Consultants in Sound and Vibration

Report

21-0009-R1

22 April 2021

Melton Road, Brooksby

Condition 13 (Noise)

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1 Introduction

1.1 BY Acoustics has been appointed to carry out an acoustic assessment for inclusion with Reserved Matters application reference 20-01388-REM, which relates to the site known as the Spinney Campus, Brooksby Melton College, Melton Road, Brooksby, Melton Mowbray LE14 2LW.

1.2 This report sets out the methodology and results of a noise survey and assessment conducted in relation to condition 13 of the planning consent for application reference 19/01371/VAC.

2 Site Description

2.1 The site comprises the disused Spinney Campus of Brooksby Melton College, located on the opposite side of the A607 Melton Road from the main Brooksby campus of the college.

2.2 The north west site boundary is with the A607 Melton Road and two residential properties.

2.3 The north east and south west boundaries are with agricultural land.

2.4 The south east boundary is with agricultural land and residential buildings accessed from a paved bridleway running with the application site, adjacent to the south west boundary.

2.5 Beyond the agricultural to the west, south and south west lies Brooksby Quarry.

2.6 The development proposals are for 70 dwellings, with the closest plot located approximately 53 m from the A607 Melton Road (and all other plots located further back from the road).

3 Planning Condition and Consultation

3.1 In May 2020 planning approval was granted for application number 19/01371/VAC, with matters reserved, to remove a condition that was attached to an earlier consent. Condition 13 of the 19/01371/VAC approval states the following:

"No development shall take place until an acoustic mitigation scheme has been submitted to and approved by the Local Planning Authority. As a minimum the scheme must achieve the façade acoustic specifications outlined in noise impact assessment DC1677-R2 by Dragonfly Consulting. The acoustic mitigation scheme shall include a copy of the approved ventilation scheme wherein 'whole dwelling ventilation' must be achieved on the presumption of windows being closed. The acoustic mitigation scheme shall demonstrate that the proposed habitable rooms are so not different in specification to those assumed in the noise assessment as to materially affect the suitability of the proposed façade acoustic specification. The approved scheme shall be completed prior to the first occupation of the development and shall be retained thereafter."

3.2 In March 2021, David Martschenko (Senior Technical Officer, Environmental Health, Melton Borough Council) was consulted in relation to the assessment methodology. The Environmental Health reference number is 21/00877/EHDCPL and the discussion outcomes are summarised as follows:

- Although Brooksby Quarry was effectively scoped out by the Dragonfly Consulting report, and the planning condition relates specifically to façade sound insulation, Mr Martschenko suggested that a subjective assessment of noise from the quarry is made, setting out observations of what can be seen and heard externally

- While the planning condition only requires a ventilation scheme which achieves whole-dwelling ventilation [e.g. via background ventilators in habitable rooms and intermittent or continuous extract fans in wet rooms] with windows closed, Mr Martschenko would like to see overheating considered to some extent, with reference to the Acoustics, Ventilation and Overheating (AVO) Residential Design Guide [i]
- The report should include calculated façade noise levels for each receiver.

3.3 This report seeks to address all of these points.

4 Planning Guidance

4.1 BS 8233

4.1.1 BS 8233:2014 [ii] is relevant in relation to façade acoustic specifications and indoor noise levels in habitable rooms due to transportation noise sources and similar.

4.1.2 The British Standard includes guidelines on indoor ambient noise levels for dwellings.

4.1.3 It does not include guidance on maximum noise levels at night to avoid sleep disturbance. However, it does include example guidance for hotels of 45-55 dB L_{Amax}. There are potential reasons either way for hotels being more or less sensitive than private dwellings. Hotels may be more sensitive, in that occupants are not used to their environment and consequently may be more susceptible to sleep disturbance due to noise events of short duration. Conversely, dwellings may be more sensitive because some occupants may be more protective of their personal environment than if they were in a hotel.

4.1.4 BS 8233 is based upon the WHO Guidelines [iii], which included L_{Amax} recommendations for dwellings. Taking account of both sources, the following table summarises the guidelines.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,\,16\,hour}$	–
Dining	Dining room / area	40 dB $L_{Aeq,\,16\,hour}$	–
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\,16\,hour}$	30 dB $L_{Aeq,\,8\,hour}$
Sleeping (noise events)	Bedroom	-	45 dB L_{Amax} not normally exceeded more than 10-15 times

Table 4.1 Internal noise criteria (for whole dwelling ventilation conditions)

4.1.5 BS 8233 notes that the levels are based on annual average data and do not need to be achieved at all times.

4.1.6 The standard also notes that the assessment should be based on open trickle vents (or other mechanisms) providing adequate ventilation.

4.1.7 It also states that where development is considered necessary or desirable, despite noise levels being above aspirational goals, the internal target noise levels may be relaxed by up to 5 dB while still achieving reasonable internal conditions. Given the preceding point above, the implication is that this can apply with windows closed and trickle vents open. The standard pre-dates the more recent development of guidance on overheating (below), so the targets in the standard (including up to 5 dB relaxation) can be applied to the whole-dwelling ventilation condition. When assessing the overheating condition, it may be appropriate to allow further relaxation in noise targets, beyond those mentioned in BS 8233 (depending on the circumstances). This is discussed further in the subsequent section below.

4.1.8 The standard also indicates that if achieving the internal noise levels (relaxed by 5 dB if necessary) relies on windows being closed, appropriate alternative ventilation will need to be provided. Section 8.4.5.4 of the standard refers to Approved Document F of the Building Regulations and indicates that habitable rooms should be provided with background ventilation (whole dwelling ventilation as defined in Approved Document F). BS 8233 states that this can be provided via open windows or trickle vents, which accords with the earlier statement referenced at paragraph 4.1.6 above. It also states that windows can remain openable for rapid or purge ventilation, or at the occupant's choice.

4.1.9 While BS 8233:2014 does not include guidance on LAmax noise levels at night in dwellings, it does include example guidance for hotels of 45-55 dB L_{Amax}. There are potential reasons either way for hotels being more or less sensitive than private dwellings. Hotels may be more sensitive, in that occupants are not used to their environment and consequently may be more susceptible to sleep disturbance due to noise events of short duration. Conversely, dwellings may be more sensitive because some occupants may be more protective of their personal environment than if they were in a hotel. The WHO Guidelines (2000) on which BS 8233 is based, do include a guideline for dwellings, which is that for a good sleep a level of 45 dB L_{Amax} should not be exceeded more than 10-15 times per night.

4.2 Acoustics, Ventilation and Overheating

4.2.1 It should be noted that the assessment in relation to overheating is conducted to a level of detail commensurate to the characteristics of the site, which:

- Has already been master planned in outline terms
- Has been granted planning consent on that basis, with a condition that does not require overheating to be considered
- Is not subject to high noise levels in residential zones, which are set well back from the road

4.2.2 Consequently, the assessment adopts a simple methodology involving examination of noise levels with windows closed and open, together with illustrative assumptions concerning the durations in which each condition might occur during a year.

4.2.3 Appendix A summarises key elements of the AVO Guide [i]. Of particular relevance is the table in the appendix setting out Level 2 assessment thresholds for road traffic noise, as applying to this site. It is reproduced overleaf.

4.2.4 Considering the table overleaf and the fact that the BS 8233 guidance is stated in terms of annual average noise levels, the approach taken is to examine noise levels under both of the following scenarios:

- Whole dwelling ventilation (windows closed and trickle vents open, or other means of background ventilation)
- Enhanced ventilation (windows open or other means of increased ventilation rates, such as Mechanical Ventilation with Heat Recovery, MVHR)

Internal ambient noise level, dB			Likely Assessment
$L_{Aeq,T}$ during 07:00-23:00	$L_{Aeq,8h}$ during 23:00-07:00	Individual noise events (L_{Amax}) during 23:00-07:00	
≤ 35	≤ 30	Do not normally exceed 45 dB more than 10 times per night	No Observed Adverse Effect
35 – 50	30 – 42	45 – 65	Possible Adverse Effect
> 50	> 42	Normally exceeds 65	Significant Adverse Effect

Table 4.2 Assessment thresholds for road traffic noise, based on AVO Level 2

4.2.5 When assessing open windows, the assessment uses a reduction of 13 dB from external free field levels to internal levels, in line with the AVO Guide.

4.2.6 An assumption is then made concerning the proportion of the year for which windows may be open. In this case a robust assumption of 4 months has been used, which is likely to be especially pessimistic because the road is northwest of the site, so windows most exposed to noise are only likely to be subject to solar gains in the evening, when the sun is weaker than during the day.

4.2.7 Finally, the annual average L_{Aeq} noise level is calculated by taking account of the periods for which windows are open and closed (in this case, 4 months and 8 months respectively).

4.2.8 When considering L_{Amax} levels, it is not appropriate to follow the same procedure, so the levels with windows closed and open are both considered, without calculating an annual aggregate.

5 Historical Noise Survey

5.1 Dragonfly Consulting report DC1677-R2 dated July 2015 sets out the results of a noise survey conducted that same month.

5.2 Dragonfly Consulting measurements were made at two locations, as follows:

- ‘Location 1’ – free field location approximately 1.5 m above ground, within the car park near the site entrance at the north end of the proposed development
- ‘Location 2’ – free field location approximately 1.5 m above ground, within the overflow carpark along the western boundary of the proposed development

5.3 The locations are also shown as 1 and 2 on a plan in Appendix C to report DC1677-R2. In the report text, the description of location 1 states that it was “in close proximity to the site entrance" but it is not clear what is meant by that. The location shown on the plan is set back from the entrance off the A607 Melton Road (and the measured noise levels also seem to indicate that the location was well set back from the road).

5.4 The full survey results are set out Appendix D of report DC1677-R2. Those results have been used as the basis for comparison with more recent BY Acoustics survey work.

6 Noise Survey Methodology

6.1 Two non-attended noise monitors were set up on Wednesday 24th March and collected on Thursday 25th March 2021. Locations were selected primarily to quantify noise from the A607 Melton Road. The measurement positions are indicated on plan F6.1 and described as follows:

BY 1.1 Free field location approximately 61 m from nearside edge of Melton Road, 1.5 m above ground

BY 2.1 Free field location adjacent to bridleway and 5 m south west of gable elevation of existing greenhouse, approximately 138 m from nearside edge of Melton Road, 1.5 m above ground.

6.2 Measurements at both locations were made in continuous 15-minute periods, with data also being logged on a 1-minute basis to aid assessment of L_{Amax} levels at night.

6.3 Unattended monitoring at BY 1.1 took place continuously from 14:45 on 24th March to 14:00 on 35th March.

6.4 Non-attended measurements at BY 2.1 took place continuously from 14:00 on 24th March to 14:00 on 25th March.

6.5 On 24th March, attended measurements were made at the following locations, while non-attended monitoring continued at both BY 1.1 and BY 2.1:

BY 1.2 Free field location near historical measurement Location 1, approximately 40 m from nearside edge of Melton Road live carriageway, 1.5 m above ground

BY 2.2 Free field location near historical measurement Location 2, approximately 130 m from nearside edge of Melton Road live carriageway, 1.5 m above ground,

6.6 Measurements at each attended location were made over at least 15 minutes in each of three consecutive hours ending at 17:00h.

6.7 All measurements were made with NTi XL2-TA sound level analysers, each fitted with a windshield (for attended measurements) or a weather protective enclosure incorporating a windshield (for non-attended measurements. Each system was calibrated before and after the survey, with no drift occurring.

6.8 Weather conditions during the set up and attended survey on 24th March were mild and dry with largely clear skies and a barely perceptible breeze. Weather conditions during the collection on 25th March were similar but with broken cloud cover and a slightly more noticeable light breeze.

F6.1 Site plan showing noise measurement positions
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7 Noise Survey Results

7.1 Observations

7.1.1 Noise levels at BY 1.1 and BY 1.2 were entirely dominated by road traffic noise, except between approximately 05:00 and 06:30h, when the dawn chorus was dominant (as determined by listening to audio files recorded by the sound level meter), as a result of the monitoring location being near numerous deciduous trees and some evergreen trees. In this part of the site, there is a small degree of screening of Melton Road, due to the fact that the ground on the site is predominantly raised above the road, preventing direct line of sight to the wheel-road contact point. The exception is at the site entrance, where the bridleway / access road meets the A607, so wheels were briefly visible from BY 1.2.

7.1.2 Noise levels at BY 2.1 and BY 2.2 were again dominated by road traffic (from the part of the A607 located to the west) but birdsong contributed during lulls in traffic. The dawn chorus was less pronounced at this location (presumably due to the presence of evergreen conifers instead of deciduous trees) but still clearly discernible. Noise from Brooksby quarry was also briefly audible on occasion (in the form of distant plant with impulsivity which was discernible but not significant). However, the quarry did not have any appreciable effect on measured noise levels, with the sources not being visible and estimated to be located more than 500 m from the measurement position (based on what could be heard and examination of aerial imagery). For much of the short time that the quarry was audible during lulls in traffic, birdsong was more significant (but road traffic noise remained dominant overall). In addition, a piece of what appeared from its sound characteristics to be agricultural machinery (which was not visible and likely to have been located well over 500 m to the west), on the opposite side of the A607 Melton Road, affected noise levels for a period of approximately 8 minutes during the attended survey.

7.1.3 The A607 Melton Road was observed to be busy but with some short-term variation. At times it appeared to be at or near capacity (i.e. there was a continuous stream of vehicles) but at other times traffic reduced to the extent that other sources such as birdsong were briefly dominant.

7.2 Comparison with Historical Survey

7.2.1 The BY Acoustics data was processed to enable direct comparison with the data from the historical survey undertaken by Dragonfly Consulting. This involved comparison of noise levels measured concurrently at the two pairs of positions BY 1.1 & 1.2 and BY 2.1 & 2.2, by subtracting the non-attended level from the attended level, as set out in Appendix B. The average differences in noise level were then determined, as follows:

Average Difference	L_{Aeq}	L_{Amax}
BY 1.2 – BY 1.1	4.9	10.2
BY 2.2 – BY 2.1	1.3	2.6

Table 7.1 Difference between concurrent measurements at attended and non-attended locations

7.2.2 For each 15-minute period of the24-hour day during which measurements were made in the historical survey (as presented in Appendix C to report DC1677-R2), the average differences in the above table were applied to the non-attended data at BY 1.1 and BY 2.1, to yield equivalent noise levels at BY 1.2 and BY 2.2. Those resultant noise levels were then compared with levels at Location 1 and Location 2 in the historical survey data (by subtracting the historical level from the recent level) and averages determined. The resulting differences are as follows:

Average Difference	L_{Aeq} Day	L_{Aeq} Night	L_{Amax} Day	L_{Amax} Night
BY 1.2 – Location 1	2.8	2.6	-2.5	9.2
BY 2.2 – Location 2	5.4	2.5	4.0	-1.5

Table 7.2 Difference between BY Acoustics and Dragonfly Consulting measurements

7.2.3 It can be seen that in terms of L_{Aeq} ambient noise levels, the BY Acoustics measurements were higher in all cases, typically by around 3 dB.

7.2.4 This is a strong indication that the BY Acoustics measurements are likely to be representative, without the need to adjust levels upwards to account for any potential reduction in traffic at the time of the survey in comparison with typical flows in the absence of any Covid-19 restrictions.

7.2.5 The situation in terms of L_{Amax} is less clear. This is likely to be due to noise sources closer to the microphone (such as birds in nearby trees) affecting measured levels at times. In any case, road traffic L_{Amax} levels would not be affected by potential small changes in traffic flow due to Covid-19 restrictions, because the levels are governed by individual vehicles, not the overall flow. Therefore, the measured noise levels are taken to be representative.

7.3 Results for Assessment

7.3.1 The following table summarises the results of the noise survey for the purpose of the assessment:

Location	Day (0700-2300) $L_{Aeq,\ 16\ hour}$	Night (2300-0700) $L_{Aeq,\ 8\ hour}$	Night (2300-0700) L_{Amax}
BY 1.1	55.0	51.5	64.1
BY 1.2	49.9	46.4	61.4

Table 7.3 Daily free field noise levels measured during the survey

7.3.2 The L_{Amax} levels presented represent the 10^{th} highest level measured during the night (excluding the dawn chorus, identified by listening to audio recordings and examining the measured data).

7.3.3 The following table sets out measured octave band spectra, which have been used as the basis for calculation of internal noise levels (please refer to the subsequent section below).

Location & Parameter	Sound Level (dB) at Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
BY 1.1 $L_{Aeq,\ 16h}$	57.4	51.8	48.3	52.6	46.2
BY 1.1 $L_{Aeq,\ 8h}$	52.1	48.2	46.0	48.0	43.5
BY 1.1 L_{Amax}	65.2	64.8	64.0	60.4	49.9
BY 2.1 $L_{Aeq,\ 16h}$	51.7	46.1	45.7	47.0	39.7
BY 2.1 $L_{Aeq,\ 8h}$	48.0	45.0	44.2	42.5	35.6
BY 2.1 L_{Amax}	67.6	62.0	59.2	58.9	52.4

Table 7.4 Free field sound level spectra measured during the survey

8 Assessment

Windows Closed

8.1 Calculations have been carried out of internal noise levels within a sample of plots, based on the levels set out in section 7.3, adjusted for distance and angle of view of the road for each plot assessed. Assessments for plots at locations other than measurement positions BY 1.1 and BY 2.1 use spectra from those two locations, uniformly adjusted to give the appropriate overall level in dBA for the assessment location. The calculations take account of the room dimensions and external building fabric, including closed windows and open trickle vents, as set out in the following tables, the first being for glazing:

Glazing Reference	Sound Reduction, *R* (dB) at Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Glazing Type G1	20	25	31	34	34
Example G1 glazing unit: 10 mm glass / 12 mm void / 6 mm glass					
Glazing Type G2	20	21	30	34	32
Example G2 glazing unit: 6 mm glass / 16mm void / 6 mm acoustic laminate					
Glazing Type G3			Standard thermal double glazing		
Example G3 glazing unit: 4 mm glass / 16 mm void / 4 mm acoustic laminate					

Table 8.1 Required glazing

8.2 On the basis of a single vent in each bedroom and two vents in each lounge and dining room, the requirements are as follows:

Glazing Reference	Element Normalised Level Difference, $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Vent Type V1	34	31	36	31	34
Example V1 vent: Titon SFXSA V25 vent with standard canopy					
Vent Type V2			Standard direct-path trickle vent		
Example V2 vent: any standard trickle vent					

Table 8.2 Required vents

8.3 Should the number of required vents differ in order to comply with Building Regulations, it may be necessary to revisit the assessment and potentially amend the specifications.

Windows Open

8.4 The assumption has been made that windows are open for 4 months of the year. In the great majority of cases this is likely to be highly pessimistic, since the A607 Melton Road lies to the northwest, so most rooms affected will only be subject to solar gains in the evening, not during the main part of the day.

Results

8.5 The results on the above basis are set out in the following tables. Noise levels at other plots will be lower, due to increased distance, decreased angle of view, increased screening, or a combination of the three.

8.6 The first table relates to daytime ambient noise levels and all are colour coded as follows:

Green: no adverse effect (BS 8233 windows closed; or + 5 dB windows open or on aggregate)
Blue: possible adverse effect
Red: likely adverse effect

Location (facing direction)	External L_{Aeq}	Glazing	Vent	Windows Closed L_{Aeq}	Windows Open L_{Aeq}	Aggregate L_{Aeq}
Plot 1 Lounge (E)	49.5	G3	2 x V2	25.9	36.5	32.4
Plot 1 Kitchen / Dining (W)	54.3	G3	2 x V2	32.5	41.3	37.5
Plot 1 Bedroom 1 (E)	49.5	G3	1 x V2	27.2	36.5	32.6
Plot 1 Bedroom 2 (W)	54.3	G1	1 x V1	29.0	41.3	37.0
Plot 1 Bedroom 3 (W)	54.3	G1	1 x V1	29.4	41.3	36.3
Plot 2 Bedroom 3 (W)	53.6	G2	1 x V2	29.2	40.6	36.4
Plot 3 Bedroom 3 (W)	53.3	G3	1 x V2	29.9	40.3	36.3
Plot 12 Bedroom 2 (NW)	52.7	G3	1 x V2	29.0	39.7	35.6
Plot 12 Bedroom 3 (NW)	52.7	G3	1 x V2	29.6	39.7	35.7
Plot 12 Lounge (NW)	52.7	G3	2 x V2	29.0	39.7	35.6
Plot 70 Bedroom 1 (NW)	50.4	G3	1 x V2	26.8	37.4	33.3

Table 8.3 Daytime LAeq, 16 hour calculated noise levels

8.7 It can be seen from Table 8.3 that daytime levels with windows closed are less than the BS 8233 guideline level of 35 dB $L_{Aeq, 16 hour}$.

8.8 When windows are open, internal noise levels in some of the assessed plots are marginally more than 5 dB above the BS 8233 guidelines but at the lower end of the “possible adverse effect” range in Table 4.2, based on the AVO Guide. Therefore, the small potential for a marginal adverse effect is assessed as negligible and no further mitigation is required. The fact that all of the aggregate levels (assuming that windows are open for 4 months of the year) are less than 5 dB above the BS 8233 guidelines serves to underline the assessment that the adverse effect is none or negligible.

8.9 The following table sets out calculated ambient noise levels at night:

Location (facing direction)	External L_{Aeq}	Glazing	Vent	Windows Closed L_{Aeq}	Windows Open L_{Aeq}	Aggregate L_{Aeq}
Plot 1 Bedroom 1 (E)	45.9	G3	1 x V2	23.4	32.9	29.0
Plot 1 Bedroom 2 (W)	50.8	G1	1 x V1	24.8	37.8	33.4
Plot 1 Bedroom 3 (W)	50.8	G1	1 x V1	25.2	37.8	32.7
Plot 2 Bedroom 3 (W)	50.0	G2	1 x V2	25.2	37.0	32.8
Plot 3 Bedroom 3 (W)	49.8	G3	1 x V2	26.1	36.8	32.7
Plot 12 Bedroom 2 (NW)	49.2	G3	1 x V2	25.2	36.2	32.1
Plot 12 Bedroom 3 (NW)	49.2	G3	1 x V2	25.7	36.2	32.1
Plot 70 Bedroom 1 (NW)	46.9	G3	1 x V2	24.4	33.9	30.0

Table 8.4 Night time LAeq, 8 hour calculated noise levels

8.10 It can be seen from Table 8.4 that ambient noise levels during the night with windows closed are well under the BS 8233 guideline level of 30 dB $L_{Aeq, 16 hour}$.

8.11 When windows are open, internal noise levels in some of the assessed plots are marginally more than 5 dB above the BS 8233 guidelines (by up to 2 dB) but at the lower end of the “possible adverse effect” range in Table 4.2, based on the AVO Guide. Therefore, the small potential for a marginal adverse effect is assessed as negligible and no further mitigation is required. The fact that all of the aggregate levels (assuming that windows are open for 4 months of the year) are less than 5 dB above the BS 8233 guidelines serves to underline the assessment that the adverse effect is none or negligible.

8.12 The following table sets out calculated L_{Amax} noise levels at night:

Location (facing direction)	External L_{Amax}	Glazing	Vent	Windows Closed L_{Amax}	Windows Open L_{Amax}
Plot 1 Bedroom 1 (E)	61.9	G3	1 x V2	45.0	48.9
Plot 1 Bedroom 2 (W)	65.8	G1	1 x V1	44.5	52.8
Plot 1 Bedroom 3 (W)	65.8	G1	1 x V1	45.0	52.8
Plot 2 Bedroom 3 (W)	64.7	G2	1 x V2	44.5	51.7
Plot 3 Bedroom 3 (W)	63.8	G3	1 x V2	44.9	50.8
Plot 12 Bedroom 2 (NW)	63.0	G2	1 x V2	43.6	50.0
Plot 12 Bedroom 3 (NW)	63.0	G2	1 x V2	44.1	50.0
Plot 70 Bedroom 1 (NW)	63.7	G3	1 x V2	44.8	50.7

Table 8.5 Night time LAmax calculated noise levels

8.13 It can be seen from Table 8.5 that typical maximum noise levels during the night with windows closed do not exceed the WHO guideline level of 45 dB L_{Amax}.

8.14 When windows are open, internal noise levels in some of the assessed plots are marginally more than 5 dB above the WHO guidelines (by less than 3 dB) but at the lower end of the "possible adverse effect" range in Table 4.2, based on the AVO Guide. Therefore, the small potential for a marginal adverse effect is assessed as negligible and no further mitigation is required. It is also worth noting that although not directly relevant to dwellings, all of the calculated L_{Amax} noise levels are within the example design range of noise levels for hotels, as discussed at paragraph 4.1.9.

Summary

8.15 In summary, while internal noise levels in a small number of plots are marginally more than 5 dB above BS 8233 guidelines when windows are open, the adverse effect is assessed as negligible or none. Therefore, open windows are considered an appropriate means of reducing overheating.

8.16 A small number of plots require acoustic mitigation to ensure internal noise levels with windows closed are within the guidelines, as set out in the subsequent section below.

9 Acoustic Mitigation Scheme

9.1 Based on the foregoing section, the following mitigation is required:

- Plot 1 Bedroom 2: Glazing G1 & Vent V1
- Plot 1 Bedroom 3: Glazing G1 & Vent V1
- Plot 2 Bedroom 2: Glazing G2 & Vent V2
- Plot 2 Bedroom 3: Glazing G2 & Vent V2
- All other rooms and plots: Glazing G3 & Vent V2 (standard thermal double glazing & vent)

9.2 For the identified bedrooms, the performance requirements set out in tables Table 8.1 and Table 8.2 must be achieved in each frequency band. Glazing configurations are provided as examples only. The complete window (including frames, glazing, seals, any openable elements and integrated vents) must achieve the required values.

9.3 In the event that a window is selected which meets the required glazing performance while incorporating an open trickle vent within the frame, the separate trickle vent requirement does not apply (provided that sufficient vents are included to satisfy Building Regulations).

10 Conclusion

10.1 BY Acoustics has undertaken a noise survey at the site and compared the results with measurements taken by others in 2015. The results indicate the likelihood that the 2021 survey data is representative, without any need for adjustment to account for potential Covid-19 influences.

10.2 Calculations have been carried out based on the survey data and an acoustic mitigation scheme specified to ensure suitable internal noise levels with windows closed and trickle vents open. Some bedrooms in plots 1 and 2 require enhanced glazing and vents. Standard thermal double glazing and standard direct-path trickle vents are sufficient for all other rooms and plots.

10.3 Although not required by the planning condition, consideration has also been given to noise levels with windows open for some of the year. They are deemed acceptable, without the need for any further mitigation beyond opening windows.

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[i] Acoustics Ventilation and Overheating Residential Design Guide (Institute of Acoustics and Association of Noise Consultants, version 1.1, January 2020)

[ii] BS 8233:2014 - Guidance on sound insulation and noise reduction for buildings (British Standards Institute, 2014)

[iii] Guidelines for Community Noise (World Health Organisation, WHO, 2000)

Appendix A - Acoustics, Ventilation and Overheating

A.1 AVO Residential Design Guide

A.1.1 A residential design guide to acoustics, ventilation and overheating [iv] was published in January 2020. The guide relates primarily to the second of the following conditions that it defines:

- ADF Ventilation condition: provisions for fresh air to achieve whole dwelling ventilation rates (applying at all times) e.g. windows closed and trickle vents open
- Overheating condition: provisions for ventilative cooling to mitigate overheating (applying only some of the time) e.g. windows open or alternative means of ventilation provided

A.1.2 The guide also mentions purge ventilation for the purpose of rapidly diluting indoor pollutants (e.g. from painting and decorating, or from burnt food), as defined in Approved Document F of the Building Regulations. It notes that no acoustic criteria apply under such conditions.

A.1.3 The guide states that:

A.1.4 "Developments will normally (but not always) require additional ventilation (above ADF whole dwelling ventilation provisions) in order to mitigate overheating"

A.1.5 Any such additional ventilation could be provided by open windows or other means (potentially with sound attenuation incorporated). In either case, an assessment may be advisable or required, to determine noise levels under the overheating condition (together with a separate assessment of the extent to which the overheating condition is likely to occur).

A.1.6 The AVO guide indicates that development proposals should consider the following design principles:

- minimise internal heat generation through energy efficient design
- orientate buildings and streets to minimise summer and maximise winter solar gains
- use trees and other shading
- increase green areas in the envelope of a building, including its roof and environs
- maximise natural ventilation
- reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- passive ventilation
- mechanical ventilation
- active cooling systems (but reducing reliance on these where possible and, where they are used, ensuring they are the lowest carbon options).

A.1.7 In Appendix B to the guide, the following statements are made:

- On smaller developments it may be disproportionate to carry out a formal overheating assessment. In this case, the risk factors for overheating may be noted [with reference to the Housing Health and Safety Rating System] along with the provisions for mitigating overheating and the associated noise levels anticipated. The level of risk to occupants may then be considered in a qualitative manner.
- A qualitative overheating assessment is likely to assume opening windows to mitigate overheating. Thus, even when the overheating risk may appear to be low, the acoustic conditions during the overheating condition should be considered.

A.1.8 The design guide advocates a two-level assessment of ambient noise levels due to transportation noise sources. The first level considers only external free field noise levels (with internal noise levels being considered indirectly by inference). Depending the outcome of that assessment it may be advisable to conduct a level 2 assessment, which directly considers internal noise levels.

A.2 Level 1 Assessment Criteria

A.2.1 The guide includes a table (3-2) setting out guidance for a level 1 site risk assessment (noting that the values presented in the table should not be regarded as fixed thresholds to be uniformly applied to all sites). The guide states that the values in Table 3-2 are based on the assumption of a 13 dB difference between the external free-field noise levels and internal ambient noise levels. Based on that table, the following daytime thresholds are proposed for this site:

Daytime external free field noise level, dB (07:00-23:00) $L_{Aeq, 16 hour}$	Potential Effect without Mitigation	Recommendation for Level 2 assessment
≤ 53	Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Not required
54 – 63	Possible adverse effect	Optional
> 63	Likely adverse effect (depending on circumstances)	Recommended

Ta AVO Level 1 assessment thresholds for road traffic noise; Day

A.2.2 Similarly, the following night-time thresholds are proposed, noting that the highest risk category applies in each case (so, for example, if the ambient noise level is 46 dB $L_{Aeq, 8 hour}$ but the typical maximum noise level is 79 dB L_{Amax} then a Level 2 assessment is recommended).

Night time external free field noise level, dB (23:00-07:00)		Potential Effect without Mitigation	Recommendation for Level 2 assessment
$L_{Aeq, 8 hour}$	L_{Amax}		
≤ 48	≤ 78	Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Not required
49 – 55	-	Possible adverse effect	Optional
> 55	> 78	Likely adverse effect (depending on circumstances)	Recommended

Ta AVO Level 1 assessment thresholds for road traffic noise; Night

A.2.3 The potential effects apply in the absence of mitigation. Some forms of mitigation could be expected to reduce the effects (and could be put forward for that reason).

A.2.4 For noise levels in the middle category (possible adverse effect) the likelihood of an adverse effect occurring will often increase with increasing noise level within the relevant range.

A.2.5 It should be noted that where an adverse effect is assessed, it is not necessarily a significant adverse effect. Its significance would need to be assessed accounting for relevant factors. In the case of ventilation and overheating, one such factor is the likelihood of it being necessary to open windows (and potentially increase internal noise levels), as well as how often and for how long. For example, even if daytime noise levels are above 63 dB $L_{Aeq, 16 hour}$ an adverse effect may not occur if the overheating condition only occurs infrequently and for short durations (so windows can be kept shut for the great majority of the time).

A.3 Level 2 Assessment Criteria

A.3.1 A level 2 assessment relates to internal noise levels under the overheating condition and sets out threshold noise levels (in Table 3-3 of the guide, noting that the values presented in the table should not be regarded as fixed thresholds to be uniformly applied to all sites). Note 8 accompanying the table reiterates the advice in BS 8233 that internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. Based on the table and the notes accompanying it, the following thresholds are proposed for this site:

Internal ambient noise level, dB			Likely Assessment
$L_{Aeq,T}$ during 07:00-23:00	$L_{Aeq,8h}$ during 23:00-07:00	Individual noise events (L_{Amax}) during 23:00-07:00	
≤ 35	≤ 30	Do not normally exceed 45 dB more than 10 times per night	No Observed Adverse Effect
35 – 50	30 – 42	45 – 65	Possible Adverse Effect
> 50	> 42	Normally exceeds 65	Significant Adverse Effect

Ta AVO Level 2 assessment thresholds for road traffic noise

A.3.2 The daytime assessment period *T* is not necessarily the 16-hour day as used elsewhere. It may be a shorter period selected to be representative of the times at which overheating could be likely to occur and the relevant room is occupied.

A.3.3 The guide refers again to the 13 dB reduction (from external free-field noise levels to internal ambient noise levels) through an open window for the purpose of a Level 1 assessment. It states that this level difference is considered representative of typical domestic rooms with simple façade openings of around 2% of the floor area. It goes on to state in paragraph 3.25:

A.3.4 "The outside-to-inside level difference for a partially open window is related to the window opening area, type and orientation in respect of directional noise sources. This is likely to differ from project-to-project and would require due consideration as part of a Level 2 assessment. A 13 dB correction ought not to be automatically taken as appropriate for all cases."

A.3.5 When considering the middle category in terms of L_{Aeq}, it should be noted that while it is possible that an adverse effect could potentially be observed in the range 35-40 dB $L_{Aeq, 16 hour}$ and 30-35 dB $L_{Aeq, 8 hour}$, it would normally be negligible (since BS 8233 and the AVO guide both indicate that the BS 8233 guideline levels can be increased by 5 dB while still achieving reasonable internal noise levels).

A.3.6 When considering the middle category in terms of L_{Amax}, it may be relevant to refer to the guidance for hotels in BS 8233:2014. This could indicate that an adverse effect is unlikely until internal noise levels exceed 55 dB L_{Amax} more than 10 times per night.

A.3.7 A full level 2 assessment would also require assessment of how frequently and for what duration the overheating condition occurs. This would necessitate input from, and collaboration with, other experts. This information would then be analysed in conjunction with the noise levels to determine the likely overall significance. The values in the table under A.3.1 could be modified by this information. For example, if a daytime internal noise level of

52 dB $L_{Aeq,T}$ is assessed for the overheating condition but that only occurs for a short time on a very small number of days per year, the overall effect is not likely to be significant. Conversely, if a daytime noise level of 48 dB $L_{Aeq,T}$ is assessed for the overheating condition and that occurs for long durations on a large number of days per year, the overall effect is likely to be significant.

A.3.8 It should be noted that these assessments include clear thresholds to help enable consistent evaluations. It does not automatically mean (for example) that an internal daytime noise level of 50.0 dB equates to an insignificant adverse effect but 50.1 dB produces a significant adverse effect. A degree of judgement is likely to be required when noise levels are close to thresholds. Furthermore, as noise levels reach the upper part of the middle category in the table under A.3.1, there is an increasing risk of a significant adverse effect, which would need to be evaluated.

A.4 Building Services Noise

A.4.1 The guide also includes internal noise levels due to mechanical services, which will apply if such services are used to provide alternative means of ventilation to avoid opening windows under the overheating condition.

A.4.2 If a mechanical system provides whole dwelling ventilation, as defined in Approved Document F (ADF) of the Building Regulations, it would typically be through systems defined in ADF as System 3 (continuous Mechanical Extract Ventilation, MEV) or System 4 (continuous Mechanical supply and extract Ventilation with Heat Recovery, or MVHR). In these cases, the following noise levels are stated as being desirable, at the minimum low ventilation rates required for whole dwelling ventilation:

Whole Dwelling Ventilation with System 3 or System 4

- Bedrooms ≤ 25 dB L_{Aeq}
- Living Rooms ≤ 30 dB L_{Aeq}

A.4.3 If a mechanical system provides extract ventilation, as defined in ADF, it would typically be through systems defined in ADF as System 1 (intermittent extract fans), System 3 (continuous Mechanical Extract Ventilation, MEV) or System 4 (continuous Mechanical supply and extract Ventilation with Heat Recovery, or MVHR). In these cases, the following noise levels are stated as being desirable, at the minimum high ventilation rates required for extract ventilation:

Extract Ventilation with System 1, System 3 or System 4

- Bedrooms ≤ 25 dB L_{Aeq}
- Living / Dining Rooms ≤ 30 dB L_{Aeq}
- Bathroom / WC / Kitchen ≤ 45 dB L_{Aeq}

A.4.4 If a mechanical system is used for purge ventilation to rapidly dilute indoor pollutants as defined in ADF (for example to clear smoke or odours such as from burnt food or painting a decorating), no desirable noise levels are set. Generally, significantly increased noise levels would be accepted during purge conditions.

A.4.5 If a mechanical system is used to provide ventilation to mitigate overheating, it may be through the provision of ambient-temperature air at high ventilation rates (ventilative cooling) or the provision of cooled air (comfort cooling). In these cases, the following noise levels are stated as being desirable, at the rates required to control overheating:

Overheating Ventilation

- Bedrooms 30 (±5) dB L_{Aeq}
- Living / Dining Rooms 35 (±5) dB L_{Aeq}

A.4.6 The systems to control overheating would normally be user-controlled. The ventilation rates may or may not be the same as those required for Extract Ventilation under Building Regulations.

It should be noted that the desirable noise levels stated for the various categories above would require very careful selection and design of mechanical ventilation systems. This is especially the case for Extract Ventilation and potentially Overheating Ventilation.

[iv] Acoustics Ventilation and Overheating Residential Design Guide (Institute of Acoustics & Association of Noise Consultants, version 1.1, January 2020)

Appendix B - Survey Data

Attended Measurements

The results of the attended measurements are set out in the following tables (along with concurrent results from the non-attended measurements for comparison).

Start	End	BY 1.2 L_{Aeq}	BY 1.2 L_{Amax}	BY 1.2 L_{A10}	BY 1.1 L_{Aeq}	BY 1.1 L_{Amax}	BY 1.1 L_{A10}
14:45	15:00	60.1	74.3	63.2	55.7	65.9	58.3
15:45	16:00	60.2	72.0	63.2	55.0	61.4	57.5
16:45	17:00	59.9	79.0	62.8	54.9	67.5	57.5
Average Difference (BY 1.2 – BY 1.1)		4.9	10.2	5.3			

Table 10.4 Attended measurement results at BY 1.2 (and unattended at BY 1.1 for comparison)

Start	End	BY 2.2 L_{Aeq}	BY 2.2 L_{Amax}	BY 2.2 L_{A10}	BY 2.1 L_{Aeq}	BY 2.1 L_{Amax}	BY 2.1 L_{A10}
14:30	14:45	52.0	63.2	54.9	51.1	59.8	54.1
15:15	15:30	54.2	65.2	56.8	51.9	62.1	54.9
16:15	16:30	51.5	66.1	53.9	50.7	64.8	53.4
Average Difference (BY 2.2 – BY 2.1)		1.3	2.6	1.1			

Table 10.5 Attended measurement results at BY 2.2 (and unattended at BY 2.1 for comparison)

Measured Sound Level Histories

21-0009-H1: Sound level history from position BY 1.1

21-0009-H2: Sound level history from position BY 2.1

Figure 21-0009-H1

Sound Level History at Position BY 1.1

Melton Road, Brooksby

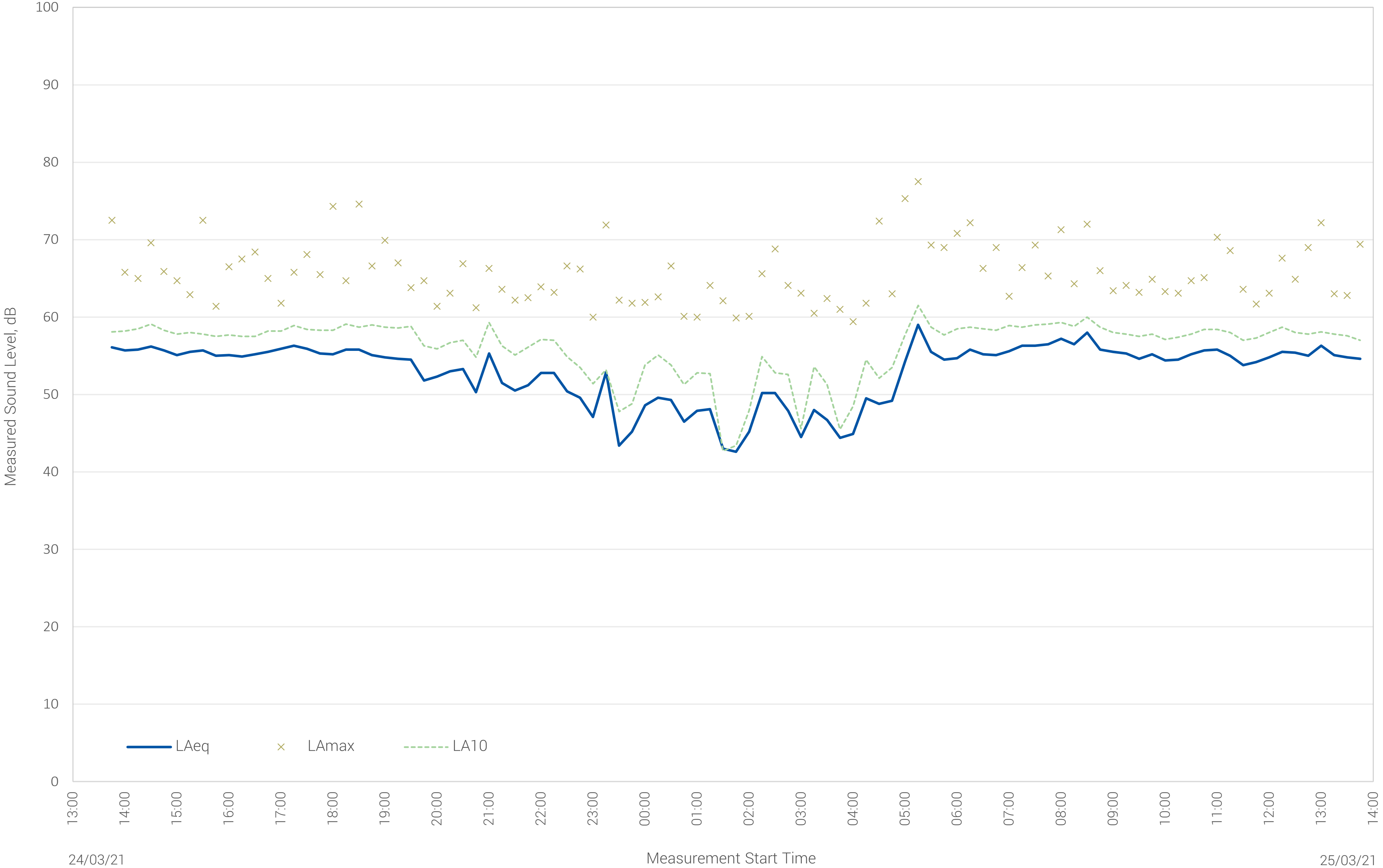
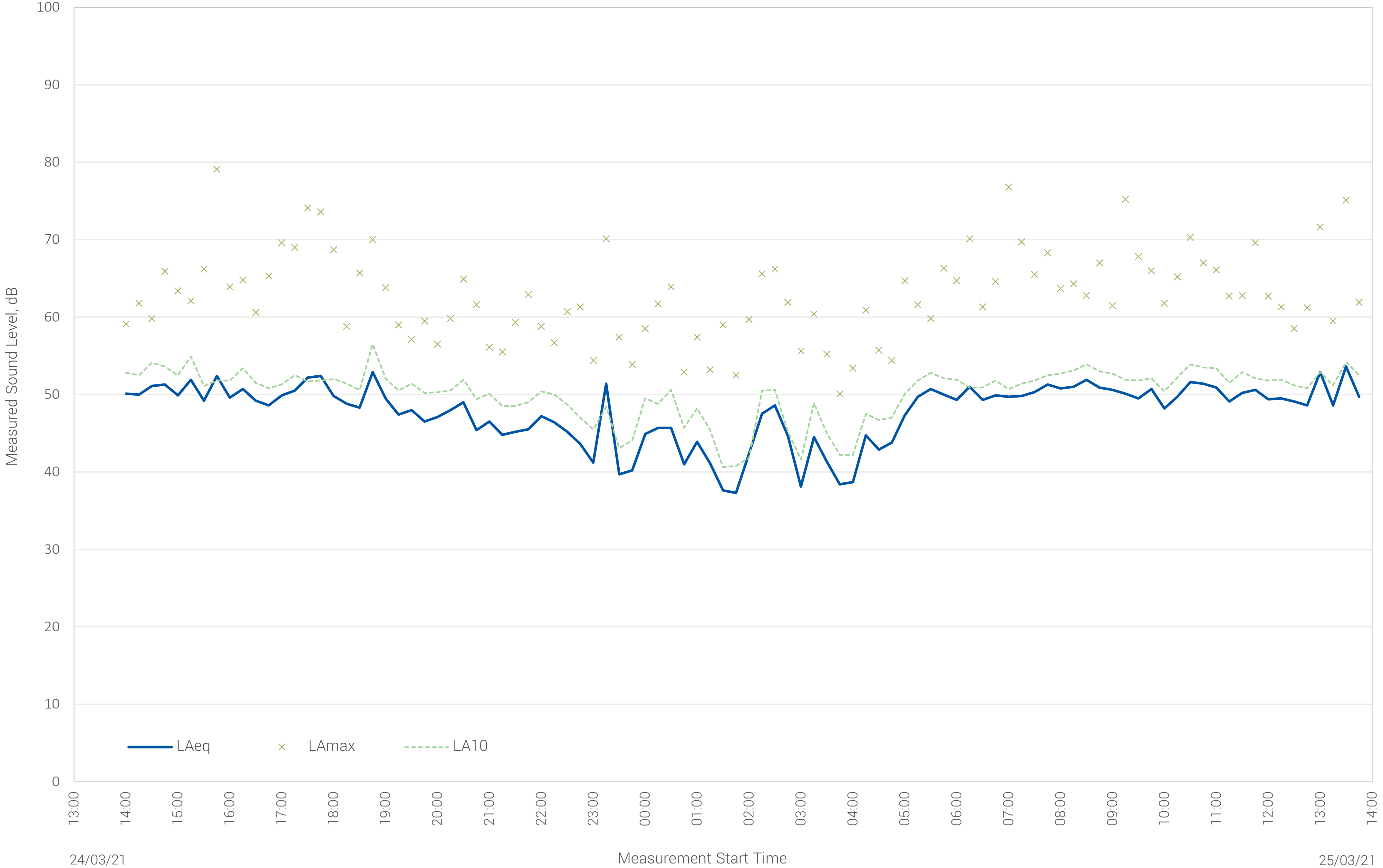


Figure 21-0009-H2

Sound Level History at Position BY 2.1

Melton Road, Brooksby



Glossary of Terms

deciBel: Usually written as decibel or dB, it is a logarithmic scale used for two purposes. One is to make the expression of numerical sound levels more convenient (with a smaller range and fewer digits). The other is to express sound levels in a manner aligned with human interpretation of differences in sound level, which itself is logarithmic in nature.

A-weighting: Applies different weight to sound levels at different frequencies, to represent the variation in sensitivity of the typical human ear with frequency. Thus, a single-value expressed in terms of dBA or dB(A) is the A-weighted sound level, which takes account of the frequency content of the sound.

L_{Aeq}: The A-weighted equivalent continuous sound level in dB. This unit can be described as the notional steady noise level that would, over a period, contain the same energy as the fluctuating noise source. It is often considered as the energy average level. This unit is typically used to described typical day and night time noise levels.

L_{A90}: The A-weighted sound level (in dB) exceeded for 90% of the time specified. This level gives an indication of the sound level during the quieter periods of time in any given fluctuating sound sample. It is used to describe the "background sound level" of an area.

L_{A10}: The A-weighted sound level (in dB) exceeded for 10% of the time specified. This level gives an indication of the sound level during the louder periods of time in any given fluctuating sound sample. It is typically used to help define, measure, and assess road traffic noise.

L_{Amax}: The maximum A-weighted level (in dB) of sound measured in any given period. This unit is used to measure and assess transient noises, particularly those such as individual vehicles, etc impacting on sensitive receptors at night. Unless otherwise stated, the L_{Amax} level is stated as measured using a “fast” sound level meter response (i.e. $L_{Amax, F}$).

L_{AX}, L_{AE}, or SEL: The sound exposure level which contains, within a notional 1-second period, the same quantity of sound energy as the time varying level contained in a single noise event. It could be considered an L_{Aeq} level normalised to 1 second. The use of this unit allows the calculation of the $L_{Aeq, T}$ level over a given period of time for a known number of such single noise events.

$L_{Ar,Tr}$: The BS4142:2014 defined rating level comprising the specific noise level for a given source over a given time period, T_r, plus any adjustment for the characteristic features of the noise.