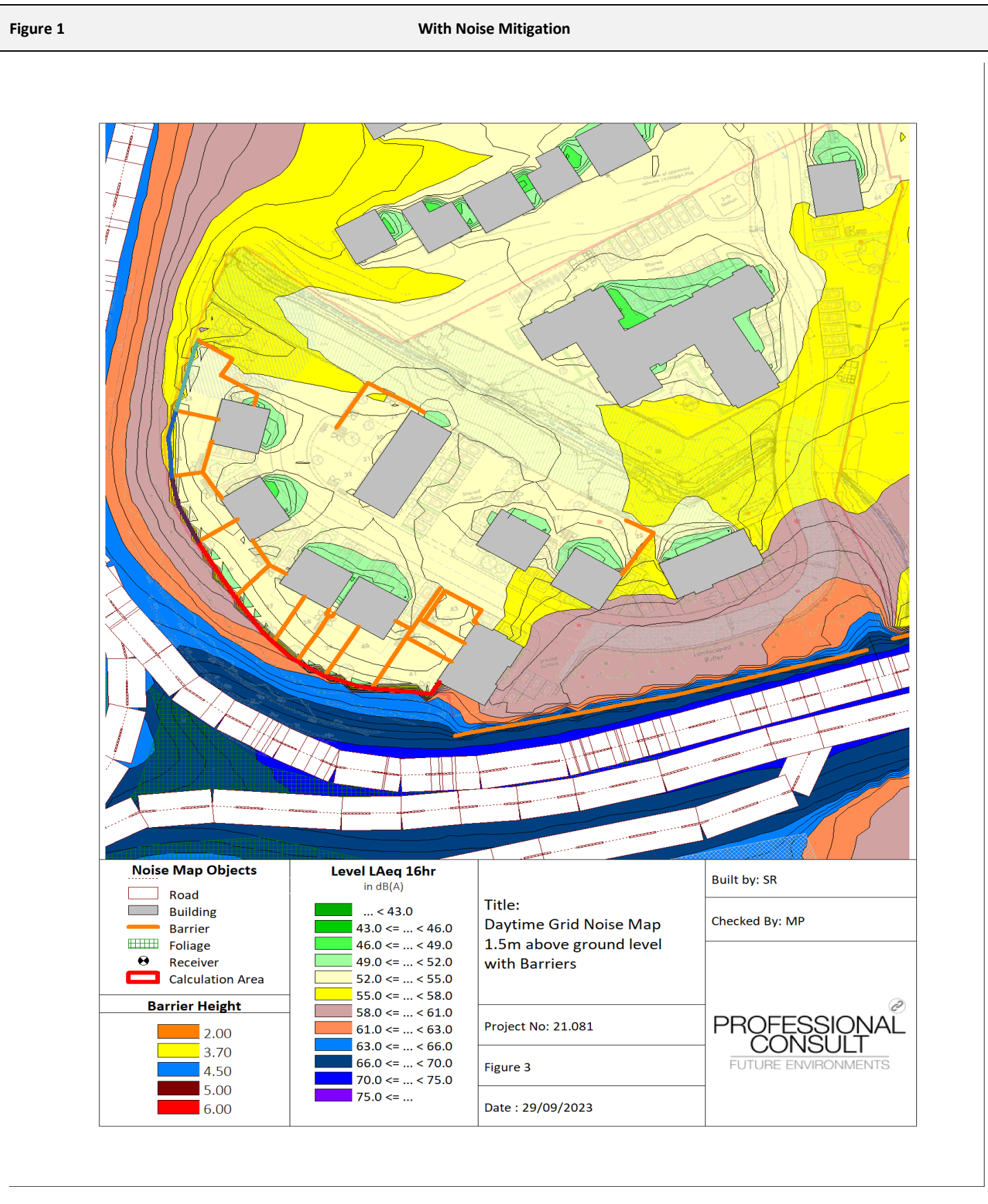
APPENDIX 5: NIGHT-TIME GRID NOISE MAP

Figure 1

Night-time Grid Noise Map



APPENDIX 6: DAYTIME GRID NOISE MAP – WITH NOISE MITIGATION



APPENDIX 7: DAYTIME FAÇADE NOISE LEVELS

Plot	Floor	Façade Direction	Calculate d LAeq,16hr at Façade (dB)	Glazing Sound Reduction Index (Rw) (Standard Thermal)	Calculate d Noise Level Inside Room (dB)	Criteria (dB)	Difference +/- (dB)	Required Sound Insulation Performance for Glazing (Rw +Ctr) (dB)	Commentary on Required Glazing	Calculate d Internal Noise Level with a Partially Open Window (dB)	Alternative Ventilation Required?	Acoustics Ventilation & Overheating Assessment - Appropriate AD-F System	Example Alternative Ventilation Scheme
Plot 1 - 18	1st	SW	56.3	30	26.3	35	-8.7	21	Standard thermal glazing	43.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	NW	54.9	30	24.9	35	-10.1	20	Standard thermal glazing	41.9	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	NE	54.1	30	24.1	35	-10.9	19	Standard thermal glazing	41.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	SE	57.3	30	27.3	35	-7.7	22	Standard thermal glazing	44.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	SW	59.9	30	29.9	35	-5.1	25	Standard thermal glazing	46.9	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 19 - 24	1st	NW	53.6	30	23.6	35	-11.4	19	Standard thermal glazing	40.6	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	NE	59.2	30	29.2	35	-5.8	24	Standard thermal glazing	46.2	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 19 - 24	1st	SE	62.4	30	32.4	35	-2.6	27	Standard thermal glazing	49.4	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 1 - 18	Ground	SW	54.4	30	24.4	35	-10.6	19	Standard thermal glazing	41.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Ground	NW	52.8	30	22.8	35	-12.2	18	Standard thermal glazing	39.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Ground	NE	51.9	30	21.9	35	-13.1	17	Standard thermal glazing	38.9	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Ground	SE	55.5	30	25.5	35	-9.5	21	Standard thermal glazing	42.5	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Ground	SW	57	30	27	35	-8	22	Standard thermal glazing	44	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Ground	NW	50.7	30	20.7	35	-14.3	16	Standard thermal glazing	37.7	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Ground	NE	57.1	30	27.1	35	-7.9	22	Standard thermal glazing	44.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Ground	SE	59.7	30	29.7	35	-5.3	25	Standard thermal glazing	46.7	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 25 - 26	Ground	NE	49.4	30	19.4	35	-15.6	14	Standard thermal glazing	36.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	Ground	NW	51.3	30	21.3	35	-13.7	16	Standard thermal glazing	38.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	Ground	SW	57.4	30	27.4	35	-7.6	22	Standard thermal glazing	44.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	Ground	SE	57.7	30	27.7	35	-7.3	23	Standard thermal glazing	44.7	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	Ground	NE	51.3	30	21.3	35	-13.7	16	Standard thermal glazing	38.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	Ground	NW	51.7	30	21.7	35	-13.3	17	Standard thermal glazing	38.7	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	Ground	SW	55	30	25	35	-10	20	Standard thermal glazing	42	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	Ground	SE	54.3	30	24.3	35	-10.7	19	Standard thermal glazing	41.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	Ground	NW	53.2	30	23.2	35	-11.8	18	Standard thermal glazing	40.2	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	Ground	SW	53.3	30	23.3	35	-11.7	18	Standard thermal glazing	40.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	Ground	SE	54.1	30	24.1	35	-10.9	19	Standard thermal glazing	41.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	Ground	NE	52.1	30	22.1	35	-12.9	17	Standard thermal glazing	39.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	Ground	E	49.6	30	19.6	35	-15.4	15	Standard thermal glazing	36.6	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	Ground	S	54.8	30	24.8	35	-10.2	20	Standard thermal glazing	41.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	Ground	W	54.6	30	24.6	35	-10.4	20	Standard thermal glazing	41.6	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	Ground	N	50.5	30	20.5	35	-14.5	16	Standard thermal glazing	37.5	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	Ground	NE	48.9	30	18.9	35	-16.1	14	Standard thermal glazing	35.9	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	Ground	SE	53.4	30	23.4	35	-11.6	18	Standard thermal glazing	40.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	Ground	SW	55	30	25	35	-10	20	Standard thermal glazing	42	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	Ground	NW	53	30	23	35	-12	18	Standard thermal glazing	40	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	Ground	NE	50.8	30	20.8	35	-14.2	16	Standard thermal glazing	37.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	Ground	SE	49.8	30	19.8	35	-15.2	15	Standard thermal glazing	36.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	Ground	SW	55	30	25	35	-10	20	Standard thermal glazing	42	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	Ground	NW	53.3	30	23.3	35	-11.7	18	Standard thermal glazing	40.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	Ground	SE	53	30	23	35	-12	18	Standard thermal glazing	40	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	Ground	SW	55.4	30	25.4	35	-9.6	20	Standard thermal glazing	42.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	Ground	NW	50.1	30	20.1	35	-14.9	15	Standard thermal glazing	37.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	Ground	NE	50.3	30	20.3	35	-14.7	15	Standard thermal glazing	37.3	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 41 - 43	Ground	NW	53.8	30	23.8	35	-11.2	19	Standard thermal glazing	40.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 41 - 43	Ground	NE	56.4	30	26.4	35	-8.6	21	Standard thermal glazing	43.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator

Reference: 21.081.1.R4

Date: 29 September 2023

Project: Proposed Residential Development – Dye House, Prescott

Plot 41 - 43	Ground	SE	60.6	30	30.6	35	-4.4	26	Standard thermal glazing	47.6	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 41 - 43	Ground	SW	62.8	30	32.8	35	-2.2	28	Standard thermal glazing	49.8	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 44 - 45	Ground	S	55.5	30	25.5	35	-9.5	21	Standard thermal glazing	42.5	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator

APPENDIX 8: NIGHT-TIME FAÇADE NOISE LEVELS

Plot	Floor	Façade Direction	Calculate d LAeq,8hr at Façade (dB)	Glazing Sound Reduction Index (Rw) (Standard Thermal)	Calculate d Noise Level Inside Room (dB)	Criteria (dB)	Difference +/- (dB)	Required Sound Insulation Performance for Glazing (Rw + Ctr) (dB)	Commentary on Required Glazing	Calculate d Internal Noise Level with a Partially Open Window (dB)	Alternative Ventilation Required?	Do Average Night-time Internal Noise Levels Achieve Compliance with AD-O?	Acoustics Ventilation & Overheating Assessment - Appropriate ADF System	Example Alternative Ventilation Scheme
Plot 1 - 18	1st	SW	49.4	30	19.4	30	-10.6	19	Standard thermal glazing	36.4	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	NW	48.1	30	18.1	30	-11.9	18	Standard thermal glazing	35.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	NE	46.2	30	16.2	30	-13.8	16	Standard thermal glazing	33.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	1st	SE	49.5	30	19.5	30	-10.5	20	Standard thermal glazing	36.5	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	SW	51.9	30	21.9	30	-8.1	22	Standard thermal glazing	38.9	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	NW	46.6	30	16.6	30	-13.4	17	Standard thermal glazing	33.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	NE	50.5	30	20.5	30	-9.5	21	Standard thermal glazing	37.5	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	1st	SE	53.9	30	23.9	30	-6.1	24	Standard thermal glazing	40.9	Yes	Yes	ADF System 3	MEV System & Acoustic-grade TV
Plot 25 - 26	1st	NE	45.5	30	15.5	30	-14.5	16	Standard thermal glazing	32.5	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	1st	NW	46.8	30	16.8	30	-13.2	17	Standard thermal glazing	33.8	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	1st	SW	52.2	30	22.2	30	-7.8	22	Standard thermal glazing	39.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 25 - 26	1st	SE	52.4	30	22.4	30	-7.6	22	Standard thermal glazing	39.4	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	1st	NE	46.2	30	16.2	30	-13.8	16	Standard thermal glazing	33.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	1st	NW	47.1	30	17.1	30	-12.9	17	Standard thermal glazing	34.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	1st	SW	49.6	30	19.6	30	-10.4	20	Standard thermal glazing	36.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 27 - 28	1st	SE	49.6	30	19.6	30	-10.4	20	Standard thermal glazing	36.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	1st	NW	48.7	30	18.7	30	-11.3	19	Standard thermal glazing	35.7	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	1st	SW	48.2	30	18.2	30	-11.8	18	Standard thermal glazing	35.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	1st	SE	49	30	19	30	-11	19	Standard thermal glazing	36	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 29 - 32	1st	NE	46.8	30	16.8	30	-13.2	17	Standard thermal glazing	33.8	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	1st	E	45.6	30	15.6	30	-14.4	16	Standard thermal glazing	32.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	1st	S	51	30	21	30	-9	21	Standard thermal glazing	38	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	1st	W	51.8	30	21.8	30	-8.2	22	Standard thermal glazing	38.8	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 33 - 34	1st	N	47.3	30	17.3	30	-12.7	17	Standard thermal glazing	34.3	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	1st	NE	43.6	30	13.6	30	-16.4	14	Standard thermal glazing	30.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	1st	SE	48.7	30	18.7	30	-11.3	19	Standard thermal glazing	35.7	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	1st	SW	51.9	30	21.9	30	-8.1	22	Standard thermal glazing	38.9	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	1st	NW	50	30	20	30	-10	20	Standard thermal glazing	37	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	1st	NE	46.3	30	16.3	30	-13.7	16	Standard thermal glazing	33.3	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	1st	SE	45.6	30	15.6	30	-14.4	16	Standard thermal glazing	32.6	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	1st	SW	51.4	30	21.4	30	-8.6	21	Standard thermal glazing	38.4	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 37 - 38	1st	NW	49.8	30	19.8	30	-10.2	20	Standard thermal glazing	36.8	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	1st	SE	49.1	30	19.1	30	-10.9	19	Standard thermal glazing	36.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	1st	SW	51.7	30	21.7	30	-8.3	22	Standard thermal glazing	38.7	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	1st	NW	46.1	30	16.1	30	-13.9	16	Standard thermal glazing	33.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	1st	NE	44.9	30	14.9	30	-15.1	15	Standard thermal glazing	31.9	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 41 - 43	1st	NW	50	30	20	30	-10	20	Standard thermal glazing	37	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 41 - 43	1st	NE	50.3	30	20.3	30	-9.7	20	Standard thermal glazing	37.3	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 41 - 43	1st	SE	57	30	27	30	-3	27	Standard thermal glazing	44	Yes	Yes	ADF System 3	MEV System & Acoustic-grade TV
Plot 41 - 43	1st	SW	57.1	30	27.1	30	-2.9	27	Standard thermal glazing	44.1	Yes	Yes	ADF System 3	MEV System & Acoustic-grade TV
Plot 44 - 45	1st	S	49.9	30	19.9	30	-10.1	20	Standard thermal glazing	36.9	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	2nd	NE	47.2	30	17.2	30	-12.8	17	Standard thermal glazing	34.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	2nd	SE	52.4	30	22.4	30	-7.6	22	Standard thermal glazing	39.4	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 35 - 36	2nd	SW	54.6	30	24.6	30	-5.4	25	Standard thermal glazing	41.6	Yes	Yes	ADF System 3	MEV System & Acoustic-grade TV
Plot 35 - 36	2nd	NW	52.1	30	22.1	30	-7.9	22	Standard thermal glazing	39.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	2nd	SE	53.1	30	23.1	30	-6.9	23	Standard thermal glazing	40.1	Yes	Yes	ADF System 3	MEV System & Acoustic-grade TV

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Plot 39 - 40	2nd	SW	55.1	30	25.1	30	-4.9	25	Standard thermal glazing	42.1	Yes	Yes	ADF System 3	MEV System & Acoustic-grade 'TV'
Plot 39 - 40	2nd	NW	51.9	30	21.9	30	-8.1	22	Standard thermal glazing	38.9	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 39 - 40	2nd	NE	48.4	30	18.4	30	-11.6	18	Standard thermal glazing	35.4	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Groun d	SW	47.5	30	17.5	30	-12.5	18	Standard thermal glazing	34.5	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Groun d	NW	46.1	30	16.1	30	-13.9	16	Standard thermal glazing	33.1	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Groun d	NE	43.7	30	13.7	30	-16.3	14	Standard thermal glazing	30.7	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 1 - 18	Groun d	SE	47.5	30	17.5	30	-12.5	18	Standard thermal glazing	34.5	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Groun d	SW	49.2	30	19.2	30	-10.8	19	Standard thermal glazing	36.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Groun d	NW	43.7	30	13.7	30	-16.3	14	Standard thermal glazing	30.7	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Groun d	NE	48.2	30	18.2	30	-11.8	18	Standard thermal glazing	35.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 24	Groun d	SE	51.2	30	21.2	30	-8.8	21	Standard thermal glazing	38.2	Yes	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator

APPENDIX 9: MEASURED BACKGROUND SOUND LEVELS

Date	Time	Measured Sound Pressure Level, dB	
		L _{Aeq,t}	L _{A90,t}
12 May 2021	11:00	57.7	54.9
12 May 2021	11:15	61.9	57.9
12 May 2021	11:30	61.4	57.8
12 May 2021	11:45	58	56
12 May 2021	12:00	58.4	57
12 May 2021	12:15	60.6	57.3
12 May 2021	12:30	58.6	56.4
12 May 2021	12:45	57.3	56.2
12 May 2021	13:00	56.2	54.7
12 May 2021	13:15	62.2	58.9
12 May 2021	13:30	60.1	55.8
12 May 2021	13:45	61.1	56.1
12 May 2021	14:00	62.8	60.7
12 May 2021	14:15	59.7	57.1
12 May 2021	14:30	64.2	59.7
12 May 2021	14:45	62.1	57.7
12 May 2021	15:00	57.2	56.2
12 May 2021	15:15	62.3	57.9
12 May 2021	15:30	63.3	61.9
12 May 2021	15:45	58.2	55.6
12 May 2021	16:00	62.2	60.7
12 May 2021	16:15	59	55.9
12 May 2021	16:30	57.5	55.8
12 May 2021	16:45	56.3	55.2
12 May 2021	17:00	55.7	55
12 May 2021	17:15	57.7	56
12 May 2021	17:30	58.3	56.9
12 May 2021	17:45	58.4	57.7
12 May 2021	18:00	57.7	56.6
12 May 2021	18:15	56.9	55.8
12 May 2021	18:30	57.1	55.8
12 May 2021	18:45	58.8	56.2
12 May 2021	19:00	58.9	53
12 May 2021	19:15	53.9	52.4
12 May 2021	19:30	57.2	54.7
12 May 2021	19:45	58.6	56.7
12 May 2021	20:00	58.8	57.8
12 May 2021	20:15	57.2	55.6
12 May 2021	20:30	55.7	54.3
12 May 2021	20:45	56.5	55.4
12 May 2021	21:00	56.3	54.6
12 May 2021	21:15	57.1	54.8
12 May 2021	21:30	54.8	53.5
12 May 2021	21:45	53.5	52.2

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12 May 2021	22:00	52.8	50.8
12 May 2021	22:15	52.3	50.7
12 May 2021	22:30	49.7	48
12 May 2021	22:45	49.2	45.3
12 May 2021	23:00	48.9	47
12 May 2021	23:15	47.3	41.5
12 May 2021	23:30	46	41.9
12 May 2021	23:45	45.7	40.5
12 May 2021	00:00	45.7	40
13 May 2021	00:15	41.7	35.6
13 May 2021	00:30	42.2	37.8
13 May 2021	00:45	43	37.3
13 May 2021	01:00	41.9	37.1
13 May 2021	01:15	42	35.2
13 May 2021	01:30	41.2	38.5
13 May 2021	01:45	43.4	38.6
13 May 2021	02:00	43	40.2
13 May 2021	02:15	43.9	41.4
13 May 2021	02:30	43.9	39.6
13 May 2021	02:45	42.3	39.5
13 May 2021	03:00	42.9	39.8
13 May 2021	03:15	41.2	38
13 May 2021	03:30	43.4	40.9
13 May 2021	03:45	44.6	42.3
13 May 2021	04:00	47.1	43
13 May 2021	04:15	48.6	44.3
13 May 2021	04:30	51.8	49.2
13 May 2021	04:45	50	48.4
13 May 2021	05:00	55.1	48.5
13 May 2021	05:15	51.7	49.4
13 May 2021	05:30	52.1	51
13 May 2021	05:45	52.2	50.4
13 May 2021	06:00	52.2	50.1
13 May 2021	06:15	53.9	52.3
13 May 2021	06:30	55.8	53
13 May 2021	06:45	55.3	53.9
13 May 2021	07:00	54.9	53.3
13 May 2021	07:15	56.6	55.7
13 May 2021	07:30	57.3	55.6
13 May 2021	07:45	58.7	56.5
13 May 2021	08:00	58.1	56.7
13 May 2021	08:15	58.7	57.6
13 May 2021	08:30	60.9	56.6
13 May 2021	08:45	60.2	56
13 May 2021	09:00	60.7	56.7
13 May 2021	09:15	60.3	56.1
13 May 2021	09:30	64.4	56

13 May 2021	09:45	60.9	55.7
13 May 2021	10:00	60.4	54.3
13 May 2021	10:15	61.7	59.8
13 May 2021	10:30	59.8	54.1
13 May 2021	10:45	62.7	60.4
13 May 2021	11:00	58.2	55.5