SHARPS REDMORE

ACOUSTIC CONSULTANTS · Established 1990

Report

Environmental Noise Assessment

Whitehall Works, Whitehall Lane, Grays

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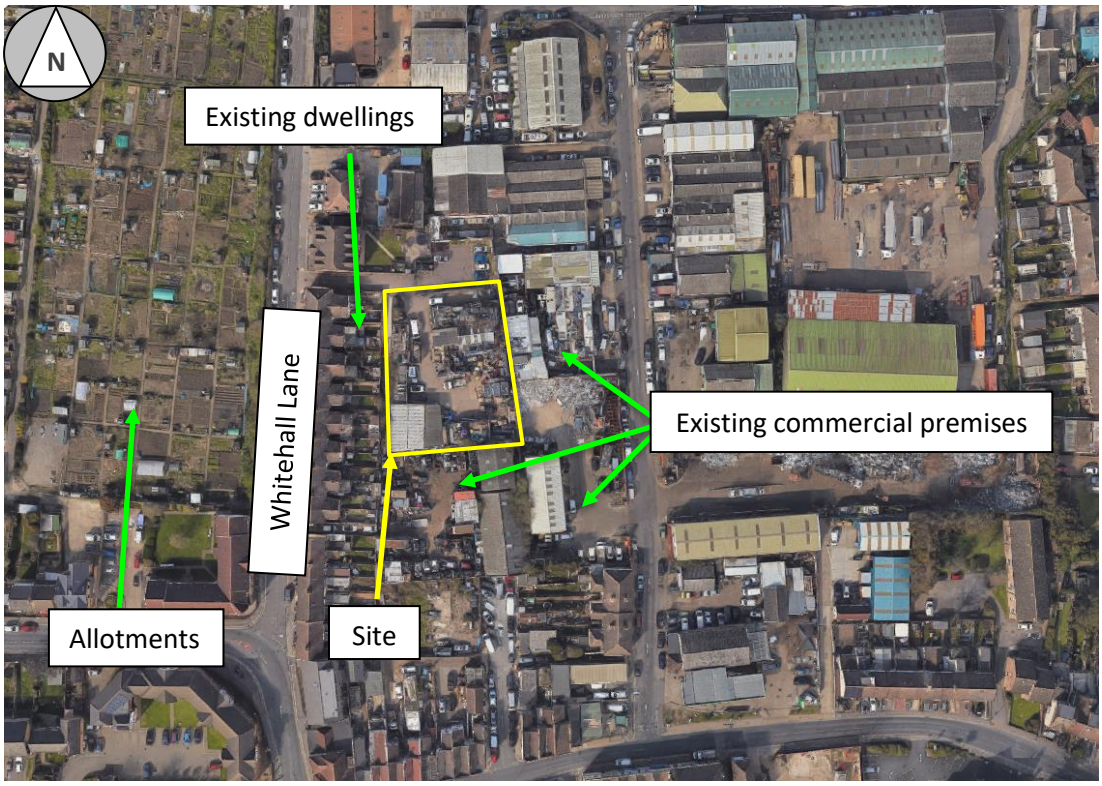
1.0 Introduction

1.1 Sharps Redmore (SR) has been instructed to undertake an acoustic assessment for the proposed erection of six terraced dwellings at Whitehall Works, Whitehall Lane, Grays, Essex. The site location and surrounding area is shown in Figure 1.1 below.

FIGURE 1.1: Site Location (approximate outline)



1.2 The site is located to the east of existing terraced dwellings along Whitehall Lane, further east of the site are single storey industrial buildings, serving as a scrap depot and a MOT centre. To its south there is another two-storey car repair garage. The surrounding premises operate between the hours of 8am to 6pm Monday to Saturday.

1.3 The proposal is to erect six terraced 3-bedroom dwellings with associated amenity spaces on land currently used as a scrap yard. A previous planning application (reference no.: 20/00108/FUL) for the erection of seven dwellings was refused, with noise associated with the existing adjacent commercial premises noted as one of the reasons for refusal.

1.4 A guide to the acoustic terminology used in the report is included in Appendix B.

2.0 Assessment Methodology and Criteria

National Policy

2.1 The National Planning Policy Framework (NPPF), September 2023, sets out the Government's planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 185 of the NPPF states the following:

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

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

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

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

2.2 Guidance on the interpretation of the policy aims contained within the NPPF is contained within National Planning Policy Guidance (NPPG). The NPPG introduces the concept of a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in the table below:

TABLE 2.1: Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate ad reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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 Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.3 The NPPF and NPPG reinforce the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

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

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.4 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.5 Taking an overview of national policy aims and guidance it is clear that when considering the impact of noise that the fact can be heard and causes impact, is not reason to refusal an application as consideration should also be given to the significance of the impact and the mitigation measures available.

2.6 It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

i) The effect may be determined by reference to guideline noise values, such as those contained in the World Health Organisation (WHO) "*Guidelines for Community Noise"*.

ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.

iii) Another method is described within BS 4142:2014 to determine the significance of sound impact from sources of industrial and/or commercial nature. The sources that the newly revised standard is intended to assess are sound from industrial and manufacturing processes, sound from fixed plant installations, sound from loading and unloading of goods at industrial and/or commercial premises and the sound from mobile plant and vehicles, such as forklift, train or ship movements.

Design Guidance

2.7 The current nationally recommended internal noise levels for dwellings are given in BS 8233:2014 (BS 8233) 'Guidance on Sound Insulation & Noise Reduction for Buildings'. BS 8233 recommends the following internal noise standards:

TABLE 2.2: Guideline noise values

BS 8233:2014 Table 4 – Indoor ambient noise levels for dwellings			
Activity	Location	0700 to 2300	2300 to 0700
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

2.8 The previous version (1999) of BS 8233 contained two guidelines for internal criteria; good and reasonable. The difference between the good and reasonable criteria was 5 dB. Whilst the 5 dB relaxation in noise criteria is not specifically referred to in the table above, Note 7 advises that "where development is considered necessary or despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."

2.9 There is no longer a L_{Amax} standard for bedrooms In BS 8233. However, footnote 4 to Table 4 states that "Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values." In this case, it is proposed that the previous BS 8233 internal standard (also referenced in World Health Organisation Guidelines for Community Noise) is applied. This is 45 dB L_{Amax} inside bedrooms occurring no more than 10 – 15 times per night.

2.10 In respect to external amenity spaces Para. 7.7.3.2 of BS 8233 states:

For traditional external areas that are used for amenity, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$. which would be acceptable in noisier environments. However, it is 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, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity space, but should not be prohibited.

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 such uses 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, design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.

Approved Document O: Guide to Overheating

2.11 Approved Document O to the Building Regulations took effect on 15th June 2022 and Section 3 of the document considers suitable means of controlling overheating in buildings. It states that windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

- 40 dB $L_{Aeq,T}$ averaged over 8 hours (between 11pm and 7am).
- 55 dB L_{Afmax}, not exceeded more than 10 times a night (between 11pm and 7am).

2.12 Should assessment indicate locations where the limits above are expected to be exceeded, windows are to remain closed to control noise ingress and alternative means of mitigating overheating must be sought.

Assessment Using BS 4142:2014+A1:2019 (BS 4142)

2.13 As outlined, this British Standard enables the significance of sound impact to be determined in relation to industrial and commercial sources. The significance of sound impact is to be determined according to the following summary process:

i) Determine the background sound levels, in terms of the index L_{A90}, at the receptor locations of interest.

ii) Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 15 minutes for night), at the receptor location of interest.

iii) Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.

iv) Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.

v) A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon context.

vi) The intent of the planning system is to ensure that a development does not result in "significant adverse impacts on health and quality of life." BS 4142 considers that the threshold of significant adverse impact is "a difference around +10 dB or more … depending upon the context". However the NPPF and NPPG state that where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement *"…all reasonable steps should be taken to mitigate and minimise adverse effects in health and quality of life while together taking into account the guiding principles of sustainable development. This does not mean that adverse effects cannot occur but that effort should be focused on minimising such effects*

2.14 BS 4142 introduces the concept of 'context' to the process of identifying noise impact. Section 11 of BS 4142 explains "The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs (our emphasis). An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context" (our emphasis).

2.15 There are many *context* points to consider when undertaking an assessment of sound impact including:

- The absolute level of sound;

- The character and level of the specific sound in the context of the existing noise climate; for example is the sound to occur in a location already characterised by similar activities as those proposed?
- The sensitivity of the receptors;
- The time and duration that the specific sound is to occur;
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level;

2.16 It is therefore entirely possible that whilst the numerical outcome of a BS 4142 assessment is indicative of adverse or significant adverse impact, when the proposal is considered in *context* the significance of the impact is reduced to an acceptable level.

Local Policy

2.17 The site falls within the administrative area of Thurrock Council (TC) who previously refused permission for the erection of seven dwellings (reference no.: 20/00108/FUL). The delegation report highlighted that whilst the council's environmental health officer (EHO) raised no objections to the proposal and agreed that the glazing specified in the noise report accompanying the application would achieve the requirements of BS 8233, a condition requiring a scheme of noise mitigation would be appropriate.

2.18 The delegation report also stated that the accompanying noise report only refers to internal noise levels as a result of glazing and is likely to only be effective during the winter months due to the requirement of having sealed window units. It concluded that the proposal fails to provide suitable living environments for future occupiers, contrary to policy PMD1.

2.19 The decision notice referred to the likely result of unacceptable noise disturbance for the private amenity space due to the close proximity to the existing commercial uses.

2.20 TC has a local plan titled "Core Strategy and Policies for Management of Development" which was adopted in January 2015. Policy PMD1 titled "Minimising Pollution and Impacts on Amenity, Health, Safety and the Natural Environment" states the following:

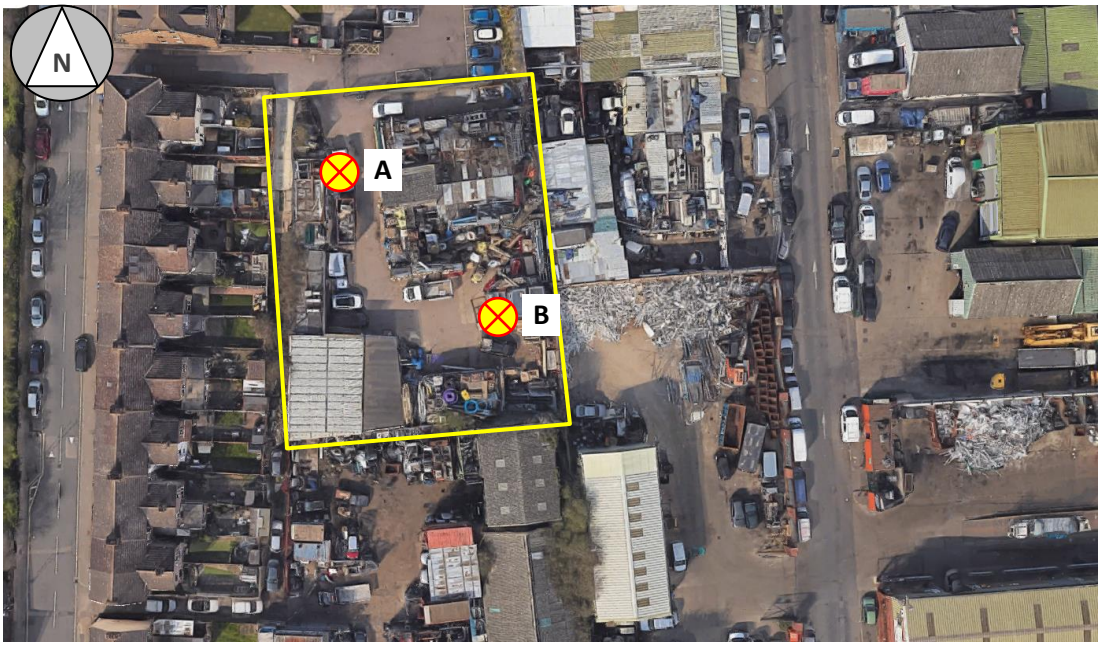
"3. The Council will require assessments to accompany planning applications where it has reasonable grounds to believe that a development may suffer from, or cause:

ii. Noise pollution;"

3.0 Noise Survey Details

3.1 A noise survey was carried out between 10:30 hours on Wednesday 13th and 10:00 hours on Friday 15th September 2023 at two locations on the site, the measurement locations are shown in Figure 3.1 below. At Location A, the microphone was installed at approximately 3m above local ground level and at Location B the microphone was at 2.5m above local ground level. At both locations noise levels were recorded over 15-minute periods.

FIGURE 3.1: Measurement locations



3.2 Noise levels were measured using a Norsonic 140 Class 1 (Location A) and a Rion NL52 Class 1 (Location B) sound level meter which were calibrated before and after the surveys with no drift in accuracy found in either meter. Weather conditions throughout the survey were dry, warm with light south-easterly/south-westerly winds. The weather was suitable for taking noise measurements.

3.3 Table 3.1 below presents a summary of the noise levels obtained and graphical results of the survey periods are contained within Appendix A. Full results are available on request.

TABLE 3.1: Summary of typical noise levels – 13th to 15th September 2023 (free field)

Location	Daytime dB $L_{Aeq,16hr}$	Daytime dB $L_{A90,16hr}$	Night-time dB $L_{Aeq,8hr}$	Night-time dB $L_{A90,8hr}$	Night-time dB L_{AfMax*}
A	57	45	45	39	61
B	59	43	42	37	57

*Level not exceeded more than 10 times in the night period

3.4 Noise levels were dominated by road traffic with occasional activity from the neighbouring businesses. At Location A, incident noise levels during the daytime are likely to be lower than that measured once the dwellings have been built, as the new dwellings will be somewhat screened from noise associated with adjacent businesses.

4.0 Noise Assessment

4.1 The octave band levels in Table 4.1 are associated with the typical external dBA noise levels presented in Table 3.1 and have been used as part of the building envelope assessment for the proposed dwellings.

TABLE 4.1: Octave Band Linear Frequency Spectra

Measurement Location (façade)	Parameter	Octave Band Centre Frequency Hz								dBA
		63	125	250	500	1k	2k	4k	8k	
A (rear/west façade)	Day dB L_{eq}	58	53	53	50	50	51	49	45	**57**
	Night dB L_{eq}	50	48	46	45	40	29	14	12	**45**
	Night typical dB L_{fmax}	66	61	62	60	56	47	42	34	**61**
B (front/east façade)	Day dB L_{eq}	59	51	58	60	52	48	43	34	**59**
	Night dB L_{eq}	46	45	44	41	37	28	15	14	**42**
	Night typical dB L_{fmax}	54	53	55	46	50	34	51	53	**57**

4.2 Having reviewed the drawings provided in terms of room and window sizes, noise break-in calculations have been undertaken in accordance with the method outlined in BS 8233:2014 and the sound insulation required of the external wall, window and ventilation systems have been reviewed. It has been assumed that the rooms have a height of 2.4m.

4.3 The airborne sound insulation performance of wall and window elements are given in terms of R_w for laboratory requirements (measured in accordance with BS EN ISO 10140-2 2021 and rated in accordance with BS EN ISO 717-1 2020 or national equivalent).

4.4 The airborne sound insulation performance of ventilation elements are given in terms of $D_{ne,w}$ for laboratory requirements (measured in accordance with BS EN ISO 10140-2 2021 and rated in accordance with BS EN ISO 717-1 2020 or national equivalent).

External Wall

4.5 For the purpose of the assessment it has been assumed that a standard cavity wall construction will be used and is likely to give the minimum sound reduction performance of 49 dB R_w required to meet suitable internal noise levels.

Roof

4.6 The proposed roof is to be pitched and using a standard construction for a pitched roof which offers a minimum sound reduction performance of 43 dB R_w, suitable internal noise levels in the second floor master bedrooms with such installed roof can be achieved.

Glazing Elements

4.7 The window and glazed door system must be considered as the glazing element, seals and frame combined. For all habitable rooms (kitchens, living / dining rooms and bedrooms) the chosen glazing systems must achieve a minimum sound reduction of 33 dB R_W. An example of this is standard thermal double glazing comprising of 4mm glazing-10mm air gap-6mm glazing.

Openable Panels

4.8 The design of the dwellings includes acoustic panels covering openable wall fragments, within the first floor bedrooms only. For the purposes of the calculation we have assumed that the internal composite panel would be akin to a UPVC composite panel with PIR with a minimum sound reduction of 33 dB R_w.

4.9 Considering the mitigation measures available, suitable internal noise levels within the dwellings can be achieved and noise from adjacent commercial premises will not cause an adverse impact in line with the policy aims of the NPPF.

Mechanical ventilation within residential units

4.10 MVHR is being proposed for the dwellings to minimise the need to open the windows. It is recommended internally that the following maximum levels (taken from suitable guidance) from HVAC related background sound should be used as a criterion (excluding external noise sources):

- Bedrooms = NR 20 to 25
- Other habitable rooms = NR 25 to 30

Note: dBA ≈ NR + 6

Overheating

4.11 As stated in Section 2 (paragraphs 2.11 and 2.12), Approved Document O states specific enforceable criteria for noise which are summarised as:

- 40 dB $L_{Aeq,T}$ averaged over 8 hours (between 11:00 and 07:00 hours).
- 55 dB L_{Afmax}, not exceeded more than 10 times a night (between 11:00 and 07:00 hours).

4.12 The site external noise levels mean that internal noise levels are likely to be meet the above criteria.

External Amenity

4.13 The proposed main external amenity spaces are outdoor rear gardens to the west of the site, adjoining to the rear gardens of the dwellings fronting Whitehall Lane. Using the daytime noise level measured at the north-west of the site, 57 dB $L_{Aeq,T}$, the external amenity spaces are just above the BS 8233 upper limit of 55 dB $L_{Aeq,T}$. However, as the measurement was taken at 3m as opposed to ground floor height, usually taken as 1.5m for a person sitting down, along with screening from the existing houses, proposed houses, the proposed 3m high acoustic fence along the east and south boundaries as well as assumed closed boarded fence for privacy in between the external gardens, it is likely that noise levels less than 55 dB will be realised.

4.14 Units 1, 3 and 5 propose to have a balcony for the master bedrooms on the second floor on the front façade (facing east). The noise level measured to the east of the site was 59 dB $L_{Aeq,16hr}$. While this exceeds the upper limit recommended in BS 8233, it states that the guideline values are not always achievable especially where a development is desirable. It also states that in higher noise areas, a compromise between elevated noise levels and factors such as the site location or making efficient use of land resources, might be warranted. It should also be noted that these are not the only amenity spaces available to the occupants, with access to the rear gardens with lower than 55 dB $L_{Aeq,T}$ noise levels also being an option.

Mechanical Services Plant

4.15 The precise details of the fixed plant equipment for the development are to be finalised, however, the fixed plant is likely to comprise of the MVHR units. It is appropriate to seek to set plant noise limits that could be secured through imposition of a suitably worded planning condition, based on the survey background sound levels.

4.16 The objective assessment of plant sound sources in commercial premises should be undertaken in accordance with British Standard 4142:2014+A1:2019. This Standard enables the resultant sound levels from new plant equipment to be compared against the existing background sound level (L_{A90}) of an area to assess the impact.

4.17 In terms of seeking to set appropriate plant rating sound limits, the advice in BS 4142 is that "The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source of having a low impact, depending on the context" (clause 11, note 'd'). Hence in relation to the guidance from BS 4142 there is a technical case to seek to set plant sound limits that match the current typical background sound climate.

4.18 The September 2023 noise survey indicates the most onerous typical background noise levels at the site are 43 dB daytime and 37 dB during the night-time. In view of these measured levels and the guidance above, it is proposed that plant rating noise level limits should be set at 43 dB daytime and 37 dB at night.

5.0 Conclusions

5.1 Sharps Redmore has undertaken an acoustic assessment to accompany a planning application for the proposed erection of six terraced houses at Whitehall Works, Whitehall Lane, Grays, Essex.

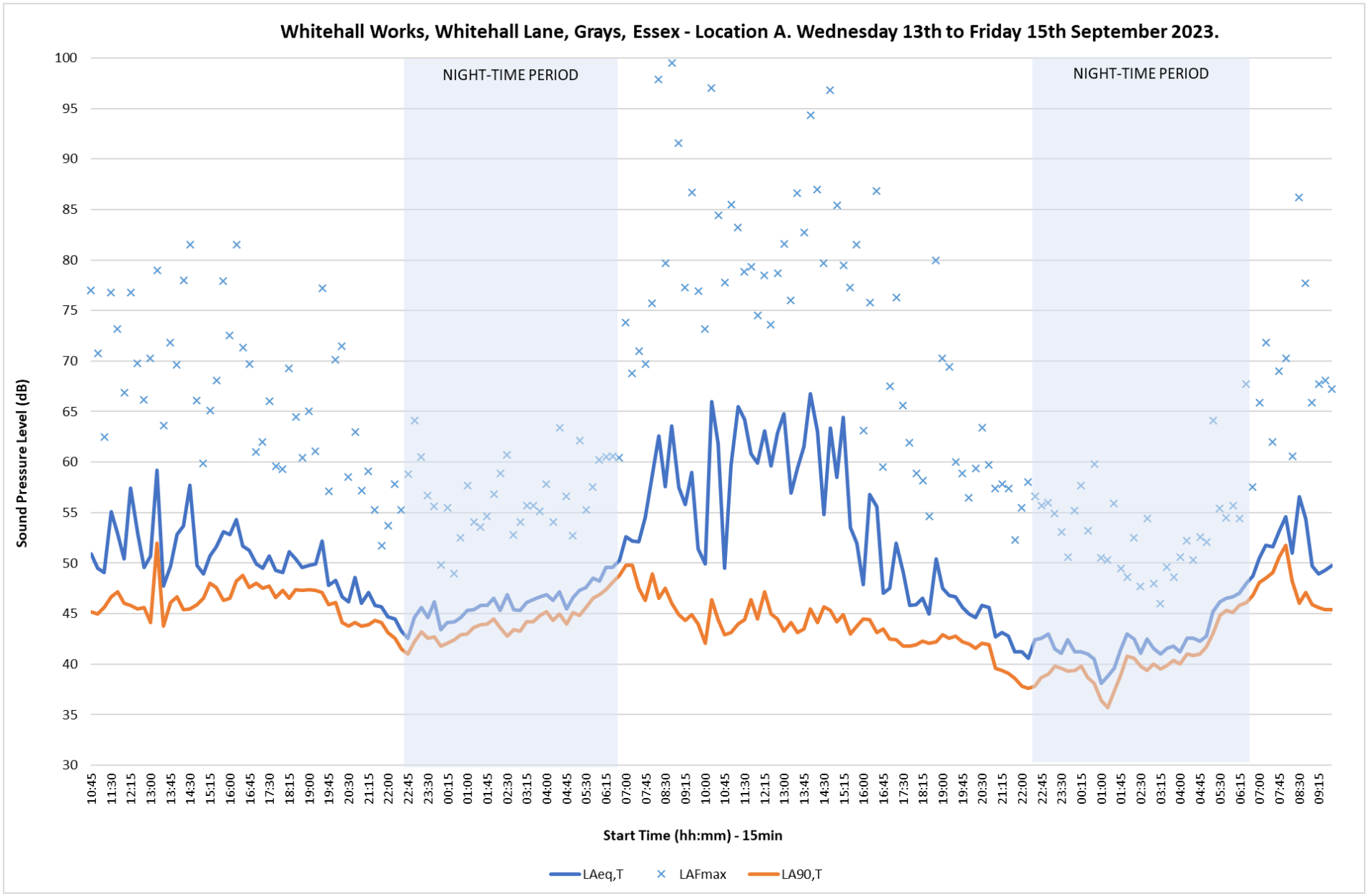
5.2 An environmental noise survey has been carried out to measure existing daytime and night time ambient noise levels on both the front and rear façades.

5.3 A performance specification has been given for external wall, roof and glazed window/door systems necessary to achieve the internal noise criteria. The external amenity has also been considered.

5.4 Having regard to the mitigation measures that can be included within the scheme it is concluded that noise will not cause adverse impact to future residents in line with the policy aims of the NPPF and TC Local Plan.

APPENDIX A

NOISE SURVEY GRAPHS


Whitehall Works, Whitehall Lane, Grays, Essex - Location A. Wednesday 13th to Friday 15th September 2023.
NIGHT-TIME PERIOD
NIGHT-TIME PERIOD
Sound Pressure Level (dB)
100
95
90
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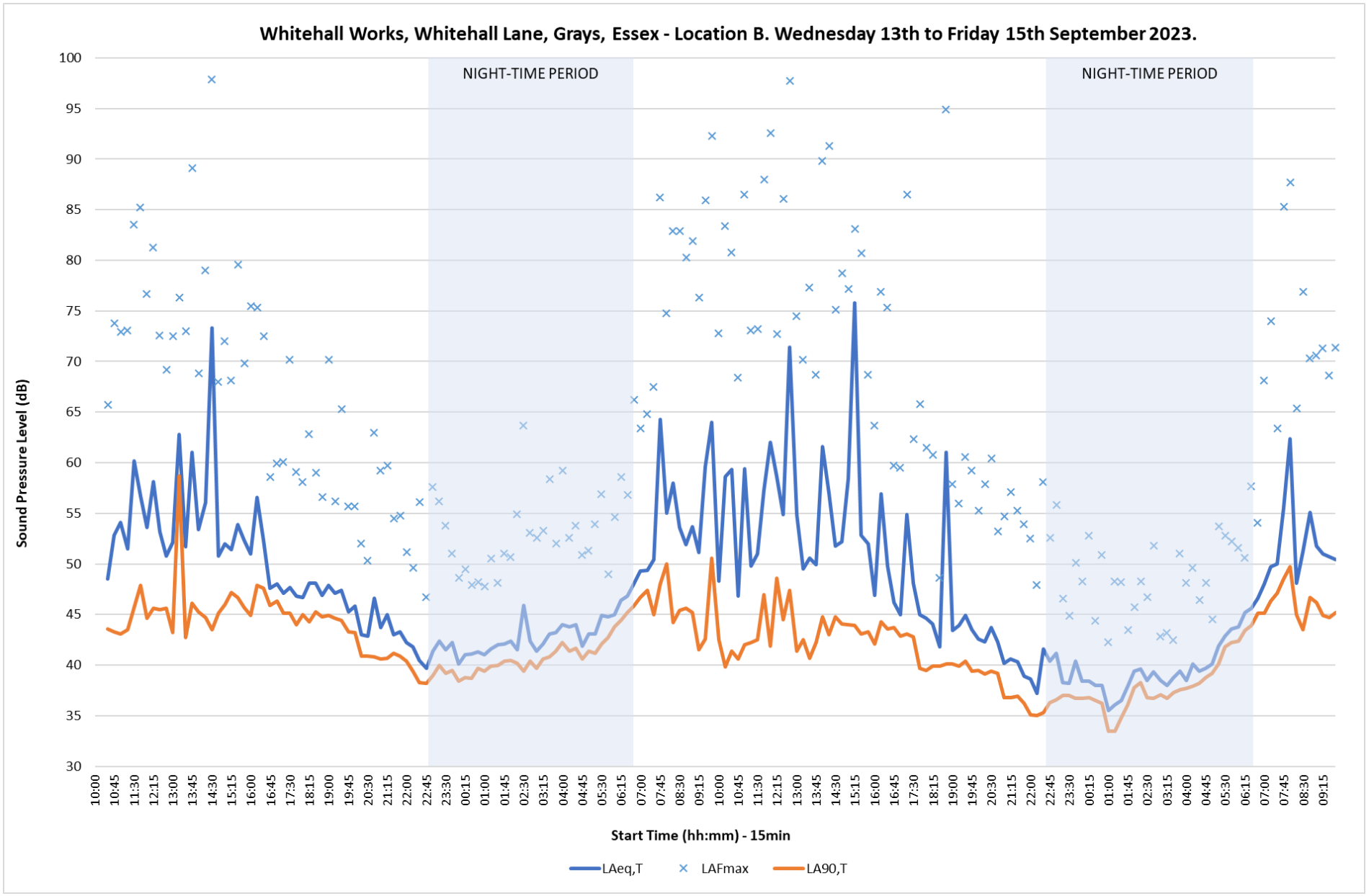
LAFmax
LA90,T


Whitehall Works, Whitehall Lane, Grays, Essex - Location B. Wednesday 13th to Friday 15th September 2023.
NIGHT-TIME PERIOD
NIGHT-TIME PERIOD
Sound Pressure Level (dB)
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06:15
07:00
07:45
08:30
09:15
Start Time (hh:mm) - 15min
LAeq,T
LAFmax
LA90,T

APPENDIX B

ACOUSTIC TERMS

Acoustic Terminology

1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible.

3 dB increase - just noticeable.

10 dB increase - perceived as twice as loud.

2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

6 The main noise indices in use in the UK are:

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

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10}: The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX}: The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB}.$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = 20 Log (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \text{ Log } {}^{160}/_{10} = 60 - 24 = 36 \text{ dB}.$$