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Acoustic Assessment of sound from Diesel Generator and Air Conditioning Condensing Units at:

Vets4Pets
Wilthorpe Road
Barnsley
S75 1JQ

Report Reference: B5117 2020-07-31 R

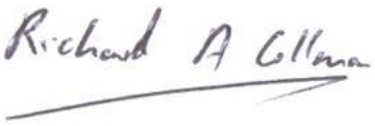
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B5117.1	Revised plant & attenuation	KT	31 July 2020
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1.0 Synopsis

1.1 1n 2910 Acoustical Control Consultants (ACC) were appointed by Mcleod and Aitken on behalf of Vets4Pets to undertake an acoustic assessment in support of the proposed installation of a diesel engine generating set (genset) at their practice in Barnsley.

1.2 As part of the initial proposals the vet's practice was extended to increase the services available, which included the installation of a CT Scanner. A genset was required to provide sufficient electricity to the CT Scanner whilst in use. This genset was planned to be installed in the customer car park to the north of the site.

1.3 An attended acoustic survey was conducted in May 2019 to gather representative residual sound level measurements during the daytime when the proposed CT Scanner and genset would be used.

1.4 The 2019 acoustic assessment showed that the proposed generator would need significant attenuation in order to comply with the suitable criteria to protect the amenity of nearby residents.

1.5 Subsequently an alternative genset with an integral acoustic enclosure was installed that produces a significantly lower sound power level than the originally proposed genset. In addition to this, eight air conditioning condensing units were installed on the northern façade of the extension to the building.

1.6 A further survey was conducted in June 2020 to measure the sound level actually produced by the genset in order to inform the design of bespoke attenuation to reduce sound from the genset to a suitable level at the closet noise sensitive receptor, which is the adjacent garden of a dwelling to the north of the site.

1.7 This report details the findings of both acoustic surveys, assesses the impact that the generator and condensing units will have on the most sensitive receptors, and quantifies the additional attenuation required for the genset.

1.8 Sound from all air conditioning units operating at maximum capacity is insignificant at the neighbouring gardens.

1.9 With the proposed additional acoustic enclosure the sound level from the genset will be approximately 47 dBA in the neighbouring garden, which is audiologically similar to the target of 45 dBA.

1.10 A Noise Management Plan will also be implemented to ensure that sound from the genset does not significantly affect the amenity of residents in the neighbouring gardens.

2.0 Introduction

2.1 ACC has been appointed to update the acoustic assessment undertaken in 2019 in support of the proposed installation of a genset at the Vets4Pets practice in Barnsley. The proposal involved the erection of an extension to the rear of the existing vet practice. containing a CT scanner which needed to be powered by a genset.

2.2 It was agreed with the local authority that a suitable sound level sound level at the nearest dwellings would be 45 dBA, on the basis that the CT Scanner and genset would ordinarily only be used during the day. In order to achieve this the genset would require significant attenuation.

2.3 Subsequent to the original acoustic assessment (report ref: B5117 2019-07-15 R), a different genset within an integral acoustic enclosure and producing a significantly lower sound level has been installed in the car park of the store. A number of air conditioning condensing units have also been installed in the vicinity of the northern façade of the building extension.

2.4 The purpose of this assessment is to assess the acoustic impact that the genset and air conditioning units may have at the most noise sensitive receptors and, as necessary, to recommend acoustic mitigation taking into account how the genset has been installed and if appropriate making best use of the visual screening already installed around the genset.

2.5 This assessment is in accordance with BS4142:2014 Methods for rating and assessing industrial and commercial sound and provides details of the site surveys and subsequent qualitative and quantitative analysis.

2.6 ACC is an independent acoustic consultancy company. All our acoustic consultants are qualified and experienced practitioners and are either Associate or Corporate members of the Institute of Acoustics. Acoustical Control Engineers Limited is our associated company specialising in engineered solutions to acoustic problems and has been instructed to design, manufacture and install the proposed additional acoustic enclosure for the genset.

3.0 Acoustic Environment

3.1 The practice is located in a predominantly residential area in north west Barnsley. There is a business park approximately 50m to the south and sports facilities around 70m to the north. Further afield is a large industrial estate around 2km to the west with the M1 just beyond this. Figure 4.1 shows the relative location of the store and surrounding areas.

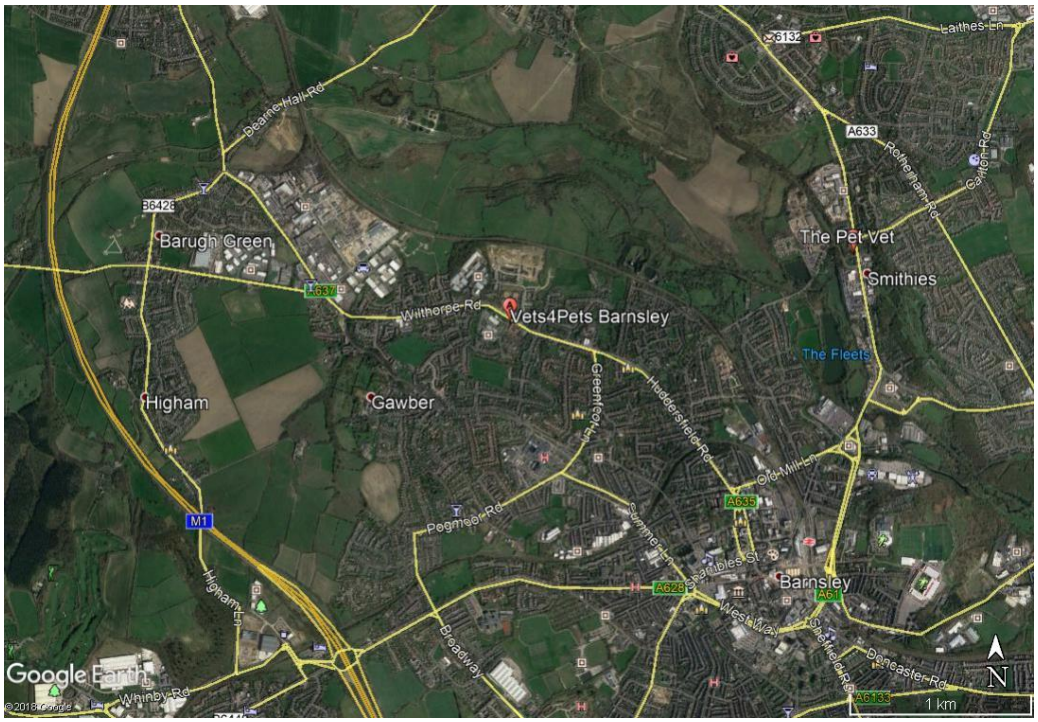


Figure 4.1 Location of store in context of surrounding area

3.2 The practice premises comprise a detached single storey building fronting Wilthorpe Road (A635), which is a relatively busy road. The store has a car park beyond an access road to the west of the building and directly to the rear of the building to the north. There are residential properties bounding the site to the north and west, and there is a car maintenance garage adjacent to the east. There is a business park across the A635, around 50m to the south of the site.

3.3 As part of the proposals a genset has been installed at the rear north east corner of the customer car park. A number of air conditioning condensing units have been installed on the northern façade of the building, around 25m from the garden of the most sensitive receptor. Both of these locations are partially screened from the garden by the masonry boundary wall.

3.4 It is understood that use of the CT Scanner is scheduled in advance which means that it, and the associated genset will only be used at planned times during the day, except in the unlikely event that the CT Scanner is required to be used for a specific emergency during the night.

3.5 As would be expected of a suburban location such as this, the acoustic environment in the vicinity of the site is influenced by a wide range of sources including local road traffic, activity at the practice and surrounding neighbourhood, occasional aircraft, and birdsong. The resultant sound level varies with these sources, depending on the time of day or night.

4.0 Surveys

Residual Survey

4.1 A fully attended site visit and acoustic survey was carried out by Kristoffer Tsinontas BSc (Hons), MIOA on Tuesday, 14 May 2019 between the hours of 20:30 to 21:45. Measurements were taken at a height of 1.2m to 1.5m above the ground and at least 3.5m away from reflective surfaces apart from the ground.

4.2 Sound pressure level measurements were taken to inform the assessment and to assist with characterising the acoustic environment. The measurements were taken where the proposed generator was due to be located as this was a suitably representative location to capture the residual soundscape of the nearby receptor.

4.3 Figure 4.1 shows the relative positions of the store (brown outline), various dwellings that may be sensitive to noise from plant, particularly during the night (orange outline), the proposed extension (green outline), plant location (blue outline), and the measurement location (yellow marker).

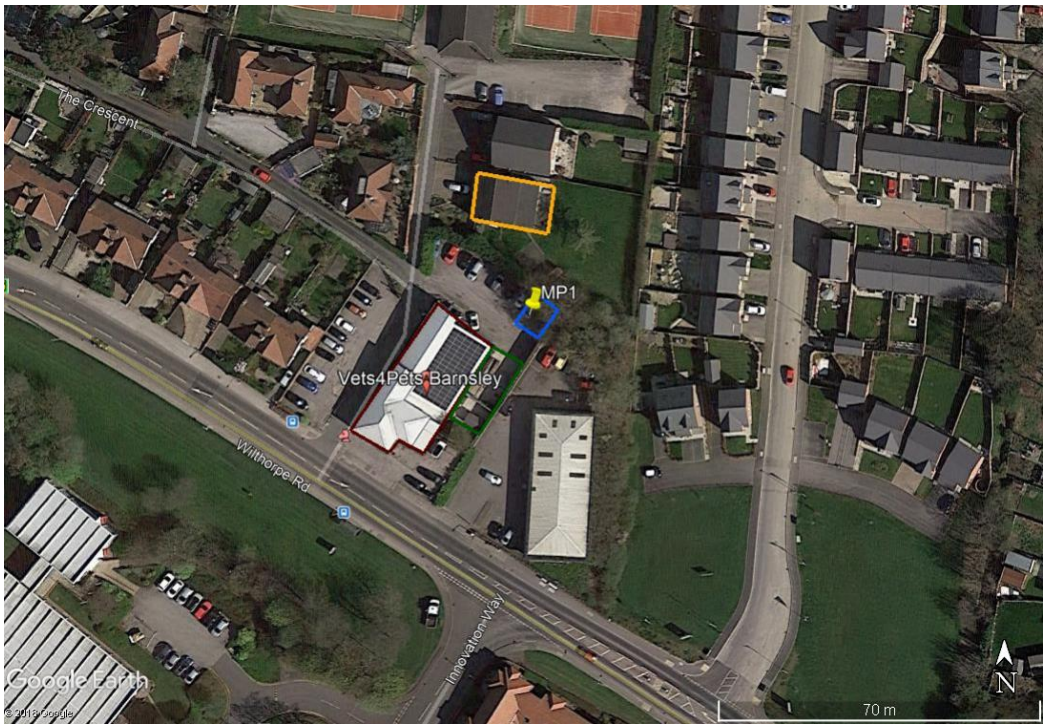


Figure 4.1 Store, Receptors, Plant, and Measurement Locations

4.4 Annex A reviews factors that affect the Background Sound Level, which varies depending upon many factors, rather than being a single value as the name may suggest. The synopsis summarises the factors taken into account when determining the most appropriate timing, duration and method for the acoustic survey.

4.5 As noted in Section 8 of BS4142: 2014, the most sensitive time of the night is likely to be when people are going to or awakening from sleep. Measurements were undertaken during these more sensitive periods. The contextual discussion is critical to properly understand the significance of any potential impact.

Instrumentation

Cirrus Optimus Sound Level Analyser Type CR 171, Serial No. G068268
Cirrus Calibrator Type CR 515, Serial No. 70553
Cirrus Windshield

Tripod
Skywatch Meteos Anemometer

4.6 An operational reference check was undertaken before and after the measurements using the calibrator. The instrument displayed negligible drift in calibration as shown in Table 4.1.

	External Calibration dB	Internal Calibration dB	Calibration Offset
Before	93.7	N/A	0.29
After	93.7	N/A	0.96

Table 4.1 Calibration record

4.7 In addition to the on-site operational check the instrumentation holds valid calibration certificates as shown in Appendix 4.

4.8 Weather conditions were logged throughout the survey. At the measurement location there was calm wind condition, clear skies, dry ground conditions and a temperature of around 15°C.

4.9 It is considered that the local weather conditions at the time of the survey were within the limits set out in the guidance and appropriate for measurements to be taken.

4.10 As explained more fully in Annex A, the ambient sound level is dependent upon the prevailing weather conditions. Under differing weather conditions, it is expected that the residual sound level may be somewhat higher or lower due to the variation in contribution from more distant sources such as the M1 motorway.

4.11 The measured Background Sound Level is what was measured at the time and under the weather conditions prevailing during the survey. This is used for the acoustic assessment, but consideration should also be given to the uncertainty that may be introduced in the outcome of the assessment due to the variation in Background Sound Level at different times or under different weather conditions.

4.12 The measurement technique used for this survey involves logging the sound level many times each second and recording relevant observations of factors contributing to the acoustic environment at this time. This technique provides a substantial amount of data regarding the acoustic environment and informs consideration of the effects of uncertainty. In the case of the residual sound level, approximately 57,600 sound level measurements are obtained for each hour of measurement and are shown graphically to enable the character of the acoustic environment to be better understood.

4.13 These measurements show the level and variability of the residual acoustic environment at the time of the survey. The fully attended survey provides a far better understanding of the factors that affect the measured sound level than is possible with an unattended survey. Even if an unattended survey is for a prolonged period of time the uncertainty regarding the measurement conditions and how this affected the measured levels remains. It is also likely that an unattended survey over a few days will record the residual sound level under relatively similar conditions and it is usually not practicable to gather data over a much longer period that includes seasonal variation and a much wider range of weather conditions. Annex A provides further detail, explaining why a relatively short duration fully attended survey provides better quality data that, together with an appropriate consideration of uncertainty, appropriately informs the subsequent assessment of the data.

4.14 The aim of the survey was to establish representative residual sound levels in the vicinity of the most sensitive areas. Graph 1 of Appendix 1 presents the results of the measurements taken during the survey.

4.15 The thicker black and red lines show the Background Sound Level ($L_{A90,15min}$) and corresponding Residual Sound Level ($L_{Aeq,15min}$) respectively and are summarised in Table 4.2 below

	Daytime Level dBA
Residual Sound Level ($L_{Aeq,15min}$)	44 - 46
Background Sound Level ($L_{A90,15min}$)	37 - 38

Table 4.2 Summary of measured sound levels

4.16 The rolling 15 minute statistical parameters shown on the graphs provides a greater understanding of the range of variation and significance of factors contributing to the residual and Background Sound Levels throughout the measurement period.

4.17 Figure 4.**Error! No bookmark name given.**3 provides statistical analysis of all the Background sound levels ($L_{A90,15min}$) captured during the survey in order to provide an overview of the likely representative Background sound level during the monitoring period.

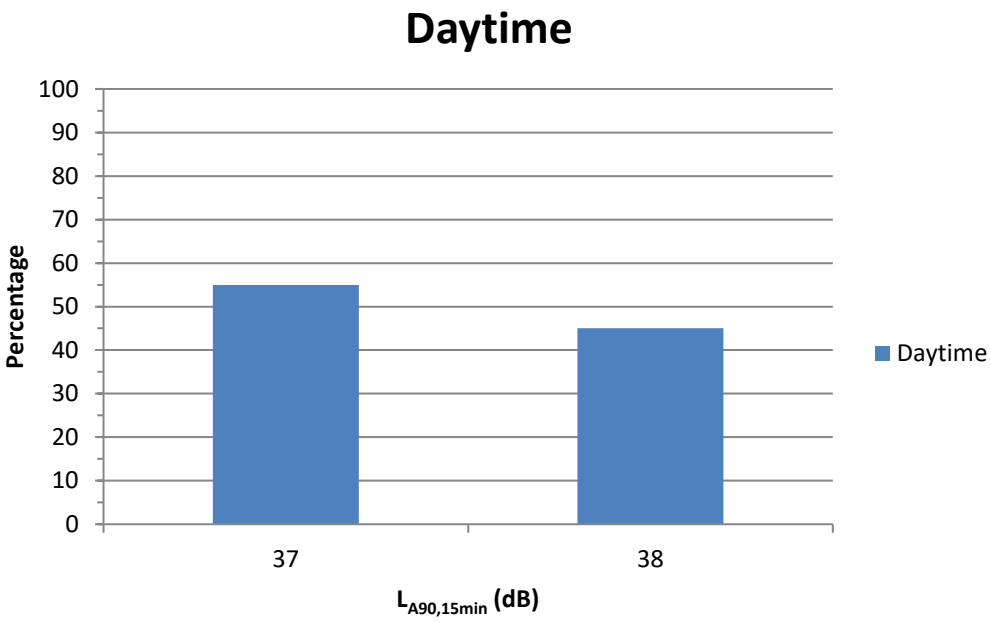


Figure 4.3 Histogram of Background sound levels ($L_{A90,15min}$)

4.18 Taking all of the above factors into account and the context of the acoustic environment, a Background Sound Level of 37dBA will be used for daytime assessment purposes in order to establish an Initial Estimate of the Likely Significance of Impact.

2020 Survey

4.19 A fully attended site visit and survey was carried out by Richard A Collman BSc (Jt. Hons), CEng, MIOA, Tech IOSH on Wednesday, 17 June 2020 between the hours of 15:00 and 16:30. Measurements were taken at a height of 1.2m to 1.5m above the ground and at least 3.5m away from reflective surfaces apart from the ground.

Instrumentation

Rion 1/3 Octave Band Analyser Type NA-28, Serial No. 01070575
Rion Sound Calibrator Type NC-74, Serial No. 35173526
Rion Windshield

4.20 An operational reference check was undertaken before and after the measurements using the calibrator. The instrument displayed negligible drift in calibration.

4.21 Sound pressure level measurements were taken of the generator as it was operating during the survey, and of the residual acoustic environment without influence from any fixed plant and equipment at the vets. The results of this survey are shown in Graph 2 in Appendix 1.

4.22 The first two measurements were taken at distances of approximately 10m and 5m from the installed genset while it was operating under normal load. The sound levels measured here were around 70 & 78 dBA respectively.

4.23 Measurements three to five were of the side apertures of the generator which were measured at 99, 97 and 95 dBA respectively. The measurement taken at the exhaust of the generator was 99 dBA. The sound level measured at the discharge aperture of the genset was 97 dBA.

4.24 A residual measurement was taken in the car park once the genset had been switched off. The measurement taken included sound from activities occurring elsewhere, which gave a short term average sound level of around 54 dB L_{Aeq}, with the sound level varying between around 45 to 65 dBA at this location and time.

5.0 Relevant Guidance & Criteria

5.1 Annex B provides a detailed review of relevant guidance that may be applicable to this assessment. The key points of each relevant document are summarised below:

BS4142:2014 Methods for rating industrial and commercial sound

Rating Level - Background Sound Level	Initial Estimate
Around 10dB or more	Likely to be an indication of a significant adverse impact, depending on the context.
Around 5dB	Likely to be an indication of an adverse impact, depending on the context.
Similar levels	An indication of the specific sound source having a low impact, depending on the context.

5.2 One of the significant differences between BS4142:2014 and previous editions of the Standard is the explicit requirement to consider context as part of the assessment. It is no longer adequate to simply compare the Rating Level and the Background Sound Level without due regard to the context of the acoustic environment and the sound source. The context can significantly affect the outcome of the Initial Estimate, which is based solely on the difference between the Rating and Background Sound Levels. The Background Sound Level (L_{A90}) specifically excludes acoustic events occurring for less than 90% of the time, such as passing vehicles or activity occurring for much but not all of the time. This means that the difference between Rating and Background Sound Levels can be identical for two locations with very different acoustic characteristics and corresponding sensitivities to noise.

5.3 In addition to comparing the level and character of the specific and residual sound, the context also includes careful consideration of other factors such as the character of the locale e.g. quiet rural or predominantly industrial; noise sensitive receptors e.g. outdoor amenity space or indoors; and duration and time of specific sound e.g. 24/7 operation or one event per week.

5.4 Depending upon the context, other guidance may be more appropriate, such as considering the potential impact of sound on residents during the night when the primary concern is to ensure that they are not disturbed whilst sleeping, possibly with open bedroom windows. In this case the difference between Background Sound Level and Rating Level outdoors is likely to be of little significance to the residents indoors.

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

5.5 For dwellings the main considerations are to protect sleep in bedrooms and to protect resting, listening and communicating in other rooms. For noise without a specific character it is desirable that the overall average levels during the 8 hour night or 16 hour day time periods do not exceed 30dBA or 35dBA respectively.

5.6 For amenity space, such as gardens and patios, it is desirable that the average level does not exceed 50dBA, with an upper guideline value of 55dBA which would be acceptable in noisier environments. For dwellings with conventional windows, an internal target of 35dBA during the day equates to around 50dBA (possibly slightly lower) outside noise sensitive rooms with openable windows.

National Planning Policy Framework (NPPF), Noise Policy Statement for England (NPSE) and National Planning Practice Guidance (NPPG)

5.7 There is a presumption in favour of sustainable development, which should be seen as a golden thread running through both plan-making and decision-taking. Assessments should be proportionate to the proposed development. Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations.

5.8 Below the No Observed Effect Level (NOEL) sound is unnoticeable and of no significance. Below the Lowest Observed Adverse Effect Level (LOAEL) sound can be heard but does not cause any changes in behaviour or attitude, although the acoustic character of the area may be slightly changed. Below the Significant Observed Adverse Effect Level (SOAEL) sound may cause slight changes in behaviour or attitude e.g. turning up volume of a television or closing windows. There is potential for some sleep disturbance and a perceived change in the acoustic character of the area and quality of life.

5.9 Areas of Tranquillity should be protected, but in general cases it may be inappropriate to achieve a level below the LOAEL as this provides no benefit but may require additional resources such energy, materials, space, time and money, adversely affecting the sustainability of doing so. Noise above the LOAEL should be mitigated and reduced to a minimum, although it may be appropriate to exceed the LOAEL and create an adverse acoustic impact, if this provides other sustainability benefits that are of greater significance. Noise above the SOAEL should be avoided.

World Health Organisation: Guidelines for Community Noise & Night Noise Guidelines for Europe

5.10 These establish that a steady level of 30dBA within bedrooms is suitable to protect vulnerable people from sleep disturbance and that occasional maximum levels of up to around 42dBA to 45dBA are also consistent with this. The difference between a sound level outdoors and the resultant level indoors with open windows varies through Europe due to differing building characteristics and particularly window type. An average difference of around 15dBA is often used, although this is also dependent upon other factors such as the frequency spectrum of the incident sound.

Chartered Institution of Building Services Engineers: CIBSE Guide A: Environmental Design

5.11 The environmental design guidance provides details of Noise Rating (NR) curves which are commonly used within Europe for specifying mechanical plant in order to control the character of the noise. The relationship between NR and dBA is not constant because it depends upon the spectral characteristics of the noise. However, for ordinary intrusive noise found in buildings, dBA is usually between 4 and 8 dB greater than the corresponding NR. BS8233 gives a single conversion value of 6dBA.

5.12 Table 1.15 of the design guidance provides a suggested maximum noise level generated within urban dwellings of NR25 for bedrooms and NR30 for living rooms. Guidance is also provided for offices and public buildings.

Local Authority Specific Guidance

5.13 Previous telephone conversations have been held between ACC and Paul Denton, EHO of Barnsley Council to discuss suitable design levels for plant.

5.14 Mr Denton agreed with ACC's proposals of achieving maximum Rating Levels of 45dBA in the closest garden during the day and 35dBA at the closest bedroom window at night, in line with BS8233:2014 and WHO Guidance.

5.15 More recent discussions with an EHO from Barnsley Council accepted that while the generator may produce sound levels in exceedance of the suggested suitable criteria, that the sound from the unit could be controlled by utilising a suitable Noise Management Plan (NMP). This document would highlight the times at which the generator could be used during the daytime period to minimise adverse impacts, and also accepts that some emergency use during the night-time period would occur.

Discussion

5.16 An Initial Estimate of the Likely Significance of the Impact can be determined from the difference between the Rating and Background Sound Levels. This will include uncertainty due to many different factors that must also be considered. The context of the assessment can also significantly alter the outcome of the Initial Estimate.

5.17 National Planning Policy recognises that development may affect amenity but clarifies that any such impact must be within acceptable limits. There may be no benefit in achieving conditions below the Lowest Observed Adverse Effect Level (LOAEL) because this is unlikely to provide any additional benefit, but have other adverse effects on the sustainability of the development.

5.18 In addition to the difference between the Rating and Background Sound Levels, which excludes consideration of most characteristics of the residual acoustic environment. Other authoritative documents such as BS8233, and that from the World Health Organisation provide guidance in terms of long term environmental sound levels which can inform the selection of appropriate thresholds depending on the context of the acoustic environment.

5.19 These identify that a level of around 35dBA inside the closest noise sensitive receptors is likely to be suitable to properly protect residential amenity. This equates to an external sound level of 45dBA to 50dBA.

5.20 At night, a steady level of around 30dBA inside bedrooms is suitable to protect residents from sleep disturbance. With open windows this can be achieved if the external sound level is around 40dBA.

5.21 Taking all of the above factors into account along with the consideration of the existing acoustic environment all proposed fixed plant and equipment should not exceed a Cumulative Design Rating Level of 45 dB at the nearest receptor during the more noise sensitive times of the day. These levels are consistent with the Local Authority's criteria and are assessed as being appropriate for ensuring sound levels from the proposed plant result in a low impact, given the context of the local soundscape. At other, busier, times of the day, it may be appropriate for the sound level from the fixed plant and equipment to be slightly higher as this will be masked by the raised residual sound levels due to the increased activity and associated noise at these times.

6.0 Analysis and Assessment of sound from Fixed Plant and Equipment

Plant Locations & Calculations

6.1 A genset has been installed in the car park to the north of the site to provide adequate electrical power for the CT Scanner. The nearest noise sensitive receptor is the garden of the dwelling to the north bounding the site. There is some screening between the plant and the receptor due to the perimeter masonry wall. It is understood the genset will only be used at planned times during daytime hours, although it is possible albeit unlikely, the CT Scanner and therefore genset may need to be used in specific emergency conditions during the night.

6.2 A total of eight condensing units have been be installed on the northern façade of the extension. These units installed include three at ground level, three above these, and finally two above. Collectively these units are partially screened from the receptor by the intervening masonry wall and/or the genset which will provide screening attenuation.

Air conditioning condensing units

6.3 The sound level data for the air conditioning condensing units is provided as the sound pressure level at 1m from the units. It is not possible to apply a standard distance correction from this sound level data as the manufacturer's provided sound levels are not a point source measurement. In order to accurately determine the sound level from these units at distance, the sound power level must be calculated from the sound pressure at 1m measurement.

6.4 This can be achieved by using the sound pressure level at 1m, using this as an indicative sound intensity measurement, and acting as if the unit is a parallelepiped producing this sound level in all directions even though this type of unit would produce directional sound from its fan. This method tends to overstate the sound level of the unit, so the resulting sound level may be lower than that calculated.

6.5 Calculation Sheet 1 in Appendix 2 shows the resulting sound level at the receptor from the condensing units. Lines 1, 2 and 3 show the quantity of the units and the sound level at 1m.

6.6 Line 4 logarithmically sums the quantity of the units and their sound pressure levels at 1m to give a total of 59 dBA.

6.7 Using the method described in section 6.3 and 6.4, the estimated correction from the cumulative sound pressure level to sound power level is 12 dBA. Line 5 adds these together to give a total sound power level from the units of 71 dBA.

6.8 Line 7 shows the distance from these units to the receptor, while Line 8 shows the Q factor which denotes the reflective positional characteristics of the source and receiver to account for reflective surfaces. Using the formula shown in the Notes column, the distance and reflectivity characteristics give a reduction of 33 dB to be applied to the sound power level to give a sound pressure level at 25m.

6.9 Line 9 shows conservative acoustic screening attenuation of 5dB to account for the mitigation provided by the masonry wall, the genset, or a combination of the two.

6.10 Line 10 shows the resulting sound pressure level of around 33 dBA at the garden receptor, due to the air conditioning condensing units, if all are simultaneously operating at maximum capacity.

Genset

6.11 The genset is labelled as producing a sound power level of 97 dBA, which can be used to calculate the corresponding sound pressure level in the neighbouring garden. Two indicative sound pressure level measurements were also taken at distances of approximately 5 & 10 metres from the genset, for comparison with the expected sound level based on the manufacturer's data. Further sound pressure level measurements were taken at the various apertures in the genset's acoustic enclosure.

6.12 The calculations for the measurements taken of the generator on site can be found in Calculation Sheet 2 in Appendix 2.

6.13 Line 1 of Calculation Sheet 2 shows the sound level measurements taken when the genset was operating, as overall dBA values and the corresponding octave bands frequency spectra.

6.14 Line 2 shows the residual sound level of 54dBA measured when the genset was not operating. This shows that, with the exception of the 2k, 4k & 8k Hz bands at 10 m, the residual sound level was at least 10 dB below that measured when the generator was operating. The sound level at 10 m was measured when the residual sound level was relatively low, so the residual sound level did not significantly affect the measured sound levels with the genset operating.

6.15 Lines 3, 4 & 5 show the stated sound power level emitted by the genset, the attenuation correction of -31 dB to a distance of 10 metres and adjustment of +9 dB for reflections from nearby walls, giving a corresponding level of 75 dBA at 10 metres from the genset.

6.16 Lines 6 & 7 compare this with the measured level of 70 dBA at 10 metres, indicating that the existing visual screening provides circa 5 dBA acoustic screening attenuation, which is broadly consistent with expectations.

6.17 Lines 8 & 9 show approximate additional attenuation expected between the measurement location in the practice car park approximately 10 metres from the genset, and the nearest noise sensitive receptor location in the neighbouring garden, with the resultant indicative sound level currently being produced in the garden of around 64 dBA i.e. around 20 dBA above the previously identified target.

6.18 Lines 10, 11 & 12 compare this with the target sound level, to give an indicative excess frequency spectrum, to inform selection of appropriate attenuation.

6.19 Lines 13 & 14 show the approximate acoustic performance expected from the proposed attenuation system, giving an attenuated sound level of around 47 dBA in the garden.

Assessment

6.20 This assessment assumes the recommended attenuation package is installed as per the quotation issued by Acoustical Control Engineers ref: 15303 2020-07-14 Q Dawson.

6.21 The maximum sound level from the condensing units is 33 dBA in the neighbouring garden which is significantly below the target, demonstrating that the sound level from the condensing units is suitable to properly protect the neighbouring residents' amenity without the need for any mitigation.

6.22 The calculated sound level in the neighbouring garden due to the genset, when operating within the proposed additional acoustic enclosure is around 47 dBA. This is marginally above the target of 45 dBA. For comparative purposes, a difference of around 3 dBA is generally regarded as 'just noticeable' and 10 dBA equates to a subjective halving/ doubling of sound level.

6.23 The proposed additional acoustic enclosure has been designed to optimise the attenuation performance whilst making best use of the existing visual screening that has already been installed, rather than scrapping all this material, with the adverse impact on sustainability this would entail.

6.24 It is expected that this attenuation system will reduce the sound level in the neighbouring garden by around 17 dBA, although there is not insignificant uncertainty in this due to the acoustic complexity of the data.

6.25 It is therefore proposed that, in addition to the proposed additional acoustic enclosure, a Noise Management Plan be implemented to ensure that sound from the genset does not significantly affect the amenity of neighbouring residents.

6.26 Plant will be operational during the day only. Therefore, the reference time interval (T_r) is 1h during the day (0700 - 2300 hours). The sound levels used in this assessment are based on the plant operating at 100% load. In reality the plant will not operate at maximum capacity all of the time however the variation in operation will depend upon several factors such as load, and ambient temperature therefore it may be prudent to assume a sound level based upon continuous maximum capacity operation throughout this period but be aware that the actual specific sound level will be lower than this.

6.27 Based on the results of the acoustic survey and the calculated cumulative rating level from the proposed fixed plant and equipment the Initial Estimate according to BS4142 is shown in Table 6.1 below.

Result	**Daytime**
Residual sound level	44dB$L_{Aeq,T}$ - 46dB$L_{Aeq,T}$
Background sound level	37dB$L_{A90,T}$
Cumulative Specific Level at Receptor	47dB$L_{Aeq,60min}$
Rating Penalty	0
Cumulative Rating Level at Receptor	47dB$L_{Aeq,60min}$
Excess over background sound level	+10
Initial Estimate	Likely to be an indication of a significant adverse impact, depending on the context

Table 6.1 Initial Estimate of Likely Significance of Impact

Rating Penalty

6.28 When applying a Rating Penalty, it is the significance or otherwise of the characteristics of the source sound at the noise receptor location that must be considered. For example, sound from the source may appear highly impulsive when standing next to it, particularly under 'laboratory' conditions, but only slightly so at a noise receptor location, where the varying residual sound level may mask the characteristics that may otherwise attract a Rating Penalty.

6.29 To establish an appropriate Rating Penalty the level and character of sound from the source must be put in the context of the residual soundscape at the noise receptor location. It is not appropriate simply to compare the sound from the source to the Background Sound Level, it must also be compared to other characteristics of the residual soundscape such as the way in which the residual sound level varies with time and the type of sound of which it is comprised.

6.30 From experience the proposed plant can exhibit some acoustically distinguishable characteristics such as tonality and intermittency. However, the proposed acoustic enclosure will significantly reduce the audibility of the characteristics at the receptors. In addition to this, the specific level is somewhat below the residual level and it is likely the high levels of road traffic noise will further mask any acoustically distinguishable characteristics. Therefore, a rating penalty is not applicable.

Context

6.31 During the day, the residual sound level will vary significantly depending upon factors such as activity in the immediate area, together with more distant sources and traffic density. The Background Sound Level will vary significantly, depending upon the time of day. The level used for this assessment was measured during the quieter part of the evening after 9pm. Therefore, during busier times of the day, when the Practice is open and it is expected that the CT Scanner and genset will be in use, the Background Sound Level will be higher and the difference in Rating and Background Sound levels correspondingly lower. In practical terms, the higher residual/ background sound levels at these times will better mask sound from the genset.

6.32 This masking will be enhanced because much of the residual sound is due to vehicular noise, which is similar in character to the sound from the acoustically enclosed genset.

6.33 It must also be borne in mind that the background sound level is that exceeded for 90% of the time i.e. it represents the quietest 10% sound level. The residual average sound level is nearly 10 dBA higher than the background sound level, so will be similar to or higher than that from the genset. In reality, this means that sound from the genset will largely be masked by residual sound.

6.34 When taking these factors into account this indicates that sound from the genset is unlikely to have a significant impact on the amenity of residents in neighbouring gardens.

6.35 Table 6.2 below details a full assessment of the impact from proposed fixed plant and equipment considering the context of all current authoritative guidance.

Results	Daytime
BS8233:2014 guidance	35dBA cumulative indoors equating to 45dBA outside internal receptors / 50dBA within outdoor amenity areas
NPSE guidance	
World Health Organization	35dBA cumulative indoors equating to 45dBA outside internal receptors
Local Authority guidance	Rating Level not to exceed 45dBA at nearest receptor.
Cumulative Rating Level	47dBA
Assessment	Low impact

Table 6.2 Assessment

6.36 The outcome of the assessment is an indication of the likely significance of the impact of sound from the plant at nearby noise sensitive receptors. The criteria that have been identified to properly protect noise sensitive receptors take account of the context of the situation, considering the acoustic characteristics of the plant, its hours of operation, the acoustic characteristics of the area where the plant is installed and where the store and noise receptors are situated, together with the locations that may be affected e.g. outdoors in gardens and indoors in habitable rooms during the day, or inside bedrooms at night, assuming that windows may be open for ventilation where this is applicable.

Uncertainty

6.37 Annex C provides further information regarding the causes and effects of Uncertainty in an acoustic assessment such as this. There is relatively little uncertainty in the measured levels due to the measurement system (perhaps of the order of 1dB or so), but far greater uncertainty in other parts of the assessment.

6.38 The Background Sound Level is representative of a range that can vary by many decibels depending upon factors such as the time of day, season, wind speed and direction. However, the selection of the criteria to ensure that residents are properly protected against disturbance is informed by both the representative Background Sound Levels and authoritative guidance that provides absolute values based on physiological responses to sound and large scale surveys. These criteria will ensure that residents will not be disturbed by noise from the plant across the range of variation of the Background Sound Level.

6.39 Any acoustic analysis such as those in the Calculation Sheets includes uncertainty due to factors such as the acoustic character of the propagation path from source to receiver. The modelling methods used adopt a conservative approach where appropriate in order to provide some margin of safety to the calculated sound levels.

6.40 There is inevitably further uncertainty in the data provided by plant manufacturers. In some cases, this is relatively small, in other cases much greater. This can be exacerbated by the appropriateness and magnitude of a Rating Penalty, which should be based on the subjective characteristics at the noise receptors. However, by applying extensive experience of the types and acoustic characteristics of the selected plant, together with the subjective method of assigning a Rating Penalty, it is possible to considerably reduce this level of uncertainty. The plant manufacturers are also aware that it is their responsibility to ensure that the plant complies with their stated performance and that should this not prove to be the case, they will be responsible for treating the plant so that it does then comply. An additional margin of safety is provided by assuming that all plant that may operate at the time being considered (daytime or night-time) may simultaneously be operating at maximum capacity for that time. In reality, it is likely that only some plant will be operating at maximum capacity at any time, as a result of which the actual sound level produced by the plant will be slightly lower than assumed for assessment purposes.

7.0 Mitigation

7.1 In order to achieve suitable sound levels at the closest noise sensitive receptors, a bespoke acoustic enclosure has been designed to suit the genset, making best use of the existing visual screening that has already been installed around the genset.

7.2 The enclosure body will be approximately 3m wide by 5.5m deep (with the intake attenuator projecting out adjacent to the enclosure door), by 2.9m high (comprising 2m enclosure body and 0.9m discharge attenuator).

7.3 It is proposed that the existing timber fencing visual screen is utilised with the acoustic panels forming the internal face of the enclosure within the visual screen and an acoustic roof comprising acoustic panels and discharge attenuator with plenum coupled to the discharge aperture on the top of the generator.

7.4 An acoustic door at the front of the enclosure will be installed perpendicular and adjacent to the existing timber compound door, with the inlet attenuator adjacent to the acoustic door.

7.5 A General Arrangement drawing for this enclosure can be found in Appendix 3 of this report.

7.6 The enclosure has been designed to provide around 17dBA reduction, with particular focus on the 250Hz and 500Hz octave bands. The indicative octave band attenuation spectrum can be seen in Line 13 of Calculation Sheet 2.

7.7 In view of the uncertainties in the analysis and additional acoustic enclosure's expected attenuation performance, it is appropriate to implement a Noise Management Plan (NMP) to further ensure that operation of the genset does not adversely affect the neighbouring residents' amenity. If it is felt appropriate to impose a planning condition regarding noise from the plant, such a condition can require that the NMP be agreed with the local authority and implemented, rather than setting a fixed limit on sound levels, enabling best use to be made of masking by residual sound.

7.8 In this case, if it is subsequently proposed to change operational hours of the equipment, that can be achieved by agreeing a revised NMP with the local authority, rather than necessitating a change to the planning condition itself.

8.0 Conclusions

8.1 Acoustical Control Consultants have been appointed to undertake an assessment of the genset and air conditioning units at Vets4Pets, Barnsley.

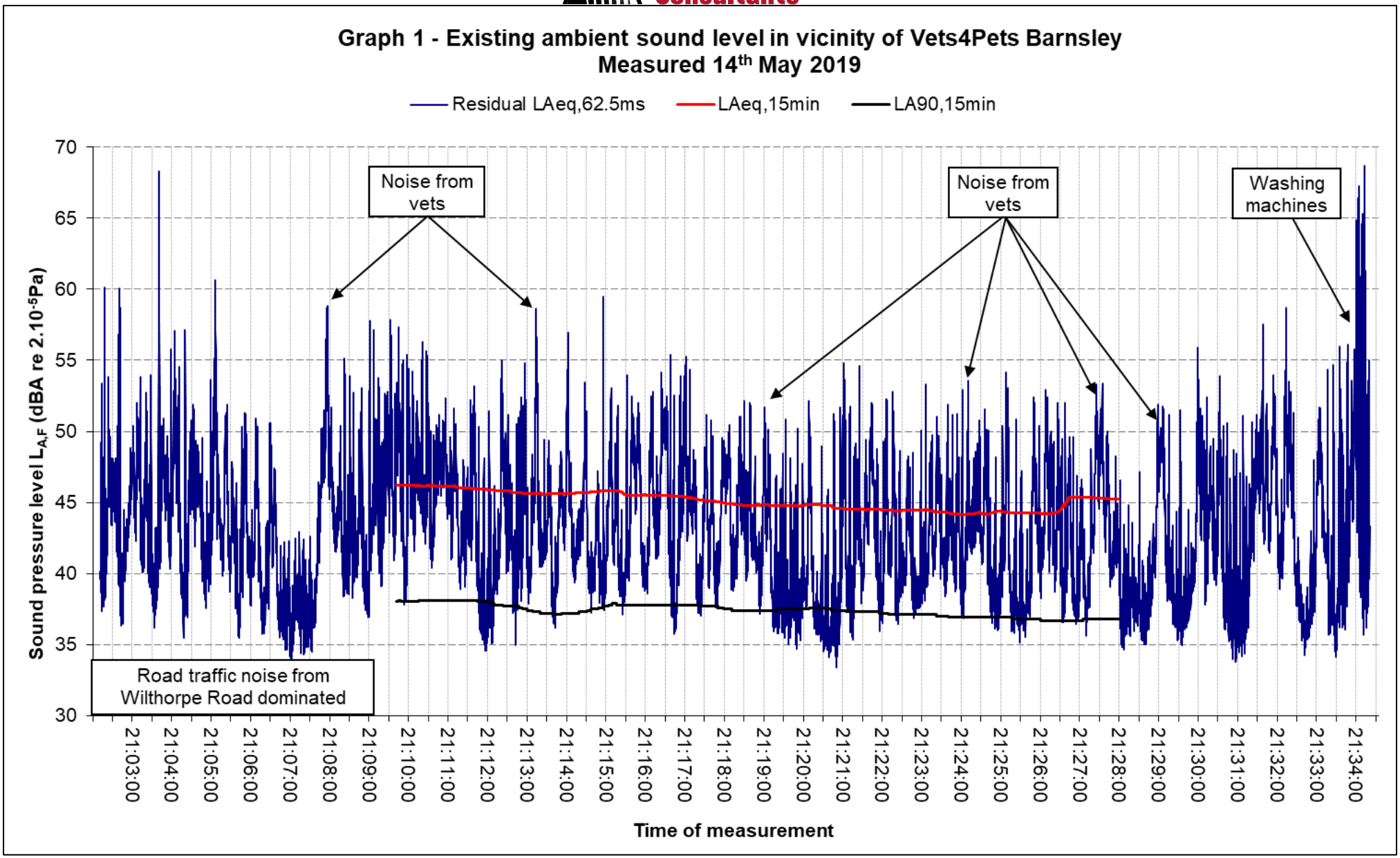
8.2 The selected plant has been assessed using relevant British Standards, National and Local planning policy and guidance.

8.3 The sound level from the air conditioning plant is insignificant at the nearest dwellings. With appropriate additional mitigation to the genset, sound from this will not significantly affect the amenity of the neighbouring residents.

Appendix 1 Measurement Graphs

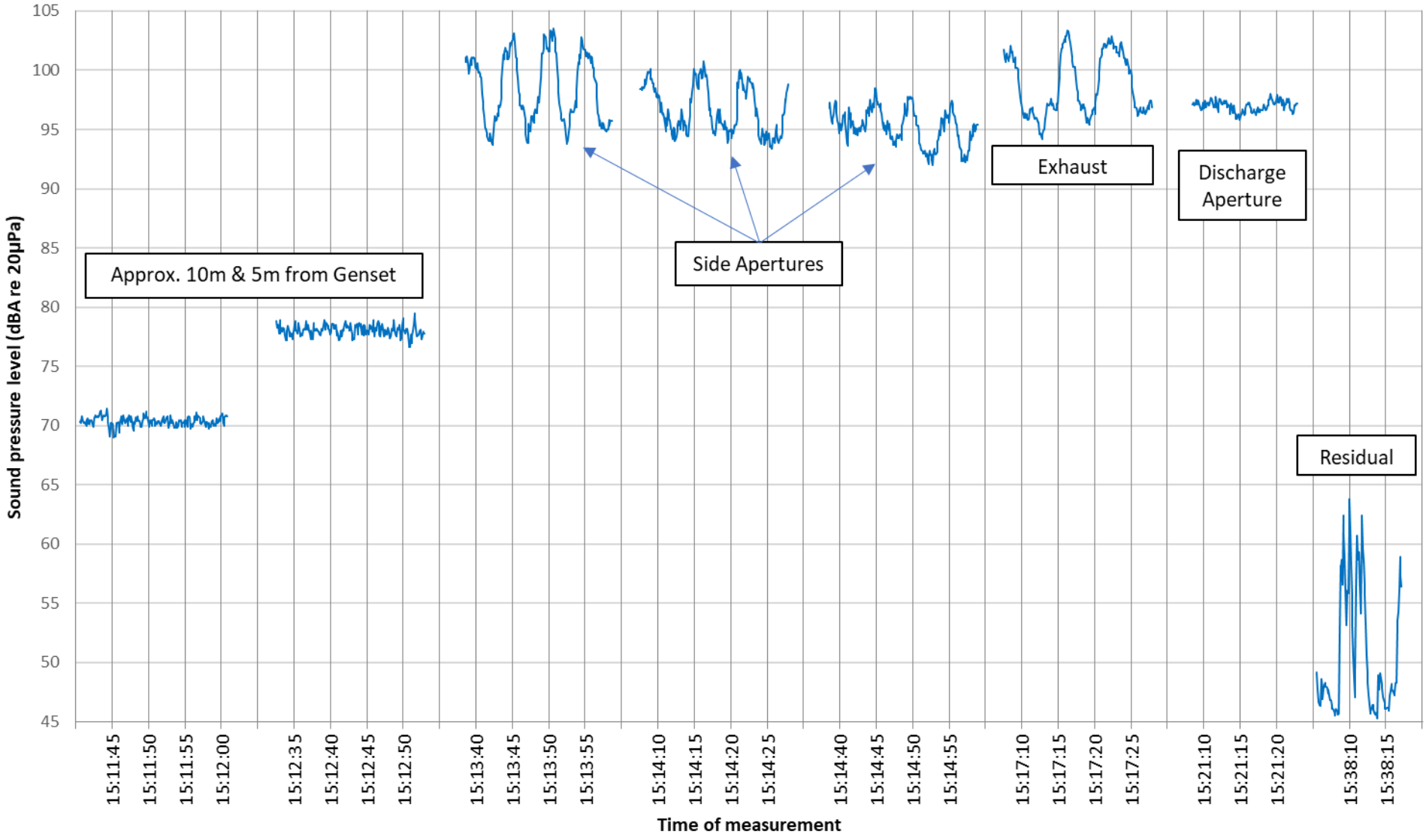
ACOUSTICAL CONTROL Engineers & Consultants

Graph 1 - Existing ambient sound level in vicinity of Vets4Pets Barnsley
Measured 14th May 2019



ACOUSTICAL CONTROL Engineers & Consultants

Graph 2: Sound Level measurements taken at Vets4Pets, Barnsley
Measured 17th June 2020



Appendix 2 Calculation Sheets

Calculation Sheet 1 - AC Units' Sound Level at Dwelling				
Line	**Details**	**Units**	**dBA**	**Notes**
1	MUZ SF 25 VE Lp at 1m	4 No.	48	Manufacturer's data
2	MUZ SF 35 VE Lp at 1m	2 No.	50	Manufacturer's data
3	MUZ SF 50 VE Lp at 1m	2 No.	52	Manufacturer's data
4	Total Lp at 1m		59	Logarithmic sum Lines 1 ... 3
5	Correction to Lw		12	Estimated for plant characteristics
6	Total Lw		71	Lines 4 + 5
7	Distance to closest Dwelling (m)	25 m		
8	Q Factor, distance attenuation	4	-33	$10 \times \text{Log}_{10} (Q / 4\pi r^2)$ [quarter spherical, wall mounted]
9	Partial Screening		-5	From boundary wall/ genset
10	**Lp at Gardens**		**33**	**'Worst case' - all at full capacity**

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Calculation Sheet 2 - Generator Sound Level at Dwelling

Line	Details		dBA	63	125	250	500	1k	2k	4k	8k	Notes
1	Approx. 10m from Genset		70	73	80	72	70	59	54	47	40	
	Approx. 5m from Genset		78	75	78	81	77	70	65	57	49	
	Side aperture 1		99	92	95	102	99	91	87	79	71	
	Side aperture 2		97	87	92	101	95	89	86	77	72	
	Side aperture 3		95	89	95	99	93	89	83	72	67	
	Exhaust		99	90	97	100	100	92	88	79	74	
	Discharge aperture		97	95	97	99	95	90	88	82	74	
2	Residual		54	60	47	48	44	42	52	38	32	
3	Manufacturer's stated sound power level (LwA)		97									
4	Distance (m) & 'Point source' attenuation	10	-31									Spherical 'free field' propagation
	'Q Factor' (Directivity correction)	8	9									In corner/ multiple reflective surfaces
5	Unattenuated level at 10m		75									Lines 3 + 4
6	Measured level at 10m		70	73	80	72	70	59	54	47	40	
7	Indicative 'screening attenuation' at present		-5									Due to visual screening around genset
8	Additional distance/ screening attenuation to garden			-5	-6	-6	-7	-7	-8	-8	-9	Estimated
9	Approximate existing sound level in garden		64	68	74	66	63	52	46	39	32	Lines 6 - 8
10	Target sound level in garden		45									From original acoustic assessment
11	'A weighting' spectrum			-26	-16	-9	-3	0	1	1	-1	
12	Individual octave band excess spectrum	-5	19	-7	3	10	16	19	20	20	18	Lines 9 - 10 + 11
13	Proposed Attenuation System Indicative Performance			-4	-13	-21	-38	-39	-30	-29	-24	
14	**Approx. Attenuated sound level in garden**		**47**	**64**	**61**	**45**	**25**	**13**	**16**	**9**	**8**	**Lines 9 + 13**

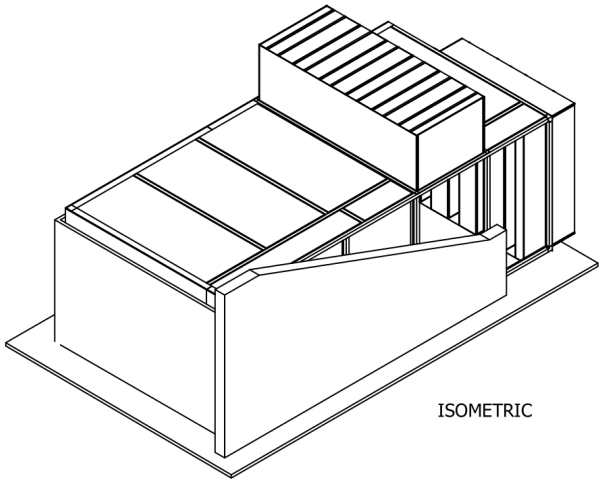
Appendix 3 Attenuation GA Drawing

IF IN DOUBT PLEASE ASK

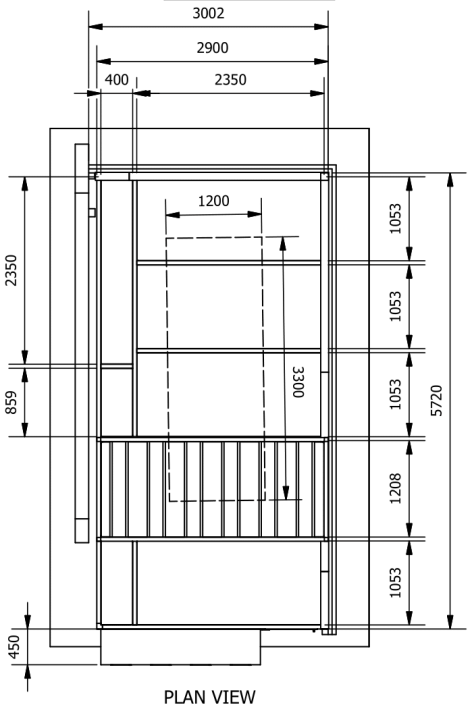
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THIRD ANGLE PROJECTION

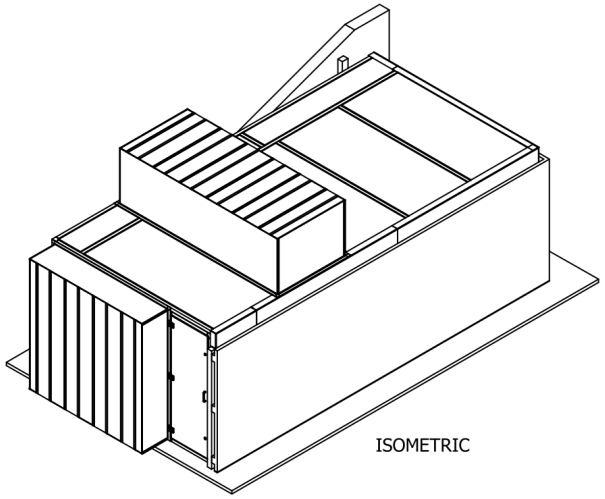
NOTES:



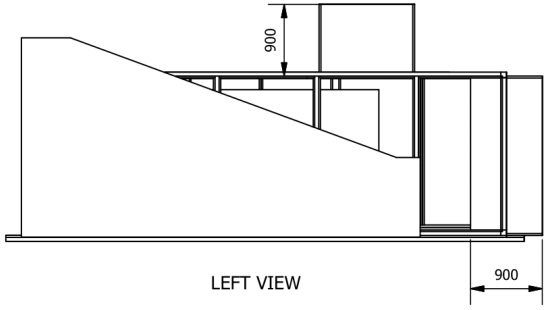
ISOMETRIC



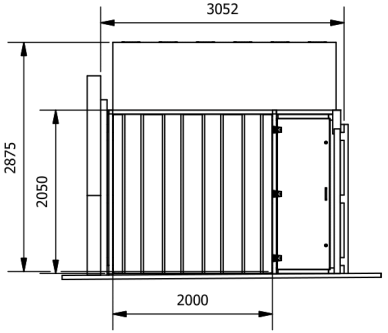
PLAN VIEW



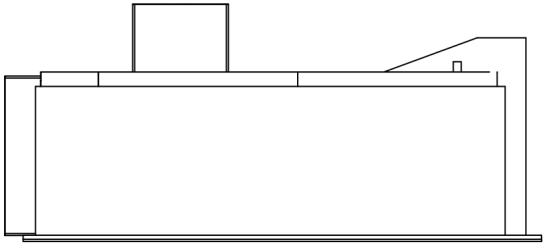
ISOMETRIC



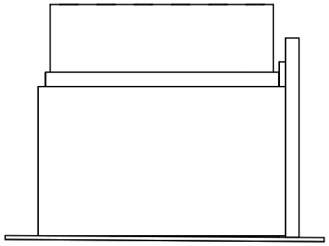
LEFT VIEW



FRONT VIEW



RIGHT VIEW



REAR VIEW

Date	Revision	Author	Description
21/07/2020	1	AH	FIRST ISSUE

ALL DIMENSIONS ARE mm [IN]

SCALE .015@A3 UNLESS OTHERWISE STATED
DO NOT SCALE FROM DRAWING

ESTIMATED TOTAL WEIGHT = N/A

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www.acoustical.co.uk

Scheme	Drawn by	Date		
1	AH	17/07/2020		
Scale	Checked by	Date	Approved by	Date
.015@A3				
ACE P-C No	Project			
15303	VETS 4 PETS, BARNSLEY			

GENSET ACOUSTIC ENCLOSURE

Client	Drawing No	Sheet
PETS AT HOME	15303-00-001	1 / 1

Appendix 4 Calibration Certificates

ACOUSTICAL CONTROL Engineers & Consultants

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171B
Description	Sound Level Meter
Serial Number	G068268

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2564324	Calibration Ref.	A1914
Calibrator Type	B&K 4231	Serial Number	2564325	Calibration Ref.	A1915
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1916

Calibrated by T. A. Goodwin.

Calibration Date 26 June 2019

Calibration Certificate Number 272006

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

ACOUSTICAL CONTROL Engineers & Consultants

Certificate of Calibration

Certificate Number: **130210**
Date of Issue: **26 June 2019**

Instrument

Manufacturer: **Cirrus Research plc** Serial Number: **70553**
Model Number: **CR:515**

Calibration Procedure

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer s data.

Date of Calibration: **26 June 2019**

Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	93.98	1000.3	0.28
2	93.98	1000.3	0.31
3	93.99	1000.3	0.31
Average	**93.98**	**1000.3**	**0.30**
Uncertainty	± 0.11	± 0.14	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.

Cirrus Research plc, Acoustic House, Bridlington Road
Hunmanby, North Yorkshire, YO14 0PH, United Kingdom
Telephone: 0845 230 2434 **Int**: +44 1723 891655
Email: sales@cirrusresearch.co.uk
Web: www.cirrusresearch.co.uk
UK Registration No. 987160

bsi. ISO 9001:2015 Quality Management FM 531001
ISO 14001 Environmental Management EMS 552104

ACOUSTICAL CONTROL Engineers & Consultants

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Date of Issue: 13 July 2018

Certificate Number: TCRT18/1605

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Customer	Acoustical Control Engineers Broadway Bourne CB23 2TA

Order No.	ACE01			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NA-28	01070575
	Rion	Firmware		2
	Rion	Pre Amplifier	NH-23	70592
	Rion	Microphone	UC-59	00390
	Rion	Calibrator	NC-74	34246504
		Calibrator adaptor type if applicable		NC-74-002
Performance Class	1			
Test Procedure	TP 2.SLM 61672-3 TPS-49			
	Procedures from IEC 61672-3:2006 were used to perform the periodic tests.			
Type Approved to IEC 61672-1:2002	Yes	Approval Number	21.21/07.01	
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003			
Date Received	13 July 2018	ANV Job No.	TRAC18/07359	
Date Calibrated	13 July 2018			

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	26 July 2016	1607396	AV Calibration

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Date of Issue: 04 July 2019

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Certificate Number: TCRT19/1533

Approved Signatory

K. Mistry

Customer	Acoustical Control Engineers Ltd Broadway Bourn Cambridge CB23 2TA			
Order No.	M250			
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators			
Description	Acoustic Calibrator			
Identification	*Manufacturer*	*Instrument*	*Model*	*Serial No.*
	Rion	Calibrator	NC-74	35173527

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	TRAC19/07286	
Date Received	04 July 2019	
Date Calibrated	04 July 2019	
Previous Certificate	*Dated*	04 May 2018
	Certificate No.	TCRT18/1391
	Laboratory	ANV Measurement Systems

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Annex A Draft Noise Management Plan

In order to prevent the noise associated with operation from the genset from disturbing neighbouring residents it is important that all the following control measures are adhered to at all times. All relevant personnel should be aware of the Noise Management Plan as laid out below:

A.1 Except in the rare event of the CT Scanner being required for emergency conditions, the CT Scanner and genset should only be operated during the times, as agreed with the local authority:

Agreed CT Scanner & Genset operating times: 12pm to 5pm Monday to Saturday

A.2 Appointments that utilize the CT Scanner should be arranged sequentially so that the generator is operational for one consecutive period per day.

A.3 Where practicable, appointments that utilize the CT Scanner should be arranged on as few days as possible.

A.4 Do not schedule appointments that utilize the CT Scanner on weekends, unless unavoidable.

A.5 No appointments for the CT Scanner should be made for outside the agreed times above. The only time the CT Scanner and genset can be used outside this is for unscheduled emergencies if necessary.

Annex B Background Sound Level

Synopsis

B.1 The Background Sound Level is not a single numerical value but a range that is unlikely to be precisely defined numerically.

B.2 It is equally important to understand the range of factors that affect the Background Sound Level as the actual measured levels.

B.3 Appropriately timed short duration attended measurements can provide much better quality data than unattended measurements taken over a significantly longer period.

Introduction

B.4 The 2014 edition of BS4142 provides clearer and more specific guidance that the background sound level should be representative and not the lowest level that can be measured. This is to prevent some abuses of the Standard which have occurred in the past, such as where criteria have been set based on the lowest background level measured during any 5 minute period throughout the night.

B.5 Clause 8.1.4 states that: '*The monitoring duration should reflect the range of background sound levels for the period being assessed. In practice, there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed*'.

B.6 This means that if a single 'representative' background sound level is used for an assessment, consideration must also then be given to the likely range of variation in background sound and its effect on the outcome of the assessment. Ideally, the range of variation should reflect the variation of the residual sound during the period(s) of interest, taking account of both level and likelihood of such levels occurring, rather than simply attempting to consider the maximum potential range between lowest or highest possible sound levels that may occur.

B.7 However, it must also be recognised that the background sound level will usually vary significantly depending upon many different factors such as weather conditions; time of the day or night; day of the week; and time of the year. Even at the same time of day/ night and same time of the year, the background sound level can often vary by more than 10 dBA depending upon wind direction, even under conditions that are all regarded as being 'suitable' for valid measurements to be taken.

B.8 Most residual sound and the associated Background Sound Levels are affected by sources close to the measurement location and also more distant sources such as transportation systems; commercial/ industrial and other human activity; and foliage moving in the wind or even water flowing. The sound level at the measurement location will therefore vary as the wind changes in speed and direction. Sound from more distant sources is affected by wind at low and higher altitudes, which can be significantly different in both speed and direction. Therefore even under apparently similar conditions at the measurement location, the residual sound level may vary to a greater extent than would be expected if the wind at higher altitude is more variable than at lower altitude.

B.9 Whilst it may appear that taking measurements for a few days will provide better data covering a range of weather conditions, this may not be the case. Weather conditions tend to remain fairly similar for several days so a measurement period of this duration is likely to provide several days data for similar conditions. It is also highly unlikely that this period will cover the range of conditions that affect the background sound level which means that the extended measurement period may provide a false sense of reliability of data when it is of no more benefit than that obtained over a single 24 hour period.

B.10 A further problem with this approach is that unattended measurements provide very little or even no data about what has actually been measured. Fully attended measurements enable the acoustic environment to be properly understood and factors that affect the sound level to be identified and their contribution quantified. A short duration attended survey can usually provide far better quality data than a longer term unattended survey, although where long term measuring is required, such as for compliance monitoring, this may not be appropriate.

B.11 Where it is necessary to fully understand the variation in residual sound during the day and night it may be appropriate to take measurements throughout this period. However, this is unlikely to be representative of different conditions such as days of the week, public holidays and even school holiday conditions. In many situations it is more appropriate to specifically consider the most sensitive times of the day or night, on the basis that if these are satisfactory then less sensitive times will also be satisfactory. For plant that operates on a 24/7 basis the most sensitive time of the night is likely to be when people are going to or awakening from sleep rather than the quietest part of the night. During the day the most sensitive time is likely to be the evening when the residual level may be lower than at other times of the day.

Annex C Rating Penalty

Synopsis

C.1 A Rating Penalty is applicable if sound has significant characteristics such as tonality or impulsivity that attract a listener's attention at the noise sensitive location to be considered for the assessment.

C.2 A Rating Penalty can comprise separate corrections for tonality, impulsivity, other characteristics (if neither tonality nor impulsivity apply), and intermittency. These corrections are additive.

C.3 The subjective method(s) should be used to determine the Rating Penalty unless agreement cannot be reached, in which case the objective/ reference methods may be appropriate alternatives.

C.4 Whilst the maximum Rating Penalty could arguably be 15 dB or possibly even 18 dB, in reality it is expected that, where a Rating Penalty is applicable, a correction in the range of 5 dB to 10 dB is likely to be appropriate in the vast majority of cases.

Introduction

C.5 Sound which has characteristics that attract a listener's attention may be significantly more intrusive than sound of a somewhat higher level that is more innocuous. The most common acoustically distinguishing characteristics are tonality, impulsivity and intermittency. BS4142 provides guidance regarding how a rating penalty should be determined. It is important to note that this is based on the level and character of the specific sound at the noise sensitive location(s) in comparison to the level, character and context of the residual acoustic environment. It is intended that the subjective method be used where agreement can be reached regarding penalties where appropriate, with the objective/ reference methods only being used in more contentious situations.

C.6 Because the level and character of both the specific and residual sound vary with time, it is likely that the significance of any acoustically distinguishing characteristics will also vary with time. It is most appropriate to establish a rating penalty for representative conditions but to then consider the range of variation of potential rating penalty as part of the consideration of the uncertainty of the assessment.

Tonality

C.7 For tonality, Clause 9.2 states that: '*For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible*'.

C.8 In most cases where plant produces sound that is tonal but similar in level to the residual sound, the tonality may tend to be slightly or clearly rather than highly perceptible at the noise sensitive location(s), with the relative prominence of the tonality being reduced due to masking by the residual acoustic environment. In such cases it may be appropriate to apply a penalty of 2-4 dB to account for this effect.

Impulsivity

C.9 For impulsivity, Clause 9.2 states that: '*A correction of up to +9 dB can be applied for sound that is* highly *impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible*'.

C.10 In most cases where plant produces sound that is impulsive but similar in level to the residual sound, the impulsivity may tend to be slightly or clearly rather than highly perceptible at the noise sensitive location(s), with the relative prominence of the impulsivity being reduced due to masking by the residual acoustic environment. In such cases it may be appropriate to apply a penalty of 3-6 dB to account for this effect.

Other Characteristics

C.11 Clause 9.2 also states that '*Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied*'.

C.12 This means that, depending upon circumstances such as the context, it may be applicable to apply a 3 dB penalty to sound that is neither tonal nor impulsive where it has other characteristics that tend to attract a listener's attention to the sound against the residual acoustic environment at the noise sensitive location(s).

Intermittency

C.13 For intermittency Clause 9.2 states that: '*When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied*'.

C.14 This means that, depending upon circumstances such as the context, it may be applicable to apply a 3 dB penalty where the intermittency of the specific sound tends to attract a listener's attention to the sound against the residual acoustic environment at the noise sensitive location(s).

Conclusion

C.15 On an extremely rare occasion when the specific sound is both highly tonal and highly impulsive at a noise sensitive location, it could conceivably be appropriate to apply a rating penalty of 15 dB and possibly even 18 dB if the intermittency of the specific sound exacerbates the impact of what is already highly intrusive sound still further. If sound is both tonal and impulsive but one of these characteristics is dominant then it may be appropriate to apply just the correction for that characteristic. In situations where the specific sound is similar in level to the residual sound it is more likely that such characteristics will be masked to some extent by the residual sound at the noise sensitive location(s). In this case it is more likely that a rating penalty of 2-4 dB for tonality and/ or 3-6 dB for impulsivity may be applicable, possibly with an additional 3 dB penalty for intermittency if this is significant. In most cases it is expected that a Rating Penalty, if applicable, will be in the range of 5-10 dB.

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Annex D Uncertainty

Synopsis

D.1 Despite sound measurement systems usual precision of 0.1dB, any measurement of environmental sound or specific components of this can only be representative of its constantly varying level and character, at best.

D.2 In addition to uncertainty in sound level measurement systems, the actual level being measured varies continuously in level and character. Analysis of the measured levels adds further uncertainty, as does assessment of the potential impact of sound, which is greatly affected by the specific context of the situation being assessed.

D.3 It is not appropriate to estimate all uncertainty that may occur and deduct this from a 'suitable' level to establish a 'safe' level that 'should be ok'. This would result in sound levels that are substantially lower than necessary or appropriate, providing no benefit for those being 'protected', whilst creating significant adverse impacts on the sustainability of any development and making many impracticable, thereby preventing much development that should proceed, and denying the benefits of such development, often to the very people that are being 'protected'.

D.4 The way in which uncertainty is addressed must depend upon factors such as the sensitivity of the situation, the potential magnitude of the uncertainty, and its potential significance on the outcome of the assessment.

Introduction

D.5 Environmental sound is constantly changing in level and character. The relative significance of any component of this similarly varies continuously as sound from both the specific component and all other residual sources varies. The propagation paths between sources and receiver change for reasons such as varying wind speed and direction which further alters the level and character of environmental sound at any location. Sound can be measured and expressed in many different ways using different parameters such as the maximum, logarithmic average, minimum, or statistical distribution. These values will themselves depend upon other factors such as the time period over which they apply and the response time of the measurement system. This means that any quantified level of residual sound or that from a specific source is representative rather than precise and it is necessary to more fully understand the acoustic characteristics of the acoustic environment that is being considered.

D.6 Uncertainty has been the acoustic 'elephant in the room' for many years. Some acousticians have considered it; many have ignored it; and other people, particularly non-acousticians, have been unaware of it, assuming incorrectly that acoustic analyses presented to a precision of 1 dB or even 0.1 dB are accurate to that level of accuracy.

D.7 In most cases, when setting sound levels based on an acoustic assessment it is not appropriate to set a criterion that incorporates uncertainty to the extent that the criterion is highly unlikely to be exceeded under any circumstances. Clearly there are some exceptions to this, such as the safety requirement to protect personnel from hearing damage at work. In this case subtracting 1 standard deviation (σ) from a hearing protector's average performance is used to give an assumed level of performance that should be achieved for 84% of users. Although subtracting 2σ would protect 97.5% of users and 3σ would protect 99.9%, a balance has been struck between cost/ practicability and benefit in deciding that uncertainty where 16% of people may not be provided with the expected level of protection is appropriate in this case.

D.8 In non-safety critical situations it is generally appropriate to accept a greater level of uncertainty in the outcome of any assessment. In many acoustic assessments it is also not practicable to numerically quantify the level of uncertainty in the manner that is possible for hearing protection devices which can be thoroughly tested and measured under carefully controlled laboratory conditions.

D.9 BS4142 aims to provide guidance as to the likely significance of impact of industrial or commercial sound, taking into account not only the level and character of that sound but also the context in which it is heard, which can significantly affect the significance of its impact.

D.10 The impact of industrial or commercial sound will vary as the level and character of both the source and residual sound changes. This means that the assessment of its impact will be a general indication and that its significance will change continuously. As noted above, it is generally not appropriate to consider a theoretical 'worst case' scenario comparing the highest possible rating level against the lowest possible background sound level. Instead, representative rating and background sound levels should be compared, considering the level, character and context of the specific sound and residual acoustic environment. There will inevitably be occasions when the impact is slightly greater than this representative situation and conversely there will be other occasions when the impact is less. This is no different to the impact of different sources of sound in the residual acoustic environment, such as pedestrians conversing loudly whilst passing a dwelling, a vehicle horn being sounded, or a siren being heard on occasion.

Measurement Uncertainty

D.11 Any measurement whether acoustic or not, includes an element of uncertainty in the measured value, the magnitude and significance of which usually depends upon many factors. The most obvious factor for measurements undertaken for this assessment is due to instrumentation, but this is minimised by a range of controls set out in Craven & Kerry's *'A Good Practice Guide on the Sources and Magnitude of Uncertainty Arising in the Practical Measurement of Environmental Noise'* (as referenced in BS4142: 2014) including:

- Use of Type 1 sound level analysers
- Bi-annual calibration of sound level analysers and annual calibration of calibrators (relevant calibration certificates are provided elsewhere.
- Periodic cross-calibration with other calibrated analysers and monitoring of system's calibration characteristics.
- On site calibration checks before and after measurements are taken.
- Avoidance and control of interference due to electromagnetic sources, weather or other factors.

Other Causes of Uncertainty

D.12 These measures ensure that the uncertainty due to the measurement system is relatively small in comparison with factors that affect the overall uncertainty incorporated in this assessment. These include:

- Variations in the level and character of residual and associated background sound at the measurement and noise sensitive receptor locations.
- Variations in the level and character of the specific sound.
- Where the specific sound level is calculated from the difference between the ambient sound level with the source operating and the residual level without, significant variability in either of these levels increases the uncertainty in the calculated specific level and significant variability in both increases the uncertainty by a greater amount.
- The magnitude of any rating penalty that should be applied and under which conditions e.g. full load or partial load operation or different plant characteristics.
- Modelling of the sound path from source to receptor.

D.13 In addition to the Good Practice measures identified by Craven and Kerry, appropriate measurement techniques can further reduce uncertainty such as undertaking fully attended surveys, recording the sound level many times each second and noting acoustically significant factors that may affect the measured level on a second by second basis.

Background & Residual Sound Level Uncertainty

D.14 In many cases the level and character of residual and background sound is strongly affected not only by the level of activity which varies with time of day, but also by seasonal effects such as foliage generated noise and to an even greater extent by weather conditions, of which the most significant is usually wind speed and direction, which itself varies with location and altitude. Because weather conditions tend to remain fairly similar for several days, taking measurements for this length of time is likely to provide a few days and nights of similar data rather than a reflection of the likely range of sound levels under different weather conditions. Where it is necessary to fully understand this effect it is necessary to undertake long term monitoring for extended periods, generally also at different times of the year. Clearly this is only likely to be practicable for major developments such as national infrastructure construction. Even for large windfarms it is usually only considered appropriate to gather data for a period of many weeks rather than many months. Long term residual and background sound level measurements are neither practicable nor appropriate for small scale developments, particularly if the background sound level informs rather than dictates the outcome of a BS4142 assessment.

D.15 Where the residual sound level is relatively steady measuring for a short time can provide as good an indication of the representative level prevailing at that time under those specific as a longer duration measurement. As the variability of the residual sound level increases the range of residual and background sound levels also increases and the uncertainty in these levels similarly increases. However, as discussed above, the variability and uncertainty in the residual and background sound levels will tend to be greater under different weather conditions than at different times of the day or night under similar weather conditions. Measuring the sound level many times every second provides a clear understanding of how the sound level depends upon a range of factors such as passing traffic, distant plant and activity, so that the likely range of variation of the residual and background sound levels can be better understood.

D.16 There is a balance to be struck between reducing uncertainty and the duration and associated costs of the measurement period(s).

Source Level Uncertainty

D.17 There is uncertainty in the level and character of sound from sources for many reasons. These include:

- Varying plant operational conditions.
- Variation in sound level produced by different items of equipment.
- Uncertainty or error in manufacturer's data.
- Uncertainty or error in measured levels of other 'representative' sources.
- Acoustic characteristics of plant such as directivity.

D.18 Plant may operate differently under different conditions and for example, may be restricted so that the level and character of sound will be different during the night than day time. Even where plant operates in only one mode, the level and character of sound that it produces may vary. BS4142 considers the average sound level that the plant may produce over a 15 minute period during the night and 1 hour during the day. The characteristics of the sound may also differ during these times as a result of which the rating correction(s) may be different.

D.19 Where there are multiple items of equipment, the variation in level and character of each is likely to result in even greater variation of the overall level and character of sound from the equipment as a whole. However, there can also be some 'smoothing' effect if the overall result is that plant operates more or less continuously, with individual items of plant starting and stopping at different times. Provided that the changes in level and character due to individual items of plant are not significant this can result in slight variations in an otherwise relatively steady sound that may be less significant than a single item of plant intermittently stopping and starting.

D.20 Where a new source is proposed, it may be appropriate/ necessary to use manufacturer's data to assess the likely significance of its impact. This data may vary from a single figure dBA level that may or may not clarify whether it is a sound pressure level measured at a specific distance under known acoustic conditions, or a sound power level, to a detailed frequency spectrum, possibly for different operating conditions. Experience can greatly assist the interpretation of such data and the assessment of its reliability. Even where detailed frequency spectra are provided, this does not provide a definitive indication of appropriateness or otherwise of a rating penalty and its magnitude if this is found to be applicable.

D.21 In many cases it is appropriate to use data obtained from other similar equipment as an indication of the likely level and character of sound that will be produced by proposed plant. In these cases it is necessary to consider the uncertainty in these measured levels including not only the effects of the measurement environment and operational characteristics of the representative plant, but also any differences due to other factors such as required maintenance.

Rating Penalty Uncertainty

D.22 The rating penalty includes corrections for sound that is tonal, impulsive, intermittent, or has other characteristics that will tend to attract a listener's attention. The significance of these characteristics should be assessed by comparison of the specific and residual sound at the noise sensitive location(s), not closer to the source. This may be difficult to do for existing sources due to difficulties in measuring the specific and residual sound, although in most cases it should be possible to use the simplified subjective method set out in clause 9.2 of BS4142.

D.23 For a proposed source it will not be possible to directly measure or subjectively assess the sound it produces at the noise sensitive receptors, but it may still be possible to apply the subjective method in such situations, considering the known level and character of sound the source will produce and the level and character of the residual acoustic environment at the noise sensitive location(s).

D.24 There may be uncertainty whether a specific sound may have tonal or impulsive content that is just or clearly perceptible; or is clearly or highly perceptible. It is up to the parties undertaking the assessment to form an opinion regarding what would constitute an appropriate rating penalty and to clearly explain how this has been arrived at. The uncertainty in the magnitude of the rating penalty and the likely significance of the character of the specific sound at the noise sensitive location(s) should then be considered further as part of the assessment process.

Modelling Uncertainty

D.25 Where an existing source is being assessed based on measurements and observations at the noise sensitive location(s) there may be no need for any acoustic modelling of the source characteristics or sound propagation path. However, in most cases it is likely that a combination of measurement and calculation will be necessary and this will introduce further uncertainty. For example levels measured close to a source can be extrapolated back to the noise sensitive location(s) but the actual level produced at the more distant location(s) will be affected by factors such as reflections or screening by structures, attenuation due to the ground or air, and possibly most significantly by wind speed and direction.

Conclusion

D.26 Some of the elements of uncertainty that affect the actual level and character of sound at noise sensitive locations can be numerically estimated, although this is unlikely to be the case for the more significant ones. However, the aim is not to derive a precise numerical outcome from a BS4142 assessment but to consider the likely significance of the impact of industrial or commercial sound at affected noise sensitive locations.

D.27 Where there is a very clear outcome and relatively small uncertainty, then the uncertainty will have negligible effect on the outcome of the assessment. However, where the outcome is less clear and/ or the level of uncertainty is greater, this should be reflected in the assessment.

D.28 The assessment must consider not only the level and character of sound from the source(s) and also the residual acoustic environment but also the context in which it is experienced. The effect of sound on a listener is subjective and it is necessary to incorporate some subjectivity into a BS4142 assessment. This is generally the most appropriate way in which to incorporate the effects of uncertainty into the outcome of the assessment.

Annex E Guidance

Synopsis

E.1 BS4142:2014 uses a comparison between the Rating and Background Sound Levels to establish an Initial Estimate of the Likely Significance of Impact. The context of the assessment must then be considered, which can significantly alter the outcome of the assessment.

E.2 Where the aim is to ensure that people are not disturbed by plant during the night it is the absolute level of sound within the dwelling that will be of most significance. What constitute a suitable level of sound from plant will depend upon the character of the acoustic environment. This means that identification of a suitable criterion to properly protect residents must be informed by the existing residual sound level, of which the Background Sound Level is one partial indicator, with others such as the average or maximum providing further information.

E.3 For gardens and other outdoor amenity areas, BS8233 indicates that an average level of 50dBA may be desirable, but this is based on considering residential development in what may be relatively noisy areas. For quieter locations NPPF and NPSE provide further assistance. When establishing what may be a suitable level in gardens etc. for sound from plant, it is important to consider the existing acoustic environment including the residual levels (background, average, etc.) and the character of the area e.g. quiet rural, busy urban, adjacent to a car park or service yard.

BS4142:2014 Methods of rating industrial and commercial sound

E.4 BS4142:2014 differs from previous editions of this Standard in many ways, including that:

- The aim is to assess the likely significance of impact not the likelihood of complaint. This is consistent with current Government planning policy but is not aligned to it because this is a British standard, whereas planning policy does not apply to all of Britain.
- The context of the situation must be considered as part of and can significantly affect the outcome of the assessment.
- The outcome of the numerical assessment will not be a single number but a range, together with uncertainty, the significance of which must be considered as part of the assessment process.
- The absolute sound levels may be more significant than the difference between the rating and background sound levels.
- It may also be appropriate to consider other guidance such as BS8233:2014 as part of the assessment.

- Sound having significant characteristics that attract a listener's attention may be significantly more intrusive than featureless sound of a somewhat higher level, as a result of which the rating penalty may now be significantly greater than before.
- The reference to a rating level 10 dB below the background sound level has been removed because this was mis-applied in many cases to impose unreasonably low criteria.
- The many factors that affect the uncertainty of an assessment must be taken into account.

E.5 Clause 11 states: '*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. 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*'.

E.6 BS4142 requires that the Rating Level be compared to the Background Sound Level to provide an Initial Estimate of the Likely Significance of Impact. This is then amended to take account of the context of the assessment, and the effects of the uncertainty in the entire process on the outcome of the assessment must also be considered.

E.7 The Background Sound Level ($L_{A90,T}$) is defined as the level exceeded for 90% of the time i.e. the quietest 10% level. This specifically excludes consideration of the sound level prevailing for 90% of the time and is intended to provide an indication of the sound level during 'lulls' in activity. This means that the same Background Sound Level can be measured outside a dwelling in a continuously quiet location with little activity or sources of residual sound, and outside a dwelling beside a road with vehicles passing at high speed every few minutes. Clearly these two locations have very different acoustic characteristics and sensitivity to sound, despite having the same L_{A90} level. In this situation the average ($L_{Aeq,T}$) levels may differ by around 20dBA to 30dBA and the maximum ($L_{AMax,T}$) levels may differ by 40dBA or more.

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

E.8 This Standard draws on authoritative guidance such as that issued by the World Health Organisation to identify suitable noise levels for a wide range of different environments. For dwellings these include bedrooms, where the aim is to protect people from sleep disturbance; other habitable rooms that are in use during the day, where the aim is to provide good listening/ communication/ recreational conditions; and outdoor amenity space including gardens.

E.9 This confirms that a steady average level of 30dBA within a bedroom, due to external sound sources, is desirable and that this should not have significant acoustically distinguishing characteristics. For habitable rooms during the day a desirable level is 35dBA.

E.10 For outdoor areas such as gardens and patios a desirable upper average level of 50dBA is stated, with an upper guideline average limit of 55dBA, which would be acceptable in noisier environments. However it is also recognised that for strategic reasons it may be appropriate to permit higher levels, such as for new dwellings in busy urban areas.

National Planning Policy Framework (NPPF), Noise Policy Statement for England (NPSE) and National Planning Practice Guidance (NPPG)

E.11 These documents clarify Government policy regarding development and noise. There is a presumption in favour of sustainable development and a recognition that when considering sustainability, the various factors that affect the sustainability of a proposed development must be considered collectively.

E.12 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

E.13 Paragraph 123 of NPPF states that:

> Planning policies and decisions should aim to:
>
> a. avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
>
> b. mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
>
> c. recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
>
> d. identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

E.14 The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy by promoting good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

E.15 Paragraph 2.23 of NPSE clarifies the first part of the above excerpt:

a. The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development.

E.16 Similarly paragraph 2.24 of NPSE clarifies the second part:

a. The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level). It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

E.17 These make it clear that noise must not be considered in isolation but as part of the overall sustainability and associated impacts of the proposed development. There is no benefit in reducing noise to an excessively low level, particularly if this creates or increases some other adverse impact. Similarly, it may be appropriate for noise to have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance when considering the overall sustainability of the proposed development.

E.18 NPSE clarifies the difference between NOEL (No Observed Effect Level) and LOAEL as used in Night Noise Guidelines for Europe, which gives values of 30dB(A) and 40dB(A) for the night time average level measured outside dwellings respectively. This indicates that there may be no significant overall benefit in achieving an average level of less than around 40dB(A) outside dwellings during the night.

E.19 It should also be considered that in order to make equipment quieter it is often necessary to use larger equipment that operates more slowly and for longer periods of time. This may increase energy consumption and hence the carbon footprint of the equipment. The overall impact of this may outweigh any acoustic benefit of the equipment being slightly quieter.

World Health Organisation: Guidelines for Community Noise; Night Noise Guidelines for Europe

E.20 The WHO publication 'Guidelines for Community Noise – 1999' provides guidance regarding suitable levels of noise that will protect vulnerable groups against sleep disturbance. A steady level of 30dB(A) in bedrooms, with occasional maximum levels of 45dB(A) are identified as being suitable to achieve this, with an assumed difference of approximately 15dB(A) between the noise level outdoors and that resulting in the bedroom, assuming that the bedroom windows are partly open for ventilation. This means that the corresponding targets for the noise level outdoors are steady levels of up to about 45dB(A) and occasional maxima of up to around 60dB(A).

E.21 The more recent WHO guidance 'Night Noise Guidelines for Europe – 2009' is more concerned with the longer term average noise levels that are covered by the EU Directive on Environmental Noise, although this does appear to suggest slightly lower external maximum noise levels of around 57dB(A) outside bedrooms during the night.

E.22 Furthermore the 1999 guidance states that: *'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dBLAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dBLAeq. Where it is practicable and feasible, the lower outdoor level should be considered the maximum desirable sound level for new development.'*

Annex F Assessment of the Impacts

Assessment Method

F.1 Clause 11 states: '*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. 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*'.

F.2 An initial estimate of the impact should be made by subtracting the background sound level from the rating level, and it may be appropriate to make more than one assessment.

F.3 This initial estimate must then be modified as appropriate to take account of the context. This must consider all pertinent factors including:

- The absolute level of sound. This may be more as or more significant than the difference between the rating and background sound levels, particularly where the residual sound level is particularly high or low.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether the receptor may be protected by specific measures that will reduce the impact in comparison to receptors without such protection.

Specific Considerations

F.4 Clause 8.1 includes the following: '*the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes*'.

F.5 Annex A of the Standard provides an increased number of examples of how to use the standard to obtain ratings for various different scenarios. This states that: '*These examples illustrate how the standard could be applied and are not to be taken as a definitive interpretation of how it is intended to be used*'.

F.6 Examples 6, 7 & 8 of Annex A *'show how similar sound levels can produce different results, depending primarily upon the context in which the sound occurs'*. Examples 6 & 8 specifically consider the likely significance of the specific sound during the night on residents *'who could be sleeping with open bedroom windows'*. In this case other guidance such as BS8233 might also be applicable for several reasons:

- At low external residual sound levels the sound level within a dwelling with open windows is likely to be controlled not by the external residual sound level but by sounds created within the dwelling by a range of sources including refrigerators, pumps, boilers, water flowing through pipes, conversation, radios/ televisions, equipment cooling fans, animals, and even people breathing particularly when considering sound during the night.
- During the night people the level and character of sound outside a dwelling is of less significance than the acoustic environment within bedrooms and its suitability for going to sleep or not disturbing residents whilst asleep.
- The World Health Organisation provides authoritative guidance regarding suitable sound levels in bedrooms, from which the guidance in BS8233 is derived.

Annex G Competence & Experience

G.1 Acoustical Control Consultants Limited has the advantage of personnel that were directly involved in the drafting of the original 1967 edition of BS4142 and the most recent 2014 edition, who have specialised in the measurement, assessment and control of noise from industrial and commercial sources throughout their careers. This type of work forms a major part of our activity and has done so for several decades. Our culture, systems and working practices are geared towards ensuring that this type of work is consistently undertaken to the high and robust level of quality for which we are known.

G.2 **Richard A Collman** now has overall responsibility for BRL's activities including BS4142 assessments. He graduated with a BSc (Class I) in Acoustics and Computer Science from Salford University in 1984, being awarded the course prize in both the second and final years. He is a Chartered Engineer and has specialised in the measurement and assessment of sound from industrial and commercial plant for over 30 years, writing articles and papers on this subject for Acoustics Bulletin and IOA conferences. He pioneered the use of digital instrumentation for short duration consecutive logging rather than longer term statistical averaging measurement techniques. As an expert on sound from refrigeration and air conditioning plant he represented the Institute of Refrigeration on the BSI committee and the Drafting Panel responsible for the 2014 edition of BS4142, presented the section on Uncertainty at the BS4142 Launch Meeting in November 2014, and authored an associated Technical Article in Acoustics Bulletin. He has been closely involved in the development of BRL's BS4142 measurement, assessment and reporting system to ensure that it is fully compliant with all aspects of BS4142.

G.3 **Kristoffer Tsinontas**, Acoustician joined the company in September 2014 and has since been carrying out noise impact assessments primarily for the food retail industry, along with assisting in other larger projects undertaken by the company. Kristoffer has a BSc (Hons) in Music Technology, whereby he specialised in Acoustics and Psychoacoustics – particularly in modelling acoustic soundscapes. Kristoffer is a member of the Institute of Acoustics.

G.4 **Sam Message,** Acoustician joined the company in June 2016. Sam has a BSc (Hons) in Audio Technology, specialising in modelling electroacoustics systems and has undertaken the Certificate of Competence in Environmental Noise and Building Acoustics Measurements. Sam is an associate member of the Institute of Acoustics and is currently focused on environmental and building design acoustics.