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THE BARNS, LOWER ROAD, HALEWOOD
NOISE AND VIBRATION ASSESSMENT FOR PLANNING

A0129-REP01B

26 March 2025

Document History

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A	9 July 2024	Revised site layout, updates to NPPF and additional survey data
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1. INTRODUCTION

1.1. This report presents the results of a noise and vibration assessment carried out in support of a planning application for a residential development on land off Lower Road, Halewood, involving the construction of 18 houses. The application supersedes a previous proposal for the site that received planning approval during in 2021 (ref: 21/00074/FUL) permitting the construction of 12 houses with vehicular access, parking, landscaping and other associated works.

1.2. Knowsley Council was consulted prior to proceeding with this latest noise and vibration assessment in order to establish whether results from the initial assessment for the application site (see Auditive report ref: A0129-REP01, December 2020) would be permissible as evidence, to which the following response was received from the local Environment Health Department¹:

“It is for the consultant to determine whether they need to do further monitoring for the change of design. They should be able to obtain data for the railway to determine if the services have changed. They will also need to account for the two new developments on Lower Road in which properties are now lived in, and assess if there has been a change in traffic flows”.

1.3. In order to address Knowsley Council’s comments train flow data² from late 2020 and March 2025 have been compared and an additional daytime noise survey undertaken in order to determine traffic noise levels from Lower Road. This exercise has confirmed that the number of train movements along the adjacent railway has not altered significantly during identical daytime and night-time periods to those used for the initial noise survey. Traffic noise levels measured during April 2024 have also been incorporated into the sound propagation model discussed later in this document in order to reflect increased vehicular activity associated with the two new housing developments recently constructed on adjoining land.

1.4. The following steps have been followed in preparing this assessment :

- An inspection of the application site and surrounding area;

¹ Response received via email from Planning Officer Maxine Wishart, 20 February 2024

² Information sourced from realtimetrains.co.uk website



- Daytime and night-time noise measurements at the application site;
- Daytime and night-time groundborne vibration measurements at the application site;
- Assessment of potential noise and vibration impacts on the proposed development;
- Development of noise mitigation measures to protect residents of the proposed dwellings.

1.5. Appendix A contains a glossary of acoustical terms referred to within this document.

2. SITE AND SURROUNDINGS

- 2.1. The application site lies to the north east of Lower Road in Halewood. The site is bounded to the northwest and northeast by recently built housing estates, to the east by a wooded area and to the south by a tree lined strip of land on the opposite side of which is a 10m high railway embankment that carries trains operating between Liverpool, Warrington and Manchester.
- 2.2. A small area of the site (approximately 40m wide) fronts onto Lower Road and contains a barn that has been converted into dwellings.
- 2.3. Two existing dwellings and their gardens lie between the railway embankment and the southwest corner of the site.
- 2.4. The application site contains a large anglers pond with a central island.
- 2.5. Figure 1 contains an aerial photograph of the application site and indicates the site boundary.
- 2.6. Lower Road is a lightly trafficked country lane that runs from Halewood in a southeast direction.



Figure 1 Location of Application Site (aerial photograph by Google Maps)



3. DESCRIPTION OF THE DEVELOPMENT

3.1. The proposed development will comprise 18 new-build houses, an access road, car parking and associated landscaping.

3.2. The proposed housing is categorised as follows:

- 4 no. two storey terraced houses (Plots 1, 2, 3 & 4) located behind the existing road-facing dwellings in the southwest corner of the application site;
- 6 no. three storey semi-detached dwellings (Plots 5, 6, 7, 8, 9 and 10) located along the northwest bank of the anglers pond. Each house will contain four bedrooms;
- 2 no. L-shaped five bedroom detached family houses, one located at the northern corner of the application site (Plot 12) and one located at the eastern corner of the application site (Plot 11);
- 3 no. three storey detached dwelling (Plots 13, 14 and 15) located near the south west corner of the anglers pond. Each house will contain four bedrooms;
- 3 no. two storey terraced houses (Plots 16, 17 & 18) located near the site entrance. Each house will contain two bedrooms;

3.3. The houses will be of traditional brick envelope construction with localised areas of feature cladding.

3.4. Background ventilation for the houses will be provided by trickle ventilators. Purge ventilation for the removal of fumes and odours will be achieved by opening windows.

3.5. The layout of the proposed development is shown in Figure 2.

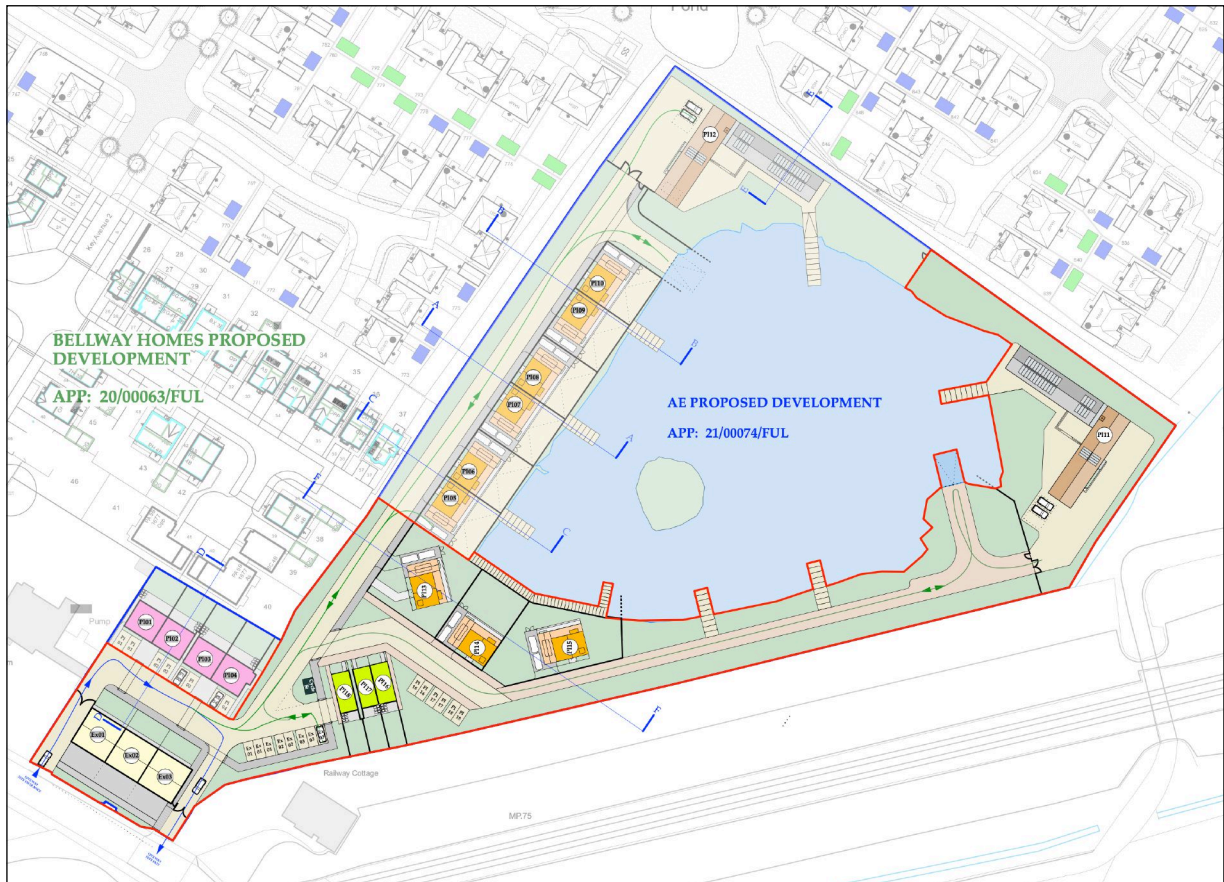


Figure 2 Proposed Site Layout



4. PLANNING POLICY & ACOUSTIC DESIGN CRITERIA

National Planning Policy Framework

- 4.1. National Planning Policy is guided by the National Planning Policy Framework (NPPF) which was introduced in 2012 and most recently updated during December 2024. The document sets out the Government's overall planning policies and advises how these are expected to be complied with.
- 4.2. Paragraph 187 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by '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.'
- 4.3. Paragraph 198 of the NPPF goes on to recommend that '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:
- 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 life;
 - identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'

The terms 'significant adverse impact' and 'other adverse impacts' are defined in the explanatory notes of the Noise Policy Statement for England (NPSE) which states:

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

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.

- 4.4. Extension of these concepts leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

- 4.5. Specific noise limits for LOAEL and SOAEL have yet to be defined, however, guidance from other acoustic standards may be employed to determine suitable levels within the overall principal of the National Planning Policy Framework.

National Planning Policy Guidance

- 4.6. National Planning Practice is guided by the National Planning Policy Framework. With regard to Noise the Framework states the following:

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- whether or not a 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.

- 4.7. 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.

- 4.8. Table 1 overleaf summarises the likely average responses to noise based upon the levels of exposure as advised by the government's Planning Practice Guidance.

Perception	Examples of Outcomes	Increasing Effect Levels	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
		Lowest Observed Adverse Effect Level	
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; closing windows for some of the time because of the noise. Potential for non-awakening 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
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. 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 Adverse 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

Table 1 Noise exposure hierarchy based on average likely response

Noise Level Criteria

4.9. The NPPF, National Planning Practice Guidance on Noise and the NPSE do not offer guidance on numerical design criteria for new residential developments. Therefore, for new housing developments reference is commonly made to recommended design criteria presented in British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings*. BS8233 advises the limits for average ambient noise levels within different room types shown in Table 2. These limits are typically required to be achieved with windows closed and with any background ventilators open.



Room Type	Recommend Indoor Ambient Noise Limit	
	Daytime 07:00-23:00	Night-time 23:00-07:00
Living Room	35dB $L_{Aeq,16hr}$	-
Dining Area	40dB $L_{Aeq,16hr}$	-
Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

Table 2 BS8233 Recommended Indoor Ambient Noise Level Limits

4.10. The indoor ambient noise criteria presented in Table 2 are compatible with guidance issued by the World Health Organisation.

4.11. BS8233 recommends that for sound sources which exhibit regular individual events that may cause sleep disturbance, such as passing trains, an acoustic design target based on the instantaneous maximum noise level (L_{AFmax}) is also appropriate. The previous edition of BS8233 (issued in 1999) recommended that regular noise events at night (23:00-07:00) should not exceed a level of 45dB L_{Amax} in bedrooms and this design standard is often sought by Local Planning Authorities. Within the context of planning and with reference to guidance presented in the Noise Policy Statement for England (NPSE, 2010), an internal noise limit of 45dB L_{Amax} may be viewed as the No Observed Effect Level (NOEL), representing the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

4.12. The World Health Organisation's *Guidelines for Community Noise* contains a recommendation that events exceeding 45dB L_{Amax} should not occur in bedrooms more than 10 to 15 times per night. This is reflected in *ProPG: Planning & Noise – New Residential Development* guidance that suggests external noise events should not normally give rise to a level of 45 dB L_{Amax} in bedrooms more than 10 times per night.

4.13. The acoustic design criteria adopted in the assessment of The Barns development are therefore as follows:

Daytime ambient noise limit in living room areas	35dB $L_{Aeq,16hr}$
Daytime ambient noise limit in bedroom areas	35dB $L_{Aeq,16hr}$
Night-time ambient noise limit in bedrooms	30dB $L_{Aeq,8hr}$
Night-time maximum noise limit for individual train movements	45dB L_{AFmax} (up to 10 events)

Vibration Level Criteria

- 4.14. Guidance on vibration level ranges for residential buildings are published in British Standard 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*. The standard also specifies frequency weighting curves for human beings exposed to whole-body vibration together with advice on measurement methods to be employed. Methods of assessing continuous, intermittent and impulsive vibration are presented.
- 4.15. The standard specifies that vibration is to be assessed in terms of Vibration Dose Values (VDV's), which are weighted vibration levels that can be used to assess human response to vibration levels in buildings in the frequency range 0.5Hz to 80Hz. The VDV levels can then be used to estimate the probability of adverse comment that may be expected by the occupants of different types of buildings, including residential and office developments. In residential buildings, which are deemed the most sensitive building type, adverse comments regarding vibration are likely when the levels involved only slightly exceed the threshold of perception.
- 4.16. To assess VDV's vibration levels are typically measured at the point at which they enter the human body. This normally involves measurements within the ground floor of an existing structure or within the ground itself before construction commences.
- 4.17. Table 3 presents the criteria published in BS6472-1:2008 for residential buildings.

Place and Time	Low probability of adverse comment $\text{ms}^{-1.75}$	Adverse comment possible $\text{ms}^{-1.75}$	Adverse comment probable $\text{ms}^{-1.75}$
Residential buildings (16 hour day)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings (8 hour night)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 3 BS6472 VDV Ranges Corresponding to Anticipated Human Response

- 4.18. In order to minimise the risk of adverse comments from occupants of the houses within the proposed development it should therefore be a design goal to ensure VDV levels in the development are no higher than $0.2 \text{ ms}^{-1.75}$ during daytime (07:00-23:00) and no higher than $0.1 \text{ ms}^{-1.75}$ at night (23:00-07:00).
- 4.19. Guidance on protecting buildings against vibration damage is provided within BS ISO 4866:2010 *Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures*. The Standard advises that the risk of vibration induced damage, including minor cosmetic damage, to modern robust buildings from transient vibration tends to zero below a peak particle velocity (PPV) of 12.5 mms^{-1} .



5. NOISE SURVEYS

November 2020 Noise and Vibration Survey

- 5.1. A noise survey was carried out at the application site during the afternoon of 17th November 2020th and the night of 19 November 2020 in support of the previous proposals.
- 5.2. An initial inspection of the site was carried out prior to commencing the daytime noise survey. This confirmed that the dominant source of noise affecting the site was that produced by trains passing along the railway embankment to the south. Between train movements the site is subject to steady low-level broadband noise from the south west direction, considered to be a combination of distant road traffic and potentially noise from the large industrial facilities located to the south west (Jaguar Land Rover etc). Traffic noise from Lower Road was low as movements along the route are infrequent during daytime and at night.
- 5.3. Measurements were carried out at the position shown in Figure 3, close to the south west edge of the pond. The microphone was positioned at height of approximately 1.4m above ground level, was in free-field conditions (i.e. no nearby vertical reflecting surfaces) and had an unobstructed line of sight to the railway embankment.
- 5.4. During the daytime survey additional roving spot measurements were taken at positions corresponding to the locations of the proposed dwellings. These confirmed that ambient noise levels in the absence of passing trains were similar across the site, thereby indicating that the underlying noise climate is primarily influenced by noise from distant traffic and industrial sources.
- 5.5. All noise measurements were attended allowing the type and direction of passing trains to be noted.
- 5.6. Noise measurements were undertaken in general accordance with the guidance presented in British Standard 7445:2003 *Description and measurement of environmental noise*.
- 5.7. The survey results are presented in terms of the following acoustic parameters:

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the measurement period. It is typically used as a descriptor for ambient noise.

L_{AFmax} is the instantaneous maximum noise level measured during the survey period.

L_{AF90} is the sound level that is exceeded for 90% of the survey period. It is typically used as a descriptor for background noise.

L_{AE} is the single event level. It is the constant sound level that has the same amount of energy in one second as the original noise event.

The “A” suffix denotes the fact that the sound levels have been “A-weighted” in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to 2×10^{-5} Pa.

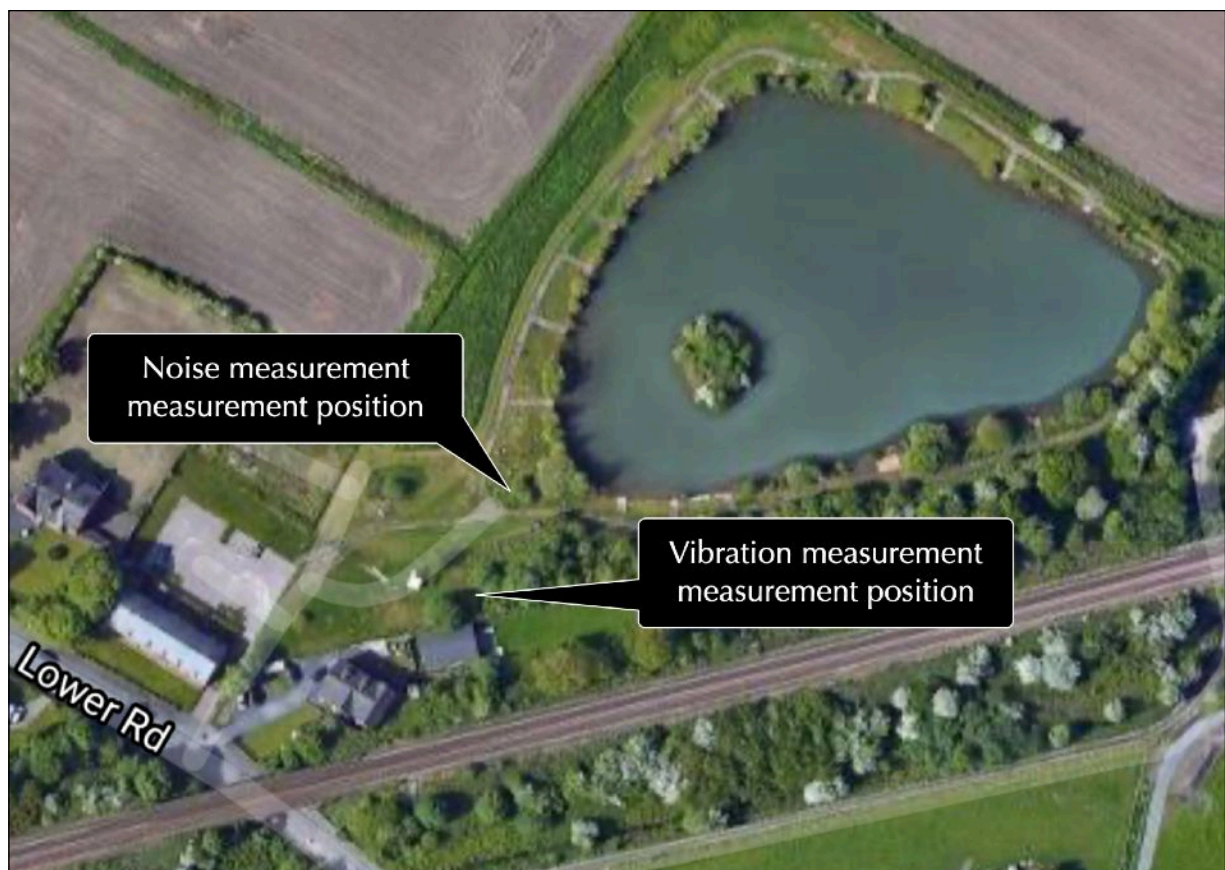


Figure 3 Locations of Noise and Vibration Measurement Positions (aerial photograph by Google Maps)

5.8. Full noise survey details and results are presented in Appendix B.

November 2020 Survey Results

5.9. The results of the noise surveys are summarised in Table 4.

Measurement Location	Measured Daytime Noise Levels (07:00-23:00)			Measured Night-time Noise Levels (23:00-07:00)		
	Ambient Sound Level dB, L_{Aeq}	Range of Maxima dB, L_{AFmax}	Typical Background Sound Level dB, L_{A90}	Ambient Sound Level dB, L_{Aeq}	Range of Maxima dB, L_{AFmax}	Typical Background Sound Level dB, L_{A90}
South west of pond	54	65 - 78	44	48	44 - 83	37

Table 4 Summary of Noise Survey Results

5.10. With noise from trains excluded from the analysis average daytime and night-time ambient noise levels at the measurement position were 46dB L_{Aeq} and 40dB L_{Aeq} respectively. These levels are 8dB lower than the average noise levels including train movements, thereby confirming that the railway is the dominant source of noise affecting the application site.

5.11. Table 5 contains a summary of the individual train movements and their associated noise levels measured during the daytime and night-time noise surveys.

5.12. The results in Table 5 confirm that maximum noise levels produced by passing trains ranged from 65dB L_{AFmax} to 78dB L_{AFmax} during the daytime noise survey. Trains at night produced maximum noise levels ranging from 66dB L_{AFmax} to 72dB L_{Amax} with one train at 00:34 reaching 83dB L_{AFmax} , however this train exhibited noticeable brake squeal that was not present during any other train movements during daytime or at night.

5.13. Records of train movements collated by the Realtime Trains website confirmed that the last train movement of the night was the 01:30 service, with the next scheduled trains operating shortly after 06:00. This slow train, pulled by a diesel locomotive, was moving empty carriages and was not a regular scheduled service.

5.14. The total number of train movements occurring during the daytime and night-time noise survey periods were 21 and 5 respectively. Data obtained from Realtime Trains for weekday services during March 2025 have confirmed that the number of train movements occurring during the same daytime and night-time periods were 23 and 5 respectively. Thus, it is concluded that average train noise levels impacting upon the application site have not altered significantly (<1dB) since the initial noise survey was conducted during November 2020.



Time	Train Type	Heading	Maximum Noise Level (dB, L _A F _{max})	Single Event Level (dB, L _{AE})
DAYTIME - 17 November 2020				
13:04	2 car passenger	West	72	78
13:11	4 car passenger	West	72	79
13:18	2 car passenger	East	75	81
13:29	2 car passenger	West	66	74
13:43	4 car passenger	East	78	83
14:00	3 car passenger	West	72	79
14:06	4 car passenger	East	77	83
14:10	2 car passenger	West	75	79
14:17	2 car passenger	East	75	80
14:34	4 car passenger	West	65	73
14:42	2 car passenger	East	76	81
15:04	2 car passenger	West	72	78
15:06	2 car passenger	East	78	82
15:17	3 car passenger	East	72	79
15:26	2 car passenger	West	72	77
15:35	3 car passenger	East	77	83
15:42	4 car passenger	East	75	79
15:49	4 car passenger	West	76	82
16:04	2 car passenger	West	74	80
16:21	3 car passenger	West	73	79
16:25	2 car passenger	East	78	82
NIGHT - 19 November 2020				
23:30	3 car passenger	West	66	72
00:02	4 car passenger	East	72	79
00:25	4 car passenger	West	68	76
00:34	4 car passenger	East	83	85
01:30	6 car passenger	East	72	81

Table 5 Noise Levels Generated by Individual Train Movements

April 2024 Traffic Noise Survey

5.15. Measurements of road traffic noise from Lower Road were carried out during the afternoon of 24th April 2024 in order to provide additional information for the acoustic assessment that reflects increased traffic in the area associated with the two new housing developments that occupy adjacent land to the application site.

5.16. Measurements were taken at the boundary wall of the converted barn that lies at the southern end of the application site as indicated in Figure 4. The microphone was located on a tripod at a height of 1.4m above ground level and with an uninterrupted line of sight to Lower Road. The measurement position was in free-field conditions.



Figure 4 Location of Traffic Noise Measurement Position (aerial photograph by Google Maps)

5.17. The average noise level measured during the survey period was 63dB L_{Aeq} . Traffic along Lower Road was light with only intermittent vehicle movements. The measured noise level includes contributions from eight trains passing across the railway bridge over Lower Road to the south.

5.18. The representative background sound level measured during the survey period was 41dB L_{A90} .

5.19. Full survey details are provided in Appendix C.

6. NOISE PROPAGATION MODEL

- 6.1. A noise propagation model for the proposed housing development has been produced using Cadna-A software in order to allow train noise levels impacting upon all of the proposed houses to be calculated.
- 6.2. The model incorporates the proposed site layout including the houses and the railway line on the adjacent embankment. Calculations within the model are carried out in accordance with '*Calculation of Railway Noise*' (1995) document that provides a standardised assessment method for predicting railway noise levels.
- 6.3. The model was calibrated by including receptor points corresponding to the microphone positions used during the noise surveys and by adjusting noise emission levels from the railway and Lower Road until the average noise levels calculated at the receptor points matched those measured. This exercise was carried out before adding the proposed houses to the model, thereby representing current conditions at the application site.
- 6.4. The general arrangement of the noise propagation model is shown in Figure 5.



Figure 5 General Arrangement of Noise Propagation Model

- 6.5. Calculated daytime train noise level contours across the application site are presented in Figure 6. The contours confirm that railway facing elevations of the proposed dwellings will typically experience average daytime noise levels in the range 50dB L_{Aeq} to 58dB L_{Aeq} .
- 6.6. Figure 7 confirms the calculated daytime noise levels impacting upon the facades of each proposed dwelling.
- 6.7. Average noise levels at night (L_{Aeq}) will lie 6dB below those indicated in Figures 6 and 7.

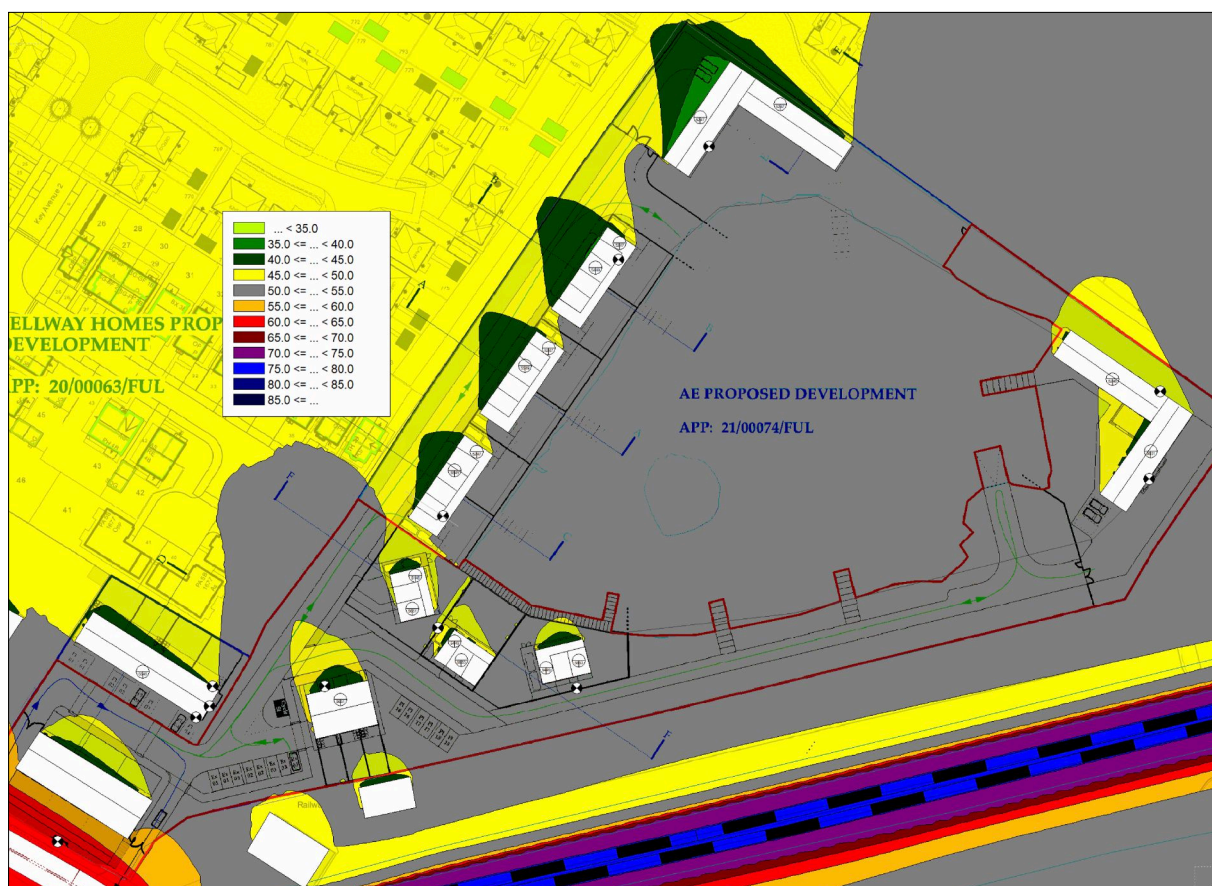


Figure 6 Daytime Noise Contours (L_{Aeq} @ height of 1.5m)

- 6.8. Maximum instantaneous noise levels that will impact upon the proposed houses as trains pass at night have also been calculated in the model using a point source travelling along the railway line. The noise emission level from the point source was set to produce a level of 72dB L_{AFmax} at the receptor point³, corresponding to the typical train pass-by level surveyed at night. The calculated maximum train noise levels impacting upon the most exposed upper floor facades of

³ i.e. the noise measurement position used during the 2020 survey

the proposed houses are indicated in Figure 8, thereby indicating maximum typical levels that will impact upon bedrooms at night (23:00-07:00).

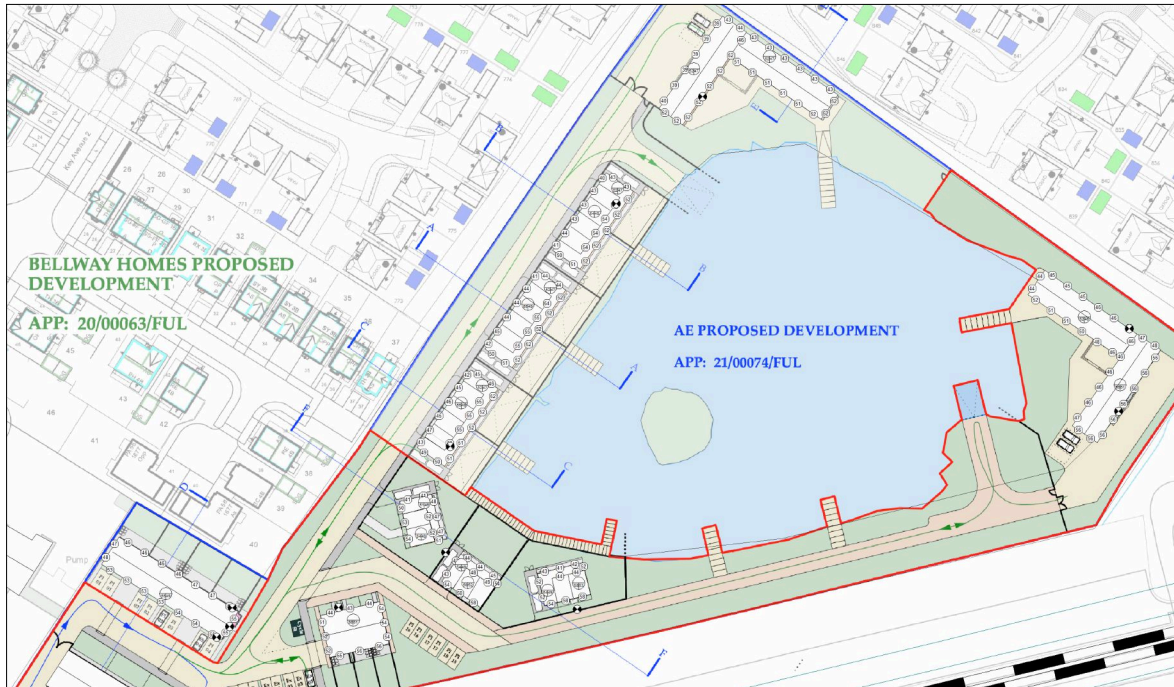


Figure 7 Daytime Average Facade Noise Levels (L_{Aeq})



Figure 8 Maximum Instantaneous Noise Levels During Train Movements at Night (L_{AFmax})



7. NOISE MITIGATION SCHEME

- 7.1. The adopted design limits for levels of noise ingress within the proposed houses are confirmed in Table 2 of Section 4.
- 7.2. The starting point for assessing compliance with the internal noise limits is to determine the composite sound reduction performance of the windows, non-glazed areas of the facade and any background ventilation openings. This information together with the levels of external noise impacting upon each dwelling are then used to calculate internal noise levels during daytime and at night in accordance with the guidance presented in Annex G of British BS8233. The method takes into account the relative area of each type of element used within the envelope, the volume of the rooms and the estimated reverberation times therein. If predicted internal noise levels are found to exceed the adopted design limits alternative 'upgraded' facade elements are then reviewed within the calculations until the internal conditions do not exceed the design limits.
- 7.3. Given that the envelopes of the houses will be formed using traditional brickwork, with localised areas of cladding lined internally with blockwork, the primary paths for noise ingress will be windows and background ventilators that both normally provide significantly less sound insulation performance than the solid external walls.
- 7.4. The noise survey and sound propagation modelling work has confirmed that average ambient noise levels across the site are relatively low during daytime and at night. The highest average daytime and night-time noise levels that will impact upon the nearest houses to the railway line are calculated to be 58dB L_{Aeq} and 52dB L_{Aeq} respectively. Levels of this magnitude do not typically justify the implementation of mitigation measures in order to satisfy the internal noise criteria of 35dB $L_{Aeq,16hour}$ during daytime (in living rooms/bedrooms) and 30dB $L_{Aeq,8hour}$ at night (bedrooms). However, instantaneous maximum noise levels produced by passing trains will reach up to 77dB L_{AFmax} outside the nearest dwellings to the railway embankment and up to 67dB L_{AFmax} outside the furthest house from the railway at night. As the number of trains travelling along the line between 23:00 and 07:00 typically ranges from 6 to 12 movements per night (according to the timetable and realtime trains.co.uk data) it must therefore be ensured that the resultant levels of noise ingress to bedrooms do not regularly exceed 45dB L_{AFmax} . In order to achieve this aim it is recommended that acoustically rated background/trickle ventilators

providing a sound reduction of at least 40dB $D_{n,e,w}$ in the open position are fitted to bedrooms within the elevations indicated in Figure 9, examples of which are provided below:

- Titon SF Sound Attenuator Vent type V75 with external canopy type C50
- Passivent type TVALdB 450/40

7.5. Alternatively, through-wall type background ventilators may be used in lieu of window mounted ventilators provided they offer the required sound reduction of 40dB $D_{n,e,w}$ in the open position (e.g. Rytons Super Acoustic Controllable LookRyt Aircore).

7.6. All other bedrooms may be fitted with 'standard' slot trickle ventilators that should be specified to provide a sound reduction of at least 33dB $D_{n,e,w}$ in the open position.

7.7. The windows of all houses within the development may be fitted with standard double glazing units (i.e. 4-16-4 or 6-16-6) that provide a sound reduction of at least 30dB R_w .



Figure 9 Noise Mitigation Strategy for Proposed Development

8. VIBRATION ASSESSMENT

Survey Method

- 8.1. Vibration levels were measured continuously at the application site between 13:30 on 17 November 2020 and 10:00 on 18 November 2020. As noted in Section 5 of this document, the numbers of train movements along the adjacent railway during daytime and night-time periods have not altered significantly since 2020, hence it is considered that initial vibration survey data are still relevant for use in the assessment of this updated application.
- 8.2. All vibration measurements were carried out using a Vibrock V901 digital seismograph fitted with two vibration transducers (see Figure 10). One transducer was used to measure Vibration Dose Values (VDV's) simultaneously in three axes while the other measured Peak Particle Velocity (PPV) in the vertical axis.



Figure 10 Vibrock Vibration Monitoring System

- 8.3. The vibration transducers were located near the southern site boundary as indicated in Figure 3, corresponding approximately to the position of the nearest proposed houses to the railway embankment (Plots 13 & 16).
- 8.4. The transducers were buried approximately 20cm below the ground surface on an area of compacted soil and were held down with a 15kg bag of dry sand. The transducers were

orientated so that the x-axis was parallel with the railway tracks, the y-axis perpendicular to the tracks and the z-axis vertical.

8.5. Subjectively groundborne vibration at the measurement location and at other points around the application site was imperceptible as trains passed by.

8.6. The vibration survey results are presented in Table 6.

	Vibration Dose Values ($\text{ms}^{-1.75}$)			Peak Particle Velocity (ms^{-1})
Start Hour	X-axis	Y-axis	Z-axis	Z-axis
13:00	0.013	0.013	0.018	0.200
14:00	0.013	0.013	0.018	0.175
15:00	0.013	0.013	0.019	0.400
16:00	0.014	0.013	0.018	0.175
17:00	0.014	0.013	0.018	0.175
18:00	0.014	0.013	0.019	0.175
19:00	0.014	0.013	0.019	0.175
20:00	0.014	0.014	0.019	0.175
21:00	0.014	0.014	0.019	0.175
22:00	0.015	0.015	0.019	0.175
23:00	0.015	0.015	0.020	0.175
00:00	0.015	0.015	0.020	0.175
01:00	0.015	0.015	0.020	0.175
02:00	0.015	0.015	0.020	0.175
03:00	0.015	0.015	0.020	0.175
04:00	0.015	0.015	0.020	0.175
05:00	0.015	0.015	0.020	0.175
06:00	0.015	0.015	0.020	0.200
07:00	0.015	0.015	0.020	0.175
08:00	0.015	0.015	0.019	0.175
09:00	0.015	0.015	0.019	0.175

Table 6 Hourly Vibration Monitoring Results

8.7. Overall VDV values for daytime were computed by the instrumentation from the measured daytime vibration levels and are presented in Table 7. The table also contains VDV's directly



measured during the overnight survey period and the maximum PPV levels occurring during both day and night.

	Vibration Dose Values ($\text{ms}^{-1.75}$)			Peak Particle Velocity (ms^{-1})
Period	X-axis	Y-axis	Z-axis	Z-axis
Day	0.028	0.027	0.038	0.400
Night	0.025	0.026	0.034	0.200

Table 7 Overall Daytime and Night-time Vibration Dose Values Measured at Site

Assessment of Vibration Survey Results

- 8.8. The results in Table 7 confirm that the measured daytime and night-time VDV levels fall below the applicable thresholds (see Table 3) at which a low probability of adverse comment occurs.
- 8.9. Similarly none of the maximum PPV levels measured on site exceeded 1mms^{-1} and are therefore significantly less than the threshold of 12.5mms^{-1} at which the risk of light cosmetic damage to buildings begins to become a consideration.
- 8.10. It is therefore concluded that mitigation measures to attenuate groundborne train vibration entering the new houses are not required for this project.



9. CONCLUSIONS

- 9.1. Noise and groundborne vibration levels at the site of the proposed housing development were surveyed during daytime and night-time periods in November 2020 in support of a previous application for the site. The survey results confirmed that the dominant source of noise affecting the site was train movements along the railway embankment that lies to the south of the application site. A recent review of railway flow data confirmed that the number of train movements along the railway has not altered significantly since 2020, thereby confirming the suitability of the initial noise and vibration survey data for use in support of this latest planning application. Supplementary measurements to confirm traffic noise levels from Lower Road were also carried out during April 2024 in order to reflect current conditions with additional traffic generated by new housing estates built in the area.
- 9.2. The noise survey results have been used to develop and calibrate a noise propagation model that has allowed noise levels impacting upon all of the proposed houses to be calculated. Whilst average daytime and night-time noise levels on the site are relatively low, instantaneous maximum noise levels produced by passing trains have the potential to cause intrusion to the most exposed houses at night. Therefore targeted noise mitigation measures have been recommended within Section 7 of this report involving the installation of acoustically rated background ventilators to bedrooms within specific plots. These measures will ensure that internal acoustic comfort criteria recommended by BS8233 are met within all of the houses when windows are closed.
- 9.3. Groundborne vibration monitoring at the location of the nearest houses to the railway embankment has confirmed that vibration dose values within the dwellings will fall below the threshold at which a low probability of adverse comments occurs and that the risk of vibration induced building damage is negligible.
- 9.4. It is therefore concluded that noise and vibration conditions at the application site are suitable for residential development provided that the noise mitigation measures recommended within this report are implemented. If necessary the implementation of an adequate scheme of noise mitigation could be ensured through the imposition of a suitably worded planning condition.



Appendix A - Glossary of Acoustic Terms

Decibel, dB

This is the unit to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure level, intensities and sound power levels. The logarithms used are to base 10; hence, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in acoustic pressure in Pascals. Subjectively, this corresponds to a doubling in the perceived loudness of sound.

Octave and Third Octave Bands

The human ear is sensitive to sound over a range of approximately 20 Hz to 10 kHz, and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands, and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For finer analysis, each octave band may be split into three one-third octave bands or in some cases, fine frequency bands.

A-Weighting

Normal hearing covers the frequency range from about 20Hz to 20KHz but sensitivity is greatest between about 500Hz and 8KHz. The "A-Weighting" is an electronic filters network incorporated in sound level meters which approximately corresponds to the frequency response of the ear. The unit of measurement of A-weighted sound level is dBA.

$L_{Aeq,T}$

The equivalent continuous A-weighted sound pressure level. It is a value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound, that within a specified time interval, T, has the same mean squared sound pressure as the sound under consideration that varies with time.

L_{Amax}

The maximum instantaneous A-weighted sound pressure level occurring during the measurement period. L_{Amax} is often referred to when examining noise intrusion to dwellings and sleep disturbance. Acoustic design noise limits for bedrooms are often specified in terms of a permissible L_{Amax} value.

L_{Amin}

The minimum A-weighted sound pressure level occurring during the measurement period.

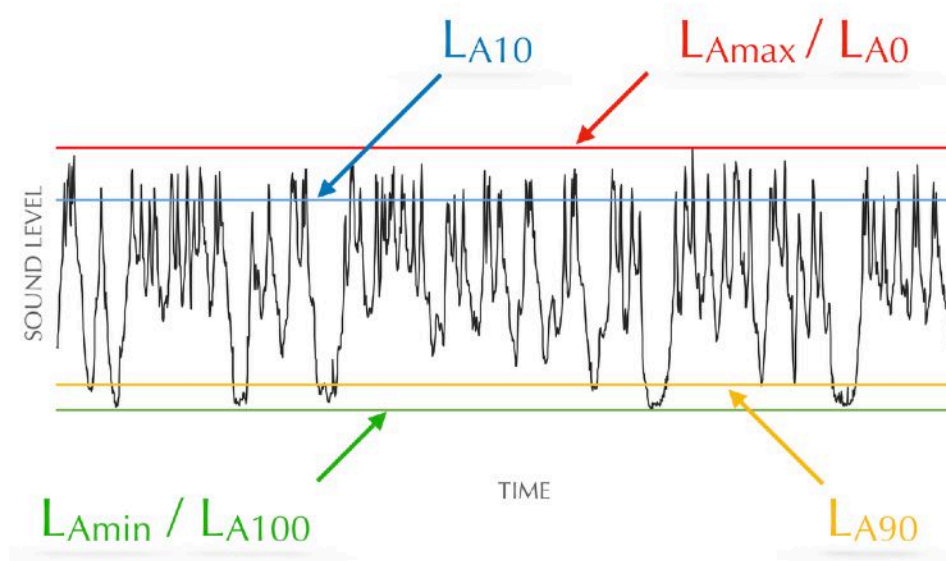
Statistical Level: L_{90}

The sound pressure level exceeded for 90% of the measurement time. Indicative of the general background noise level in the absence of any higher level short duration events that occur during the period.

Statistical Level: L_{10}

This is the sound pressure level exceeded for 10% of the measurement time. It is widely used to measure traffic noise. For a given measurement period, the L_{10} level is by definition greater than or equal to the L_{90} level.

The relationship between the parameters described above is indicated in the attached figure.



Sound Insulation

The use of structures and materials designed to reduce the transmission of sound from one room or area of a building to another, from the exterior to the interior of a building or between the exterior and interior of a building.



Appendix B - 2020 Noise Survey Details and Results

Survey Location

Land off Lower Lane

Halewood

Knowsley

Survey Dates

Daytime noise survey - 17 November 2020, 12:30 - 16:00

Night-time noise survey - 19 November 2020, 23:00 - 02:00

Vibration survey - 17 to 18 November 2020, 13:30 - 10:00

Weather Conditions

Dry and calm throughout, 12°C during daytime, 7°C at night.

Instrumentation

Equipment Description	Type Number	Manufacturer	Serial Number	Date of Last Laboratory Calibration/Verification
Sound Level Meter	XL2-TA	NTi Audio	A2A-11085-E0	26 and 27 August 2020
Pre-amp/ Microphone	M2230	NTi Audio	6647/A15224	26 and 27 August 2020
Calibrator	CAL200	NTi Audio	12583	26 August 2020
Digital seismograph	Vibroek 901	Vibroek	1001	9 November 2020
5m Microphone Extension	ASD Cable	NTi Audio	n/a	n/a

Copies of the calibration certificates for the instrumentation referred to above can be provided on request.

**Table B1** - Results of attended noise measurements during daytime, 17 November 2020

Measurement Position	Start Time	L _{Aeq}	L _{Amax}	L _{A90}	Sound Level (L _{eq} dB) @ Octave Band Centre Frequency (Hz)						
					63	125	250	500	1k	2k	4k
South west edge of anglers pond	13:00	54	72	44	59	50	44	50	50	47	39
	13:15	54	75	45	66	57	47	51	50	45	38
	13:30	55	78	45	64	54	44	51	52	47	39
	13:45	51	70	45	71	61	51	45	44	38	33
	14:00	57	77	46	66	57	48	53	52	50	42
	14:15	52	75	44	61	51	44	49	49	45	37
	14:30	53	76	44	61	51	43	49	50	46	37
	14:45	46	59	44	60	51	42	42	43	36	27
	15:00	55	78	44	60	51	46	52	51	48	41
	15:15	53	72	43	58	51	46	50	48	46	38
	15:30	55	77	43	58	51	45	52	51	49	39
	15:45	53	76	45	57	50	45	49	49	48	39
	16:00	53	74	46	60	53	47	49	49	45	36
	16:15	55	78	46	63	53	47	51	50	49	42

**Table B2** - Results of attended noise measurements at night, 19 November 2020

Measurement Position	Start Time	L _{Aeq}	L _{Amax}	L _{A90}	Sound Level (L _{eq} dB) @ Octave Band Centre Frequency (Hz)						
					63	125	250	500	1k	2k	4k
South west edge of anglers pond	23:00	40	57	38	50	44	37	38	37	30	27
	23:10	39	54	38	50	44	36	38	36	27	16
	23:20	45	66	37	52	46	40	42	41	39	30
	23:30	43	51	41	51	45	38	40	41	32	18
	23:40	42	49	40	51	44	37	39	40	31	16
	23:50	41	51	37	49	44	38	39	37	28	16
	00:00	51	72	38	54	51	43	49	47	43	36
	00:10	41	54	37	49	43	37	41	38	26	16
	00:20	48	68	37	50	44	42	46	44	40	35
	00:30	58	83	36	52	46	44	52	52	54	43
	00:40	41	51	37	50	52	42	41	34	22	14
	00:50	39	60	37	50	46	38	38	33	22	24
	01:00	38	45	36	49	44	36	38	32	21	14
	01:10	37	53	36	49	42	35	36	33	26	18
	01:20	53	72	35	57	54	52	52	47	46	38
	01:30	39	44	37	50	45	39	40	34	21	14
	01:40	39	47	37	49	44	38	38	34	21	14
	01:50	40	55	37	50	44	38	39	35	29	26



Appendix C - 2024 Noise Survey Details and Results

Survey Location

Land off Lower Lane

Halewood

Knowsley

Survey Dates

Daytime 24 April 2024, 13:15 - 15:45

Weather Conditions

Dry and calm throughout, 15°C.

Instrumentation

Equipment Description	Type Number	Manufacturer	Serial Number	Date of Last Laboratory Calibration/Verification
Sound Level Meter	XL2-TA	NTi Audio	A2A-11085-E0	30 and 31 August 2022
Pre-amp/ Microphone	M2230	NTi Audio	6647/A15224	30 and 31 August 2022
Calibrator	CAL200	NTi Audio	12583	13 September 2023

Copies of the calibration certificates for the instrumentation referred to above can be provided on request.

**Table C1** - Results of attended noise measurements during daytime, 24th April 2024

Measurement Position	Start Time	L _{Aeq}	L _{Amax}	L _{A90}	Sound Level (L _{eq} dB) @ Octave Band Centre Frequency (Hz)						
					63	125	250	500	1k	2k	4k
Wall along southern boundary of application site	13:15	60	79	43	62	55	55	54	59	51	41
	13:30	62	78	43	66	58	57	56	60	53	43
	13:45	61	79	40	64	56	55	55	58	53	43
	14:00	64	80	41	63	59	58	58	62	55	46
	14:15	62	78	41	62	57	57	56	60	54	46
	14:46	64	80	43	65	57	58	58	62	55	46
	15:01	64	82	44	64	58	58	58	62	56	46
	15:24	65	78	45	66	59	61	59	62	56	45