



Anderson
Acoustics

PLANT NOISE ASSESSMENT

WIX HILL, WEST HORSLEY, LEATHERHEAD

MR. NICK SCOTT

FEBRUARY 2024

PLANNING NOISE ASSESSMENT WIX HILL, WEST HORSLEY, LEATHERHEAD

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APPENDIX A: NOISE SURVEY RESULTS

1 INTRODUCTION AND SUMMARY

Anderson Acoustics Ltd has been commissioned by Mr. Nick Scott to undertake a noise impact assessment to support a planning application for the operation of a swimming pool heating system at The White House, Wix Hill, West Horsley, Leatherhead.

Guildford Borough Council has requested a detailed noise impact assessment be carried out in order to:

- a) evaluate the existing acoustic environment and background sound levels at neighbouring noise sensitive receptors;
- b) establish appropriate plant noise emission limits that will be required outside noise sensitive receptors to maintain occupant amenity; and
- c) predict noise emission levels from the proposed installation at sensitive receptors and provide mitigation advice where required to comply with the noise emission limits.

Accordingly, guidance relevant to the assessment has been presented in Section 2; a brief description of the site and plant installation is given in Section 3; the methodology and results of an environmental noise survey undertaken at the site are given in Section 4; the assessment of the plant noise levels against the environmental noise survey results are presented in Section 5; and the conclusions are presented in Section 6. A glossary of acoustics terms can be viewed on the [Anderson Acoustics website](#).

2 ASSESSMENT CRITERIA

2.1 Local Authority Requirements

Guildford Borough Council has approved the planning application (Ref: 22/P/00500) subject to conditions, the following of which is related to noise:

- "2. *Within 4 months of the date of this decision, a noise impact assessment on the nearby noise sensitive properties must be carried out and then submitted to and approved in writing by the local planning authority. It should also include details of any noise mitigation measure required to ensure that the proposed installation will meet the following noise criteria:*

Any air handling plant, fixed mechanical, electrical or hydraulic equipment etc., installed and operated at any time in connection with the carrying out of this permission shall not produce broadband noise that is clearly audible at the boundary of any noise sensitive premises. The noise from the plant shall not impact more than -5dBA below the existing residual background noise level (LA90) or generate any transient, cyclical tonal or impact noise or vibration that would significantly increase the residual continuous equivalent noise level (> +1dBA LAeq) and be clearly heard at the nearest noise sensitive boundary. Correction factors must be included to account for any tonal characteristic and impulsivity of the noise (Ref BS4142:2019). A regular and routine maintenance programme will be employed to ensure operational plant does not increase noise output due to mechanical wear or defect that will result in any unit failing to meet the above noise criteria.

The development must then be carried out in accordance with the agreed noise impact assessment.

Reason: In the interests of protecting the local residents from unreasonable noise levels which would be detrimental to neighbouring amenity."

2.2 British Standard 4142 Methods for rating and assessing industrial and commercial sound

Guidance on the rating of noise from fixed installations and sources of an industrial nature is provided in BS 4142:2014+A1:2019 [1]. This standard provides a procedure for the measurement and rating of noise levels outside dwellings in mixed residential and industrial areas. A methodology for predicting the likelihood of adverse noise impact is provided in this document, but where the assessment of nuisance explicitly falls outside the scope of this British Standard.

The assessment methodology evaluates the "specific sound level" of each industrial or commercial sound source, corrects, where required, for distinguishable features to derive the "rating level", and compares this with the "background sound level".

The advice is that the background sound level ($L_{AF90,T}$) should be derived from continuous measurement of normally not less than 15 minute intervals over the period of interest, and that it should be representative of typical conditions at the noise-sensitive receiver(s) relevant to the period(s) of operation.

The specific sound level ($L_s = L_{Aeq,Tr}$) is obtained (by measurement or calculation) over a reference period of 1 hour in terms of the daytime (07:00 to 23:00) and 15 minutes during the night-time (23:00 to 07:00).

The rating level ($L_{Ar,Tr}$) is the specific sound level corrected to account for any acoustic features present in the sound in question, as experienced at the receptor, such as distinguishable, discrete, continuous noise (a whine, hiss, screech or hum etc.) or distinct impulses (bangs, clatters or thumps etc.). Where no correction is warranted, the rating level is equal to the specific sound level.

The “subjective method” to calculate the rating level incorporates the following corrections:

- up to +6 dB due to tonality, subjectively this might be +2 for a tone that is just perceptible, +4 where it is clearly perceptible and +6 where it is highly perceptible;
- up to +9 dB for impulsivity, subjectively this might be +3 for impulsivity that is just perceptible, +6 where it is clearly perceptible and +9 where it is highly perceptible;
- +3 dB if the intermittency is readily distinctive against the residual acoustic environment; and
- up to +3 dB for other acoustic features that are neither tonal nor impulsive, though readily distinctive at the receptor.

An “initial estimate” of the impact of the specific sound is calculated by subtracting the background sound level from the rating level. The following advice applies:

- a) Typically, the greater this difference, the greater the magnitude of the impact.
- b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. 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 on the context.

Key is the statement “depending on context”, since the significance of the sound in question 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. 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.

Where the initial estimate of the impact needs to be modified due to the context, the assessment should take into account all pertinent factors, including:

- the absolute level of sound;
- the character and level of the residual sound compared to the character and level of the specific sound; and
- the sensitivity of the receptor and whether dwellings will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

Helpfully, BS 4142 includes some example assessments, which include the following statements:

“Although the plant noise is somewhat different in character to the residual acoustic environment the rating level of 30 dB is low and will have little impact on residents using their patio during the evening.”

“In addition to the rating/background sound level comparison...” where “the primary concern is the potential for disturbance of residents who could be sleeping with open bedroom windows... Other guidance, such as BS 8233 [2], might also be applicable in this instance.”

“BS 8233 indicates that 35 dBA sound level from the plant, equating to an internal level of around 25dBA or lower, with no significant acoustically distinguishing characteristics is suitable for a bedroom.”

“...the residual acoustic environment varies considerably with time, which also tends to mask sound from the source, reducing its relative significance...”

An assessment, therefore, is effectively in two parts. The first part results in an initial indication of the impact, which is subsequently considered in terms the context unique to the situation at hand; and where this second part may require consideration of alternative guidance and metrics.

3 SITE DESCRIPTION

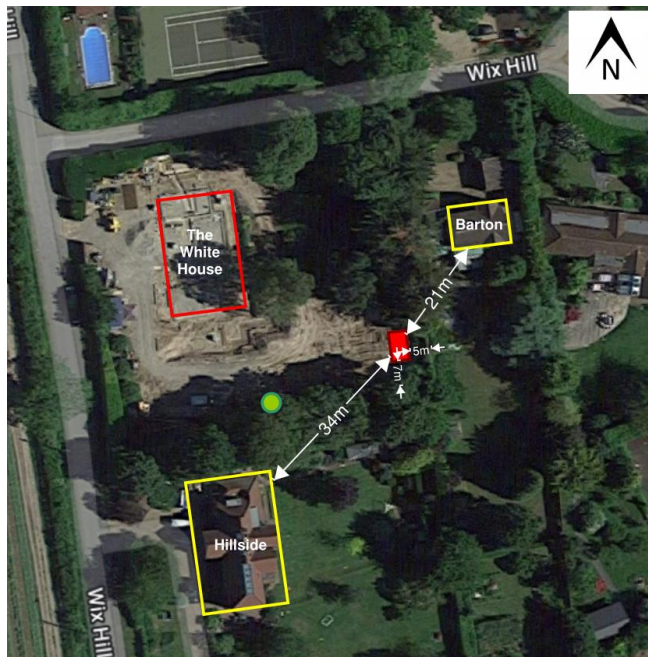
The site is located on Wix Hill, West Horsley, Leatherhead, in an area neighboured by residential properties.

The area where the plant is located is in the back garden of the property (known as The White House) and is approximately 5 m to the south-west of garden boundary of Barton and 21 m from Barton itself. The plant is located approximately 7 m to the north of the garden boundary of Hillside and 34 m to the north-east of Hillside itself. These neighbours have been recognised as the nearest noise-sensitive receptors (see Figure 3.1). On-site observations have established that neither receptor has a clear line of sight to the plant location.

During visits to site, it was noted that road traffic from the A246 was the most prominent sound source. Outside of this, distant aircraft movements associated with London Heathrow Airport and bird song were also audible. It was observed that landscaping work was taking place at the property, with site activities limited to 0900 – 1630 hrs (and where the night-time period is key here in any case).

The site boundary, the location of the plant, the nearest sensitive receptors and the location of the unattended environmental noise survey (detailed in Section 4) are illustrated in Figure 3.1 below.

Figure 3.1: Plant location (red), nearest sensitive receptors (yellow) and unattended survey location (green)



The application comprises of the installation of a swimming pool heating system located in the garden of The White House (see Figure 3.2).

The swimming pool plant comprises of a water pump, heat pump, chlorinator and jets installed within an aluminium enclosure (see Figure 3.3), and has a measured sound pressure level of 57 dBA at 2m from the unit (see Section 5.1 for measured spectrum information).

It has been confirmed by the client and verified with on-site measurements that the plant is in operation for approximately 10 minutes every hour during daytime and night-time hours. The client has also confirmed that the pool is not in use over the winter period and is covered every autumn (October) by a semi-solid safety cover until the end of Spring (May) the following year. The pool plant is shut off during this time and therefore will not emit any noise.

Figure 3.2: Swimming pool and associated plant location plan view

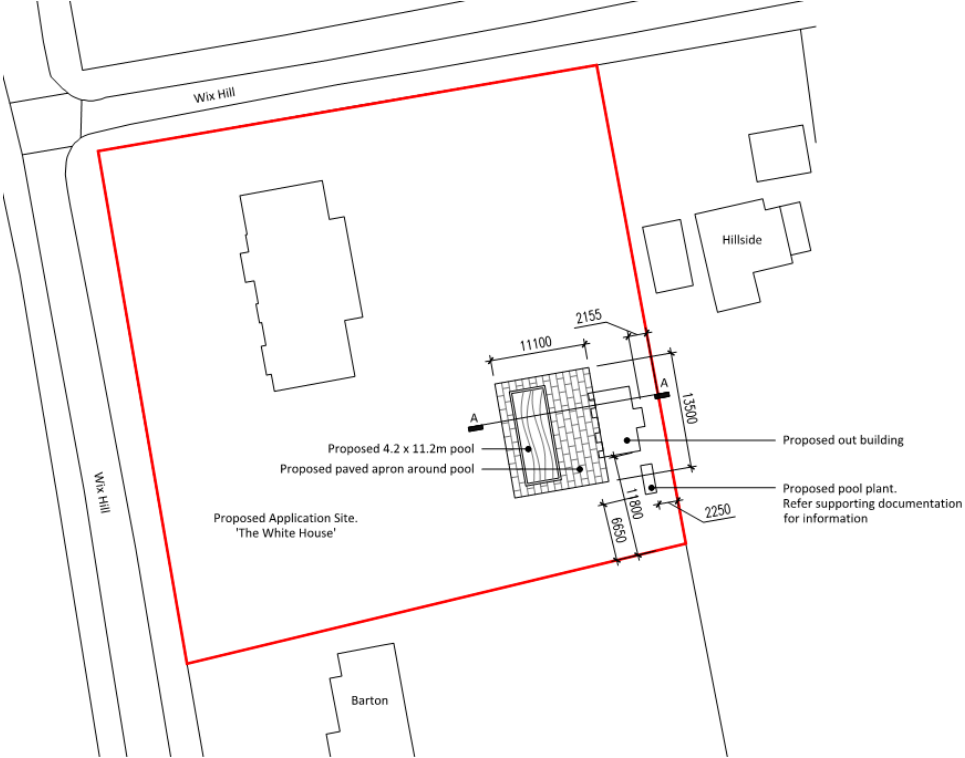


Figure 3.3: Swimming pool heating system enclosure (as installed)



4 SOUND LEVEL MEASUREMENTS

4.1 Unattended Survey and Measurement Procedure

Continuous, unattended sound level measurements were obtained over a 48-hour period between approximately 14:33 hrs on Monday 23rd January and 10:48 hrs on Wednesday 25th January 2023.

Consecutive 15-minute measurements of the $L_{Aeq,T}$ and $L_{AF90,T}$ noise indices were obtained under 'free field' conditions. The microphone was mounted at approximately 1.5m above the ground at the southern boundary of the garden of The White House, towards Hillside (see Figure 4.1).

Despite Barton being closer to the plant location, the fence and topography at the eastern boundary of the site mean that Hillside has a clearer view of the plant area. The measurement position is therefore considered representative of the noise environment at the most sensitive receptor.

Measurements were captured using a Rion NL-52 precision integrating sound level meter powered by dry cell batteries and stored inside a weatherproof environmental case, with a weatherproof windshield fitted to the microphone.

Figure 4.1: Location of sound level meter for the unattended survey (highlighted in green)



4.2 Attended Survey and Measurement Procedure

A supplementary 30-minute attended measurement was undertaken on the 23rd of January 2023. The sound level meter was positioned such that the microphone was located approximately 2m away from the enclosure, 1.5m above ground level under 'free field' conditions.

All survey equipment was calibrated before and after each survey using a Rion NC-74 sound calibrator to generate a calibration level of 94.0 dB at 1 kHz. No significant calibration drift was observed. Equipment details are summarised in Table 4.1.

4.3 Equipment Details

Table 4.1: Survey equipment details

Equipment	Serial no.	Date calibrated	Calibration certification number ¹
Rion NL-52 sound level meter (unattended survey)	00743139	15/04/2021	UCRT21/1498
01 dB DUO (attended survey)	10667	30/04/2021	1500195-1
Rion NC-74 calibrator	34625656	24/02/2022	1501872-1

¹Certificates available on request

4.4 Weather Conditions

Weather conditions during the survey periods have been obtained from an internet source www.wunderground.com (weather station in Leatherhead), which indicates wind speeds were low (at less than 3 m/s) and conditions were predominantly dry. Indeed, at the time of setting up and collecting the unattended sound level meter, conditions were noted to be dry with a light breeze.

Accordingly, the measured levels are not anticipated to have been adversely or atypically affected by the weather conditions.

Due to the presence of the major noise sources of A246 in the area, the noise conditions – especially the background (L_{A90}) levels – could be subject to change under different meteorological conditions (since these can affect how sound propagates over larger distances).

Since the A246 is primarily to the North and West of the site, and prevailing wind direction is from the South-West (thus towards the North-East), sound from the A246 should typically be lower than under other (atypical) wind directions or other (atypical) meteorological conditions that can affect sound propagation (such as temperature inversions). Since, therefore, the wind direct (albeit with low wind speeds) during the survey was primarily a combination of from the South and South-West, it is taken that any contribution of sound from the A246 will be a) representative of conditions typically; and b) at its lowest level, which is worst case for the purposes of the assessment (i.e. where the background sound levels, that the plant noise is compared against, would be lowest).

4.5 Results

The results of the continuous sound level monitoring survey are presented graphically in Appendix A and summarised in Table 4.2 below.

In keeping with the BS 4142 guidance, the typical measured $L_{AF90,15min}$ levels for the daytime and night-time periods are presented, which is determined by the most commonly occurring values over the course of each time period. For context, the period L_{Aeq} levels have also been presented, which are indicative of the ambient sound conditions.

At the time of installing and collecting the equipment, it was noted that landscaping work was taking place at the property and has been deemed atypical of the noise environment in the area (highlighted in red in Appendix A). Therefore, the results between working hours (1630 – 2300 on the 23rd of January, 0700 – 0900 and 1630 – 2300 on the 24th of January, and 0700-0900 on the 25th of January) have been removed from the daytime L_{Aeq} and L_{AF90} results.

Table 4.2: Unattended Sound Level Survey Results

Time Period	$L_{Aeq,T}$, dB	Typical $L_{AF90,15min}$, dB
Day 07:00 to 23:00	51*	33**
Night 23:00 to 07:00	42	31

* - logarithmically averaged during morning and evening periods outside of landscaping working hours

** - most commonly occurring value during morning and evening periods outside of landscaping working hours

The results of the attended survey are presented in Table 4.3.

Table 4.3: Attended Sound Level Survey Results

Plant Operation	Time of Measurement	$L_{Aeq,T}$, dB	$L_{AF90,T}$, dB
Off	14:35 to 15:02	43	37
On	15:02 to 15:12	57	56

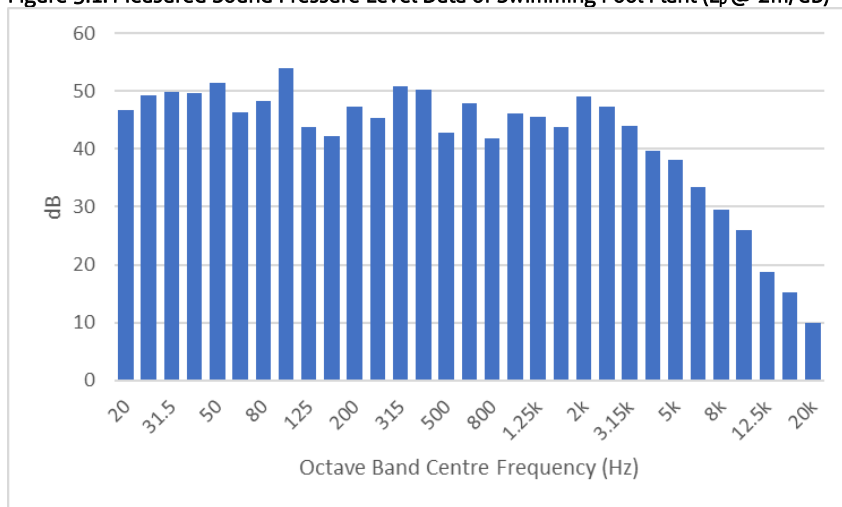
The attended sound level measurements captured a full and uninterrupted 10-minute period of the plant performing a cycle and is considered representative of the installed plant in operation (at 2m distance).

5 ASSESSMENT

5.1 Plant Details

Measured sound level data for the installed plant is summarised in Figure 5.1 below, taken from the attended survey results at 2m from the plant location. They are the un-weighted (i.e. linear) sound pressure levels in the 1/3rd octave bands between 20 Hz and 20 kHz. As per Table 4.2 above, the single figure A-weighted sound pressure level was 57 dB ($L_{Aeq,T}$).

Figure 5.1: Measured Sound Pressure Level Data of Swimming Pool Plant (L_p @ 2m, dB)



Whilst there are slight peaks in some frequency bands (particularly at 100 Hz), according to the objective method in BS 4142, these do not indicate the presence of a prominent tone. Indeed, no tonal sounds or other notable characteristics were observed.

5.2 Noise Criteria

Based on the Council’s requirement for the plant noise to not exceed the -5dBA below the existing residual background sound level, and that the plant operates day and night, the relevant limit is therefore 28 dB ($L_{Ar,Tr}$) during daytime hours and 26 dB ($L_{Ar,Tr}$) at night-time hours.

It needs to be acknowledged that this is a very low level, however, which may be lower than is necessary to avoid an adverse impact in practice.

BS 8233 provides guidance on external noise levels for amenity areas (e.g., private gardens, terraces etc.) which states that:

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

Additionally, as stated in Section 2, BS 4142 includes some example assessments, which include the following statements:

“Although the plant noise is somewhat different in character to the residual acoustic environment the rating level of 30 dB is low and will have little impact on residents using their patio during the evening.”

“In addition to the rating/background sound level comparison...” where “the primary concern is the potential for disturbance of residents who could be sleeping with open bedroom windows... Other guidance, such as BS 8233, might also be applicable in this instance.”

“BS 8233 indicates that 35 dBA sound level from the plant, equating to an internal level of around 25dBA or lower, with no significant acoustically distinguishing characteristics is suitable for a bedroom.”

On balance, it is considered that the target of 28 dB at the garden boundary and 26 dB at the neighbouring façade should be considered as aspirational, but that rating levels of up to 50 dB at the garden boundary and 35 dB at the neighbouring façade could be acceptable where all reasonable steps have been taken to keep levels to a practicable minimum.

5.3 Calculations

The plant rating levels are calculated as follows.

Table 5.1: Calculated Rating Level at Nearest Noise Sensitive Window (Daytime Assessment)

Description	Barton	Hillside	Notes
Measured sound level of plant at 2m (d1), $L_{Aeq,T}$	57 dB		As per Table 4.3
Distance (d2): source to receptor	5 m	7 m	The receptor is taken to be the boundary of the garden of each property
Distance correction: $20\log(d1/d2)$	-14 dB	-17 dB	Based on geometric spreading of sound from a point source, since the size of the enclosure is relatively small, and the intervening ground is acoustically soft
Screening correction	-10 dB	-5 dB	The enclosure is well-screened from the Barton Garden. 10 dB is the standard value where full screening is provided. The on-site shed next to the pool house will provide partial screening.
Time correction: $10\log(T/Tr)$	-2 dB	-2 dB	Since the plant operational time (10 minutes per hour, T) is shorter than the assessment period (15 minutes at night, T_r), a correction applies
Specific sound level at 1m from window, $L_{As,Tr}$	31 dB	33 dB	This is the measured level plus the corrections for distance, screening and operational time.
Character correction	3 dB	3 dB	The operation of the plant is intermittent (approx. 10mins per hour), which would be audible at the boundary of the neighbouring gardens.
Rating level at 1m from window, $L_{Ar,Tr}$	34 dB	36 dB	This is the specific sound level plus the character correction
Threshold 1. Council criterion	28 dB		Based on the -5 dBA below the existing residual background sound level (Table 4.2)
Threshold 2. BS 8233 alternative criterion	50 dB		Based on the example in BS 8233 for external amenity areas.
Comparison of rating level with the three thresholds	+6 dB -16 dB	+8 dB -14 dB	It can be seen plant noise levels exceed the council’s criteria, but is well below the alternative criterion.

Table 5.2: Calculated Rating Level at Nearest Noise Sensitive Window (Night-time Assessment)

Description	Barton	Hillside	Notes
Measured sound level of plant at 2m (d_1), $L_{Aeq,T}$	57 dB		As per Table 4.3
Distance (d_2): source to receptor	21 m	34 m	The receptor is taken to be the nearest window of each property
Distance correction: $20\log(d_1/d_2)$	-20 dB	-25 dB	Based on geometric spreading of sound from a point source, since the size of the enclosure is relatively small, and the intervening ground is acoustically soft
Screening correction	-10 dB	-10 dB	The enclosure is well-screened from the receptors. 10 dB is the standard value where full screening is provided.
Time correction: $10\log(T/Tr)$	-2 dB	-2 dB	Since the plant operational time (10 minutes per hour, T) is shorter than the assessment period (15 minutes at night, Tr), a correction applies
Specific sound level at 1m from window, $L_{As,Tr}$	25 dB	20 dB	This is the measured level plus the corrections for distance, screening and operational time.
Character correction	0 dB	0 dB	The sound does not contain any distinctive acoustic characterises, and where the specific levels are also very low. Accordingly, whilst the operation is intermittent, this is not expected to be readily distinctive against the higher residual acoustic environment
Rating level at 1m from window, $L_{Ar,Tr}$	25 dB	20 dB	This is the specific sound level plus the character correction
Threshold 1. Council criterion	26 dB		Based on the -5 dBA below the existing residual background sound level
Threshold 2. Alternative criterion	35 dB		Based on the example in BS 4142 and the criterion in BS 8233 for bedrooms at night
Comparison of rating level with the two thresholds	-1 dB -10 dB	-6 dB -15 dB	It can be seen that no threshold is exceeded at both noise sensitive receptors. See further discussion below.

5.4 Discussion and Mitigation

In regard to the daytime assessment, BS 4142 states that: "A difference (of the rating level to the background level) of around +5 dB is likely to be an indication of an adverse impact, depending on the context." Results in Table 5.1 indicate that the installed plant is likely to exceed the background noise level between 6-8 dB at the boundary of the nearest garden.

This is subject to a further consideration of context, where it is shown that the calculated levels are expected to be well below the measured ambient noise levels and the BS 8233 guidance for external amenity areas. Additionally, when the neighbouring gardens are in use, it is not expected that the user of the garden will be located at the very boundary of the garden and more likely towards the centre. This increase in distance is also expected to decrease the experienced noise levels in the neighbouring gardens. Finally, after discussions with the client, the installed plant will only be in operation during the Spring and Summer months and will be turned off during the winter months. Further decreasing the potential noise impact at the neighbouring gardens.

In regard to the night-time assessment, BS 4142 states that 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 on the context." Accordingly, it is likely that, at most, any noise impact would be "low".

This is also subject to further consideration of context, and where it is shown above that the rating levels are well below the level of 35 dB noted in BS 4142 as being suitable for outside a bedroom.

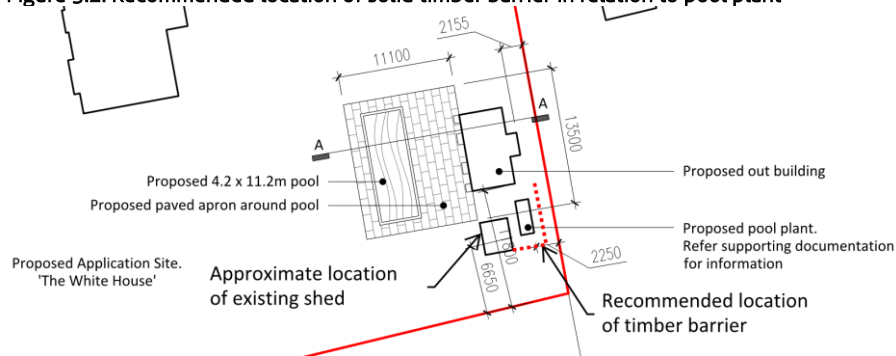
Further to this, it is shown in Table 4.2 that the night-time ambient level was 42 dB ($L_{Aeq,T}$), which, again, the rating levels are well-below.

In context, therefore, it is considered likely that there would be no adverse noise impact during daytime and night-time hours.

That being said, following the most recent refusal by Guildford Borough Council. Further discussion on mitigation measures have been explored to further reduce the potential noise impact at the neighbouring receptors.

It is recommended that a solid timber barrier be installed at location of the pool plant. The barrier would need to be constructed of 18 mm marine plywood (or a material of similar mass and resilience to external conditions). The exact height and extent of the barrier would need to be sufficiently high enough to block the line of sight to the garden boundary of the neighbouring receptors and sufficiently placed to support condenser air flow requirements, as shown in Figure 5.2 below.

Figure 5.2: Recommended location of solid timber barrier in relation to pool plant



5.5 Uncertainty

Uncertainty can arise from a number of different aspects of an assessment. There is a degree of uncertainty associated with: the survey instrumentation itself; the use of instrumentation; the source data; the sound propagation model; and, of course, the subjective response of recipients.

In terms of the assessment presented above, uncertainty due to instrumentation error has kept to a minimum by the use of the highest standard of instrumentation and by ensuring that all instrumentation is calibrated before and after each measurement period and is within accepted calibration intervals.

In terms of the baseline data, the management of uncertainty has included carrying out the survey over a 48-hour period, being mindful of the weather conditions, which were predominately dry and calm, and careful consideration of the results.

In terms of the adopted source data and associated assumptions, it has greatly limited uncertainty by being able to measure the plant in-situ, whilst the assumptions regarding the propagation of sound with distance and due to screening are considered entirely suitable.

With regard to subjective response, the guidance (from BS 4142) adopted for the assessment is based on the subjective response of the majority of the population, with care taken to consider relevant contextual factors. Whilst, again, there is comfort in the operation of the plant having been witnessed on site.

On the basis of the above, therefore, whilst the magnitude of uncertainty cannot be quantitatively defined, it is considered that sufficient measures have been taken to minimise this to an acceptable degree.

6 CONCLUSIONS

It can be seen that the plant rating levels are calculated to be below the council's criterion of -5 dBA below the existing residual background sound levels during night-time hours at the receptor façade, but expected to exceed the criterion during daytime hours at the neighbouring garden's boundary.

Despite being well-below the ambient conditions during both periods and below alternative guidance provided in BS 4142 and BS 8233. In context, it is also considered likely that there would be no adverse noise impact.

That being said, additional noise mitigation measures have been recommended to further reduce noise levels at the neighbouring garden boundary to bring noise levels in line with the council's criterion.

Accordingly, it is considered that noise need not be a barrier to granting planning permission for the plant.

7 REFERENCES

- 1 British Standards Institution. Methods for rating and assessing industrial and commercial sound. BS 4142:2014+A1:2019.
- 2 British Standards Institution. Guidance on sound insulation and noise reduction for buildings. BS 8233:2014.

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APPENDIX A

NOISE SURVEY RESULTS

Figure B1: Unattended Survey Results in Graphical Form (blue = night-time hours, red = landscaping works hours)

