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NEW SCHOOL, BLOFIELD

NOISE IMPACT ASSESSMENT

AJA Report no. 12746/4

Adrian James Acoustics Document Control Sheet

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QA Control

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–	4 March 2024	Julez Redding AMIOA	Pete Erskine MIOA	Pete Erskine MIOA

Revision History

Rev	Details
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1 INTRODUCTION

1.1 Background

We have been appointed by NPS Property Consultants to assess the impact on the surrounding area of the installation of plant at a new school in Blofield, Norfolk. Four air-source heat pump (ASHP) units are proposed as part of the new school.

We understand that there is a planning condition relating to noise that must be discharged before construction can progress, this is discussed in Section 2.2.

1.2 Statement of technical competency

The assessment in this report was carried out by Julez Redding, an Associate Member of the Institute of Acoustics (AMIOA). Julez has worked in the field of acoustics since 2022. His educational qualifications are a B.Mus (Honours) degree in *Music and Sound Recording* from the University of Surrey's Tonmeister course. He completed the Institute of Acoustics (IOA) Diploma in *Acoustics & Noise Control* in 2023.

The survey and supervision were carried out by Pete Erskine, a full corporate member of the Institute of Acoustics with 6 years of experience as an acoustics consultant and a diploma in *Acoustics & Noise Control* from the IOA.

1.3 Source information

The report is based on the design information from NPS listed in Table 1.

Drawing no.	Revision	Title
107733-NPS-00-DR-A-012	C1	Proposed Site Plan

Table 1 – Design information used in the assessment

2 PLANNING POLICY

2.1 National planning policy

Details of national planning policies and associated guidance relevant to this assessment are provided in Appendix B. This includes:

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

In combination, these documents set out national planning policies relating to noise, and the current guidance on appropriate terminology and methodology for noise assessment.

2.2 Planning condition

Local environment and development planning policy are the remit of South Norfolk and Broadland District Council (SNBDC). SNBDC have set a pre-commencement condition for this project which is reproduced below:

> *"Development shall not begin until a comprehensive noise assessment to determine the level of noise both internally and externally has been completed in accordance with a scheme to be first agreed in writing by the Local Planning Authority. The written report(s) shall identify and consider the potential impacts on all identified receptors. All investigation and reports must be carried out in accordance with current best practice. Based on the findings of this study, details of whether remediation is required together with a remediation method strategy as appropriate shall be submitted to and approved in writing by the Local Planning Authority."*

2.3 Local authority consultation

We consulted with Alex Grimmer, Environmental Management Officer at SNBDC on 29 February 2024 to discuss local noise policy and assessment criteria for the installation of new plant.

Mr. Grimmer confirmed that plant noise should generally be assessed in accordance with the guidance BS 4142:2014+A1:2019. He stated that SNBDC's preferred criterion would be for the rating level at the nearest noise-sensitive receptors be no higher than level with the background sound level. Further details of BS 4142 are provided below.

3 TECHNICAL STANDARDS AND GUIDANCE

3.1 BS 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'* (BS 4142) describes a method for the rating and assessment of sound of an industrial and/or commercial nature. Details of the standard are provided in Appendix C.

In summary, the BS 4142 assessment methodology can be summarised as follows:

1. Determine the background sound level (dB $L_{A90,T}$) at the noise sensitive receptor(s).
2. Determine the specific sound level of the source under assessment (dB $L_{Aeq,T}$) at the receptor location(s).
3. Apply corrections to the rating level if the sound has tonal, impulsive, intermittent, or other characteristics which attract attention (see Table 7 of Appendix C for details).
4. Compare the rating level (dB $L_{Ar,Tr}$) with the background sound level.

According to BS 4142:

- If the rating level is 5 dB or more above the background sound level this indicates an adverse impact, depending on context.
- If the rating level is 10 dB or more above the background sound level this indicates a significant adverse impact, depending on context.
- Where the rating level does not exceed the background sound level this indicates a low impact, depending on context.

BS 4142 places a strong emphasis on context when considering any assessment outcome.

The BS 4142 methodology also requires that any areas of uncertainty are reported and that, where necessary, reasonable, practicable steps should be taken to reduce the uncertainty.

3.1.1 Low background sound levels

BS4142 states in Section 11 that: "*Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.*"

The standard does not specify thresholds below which background sound and rating levels should be considered low. However, the Association of Noise Consultants guidelines for the use of BS4142 state:

> "*BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB L_{Ar},.*

The WG suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate."

4 DESCRIPTION OF SITE AND PROPOSALS

4.1 Description of site and proposals

A new school is under construction in Blofield, Norfolk. The site is situated south of the Blofield Bypass (A47) dual carriageway, separated from the site by an earth bund. The school is surrounded to the south by housing, and there is a doctor's surgery immediately west of the proposed new school building. The project is proposing to install four air-source heat pump (ASHP) units in a compound on the western edge of the school site.

An aerial photograph of the site is shown in Figure 1 and an annotated plan of the proposals is shown in Figure 2.

Figure 1 – Annotated aerial photograph of site and surroundings. © Google 2024

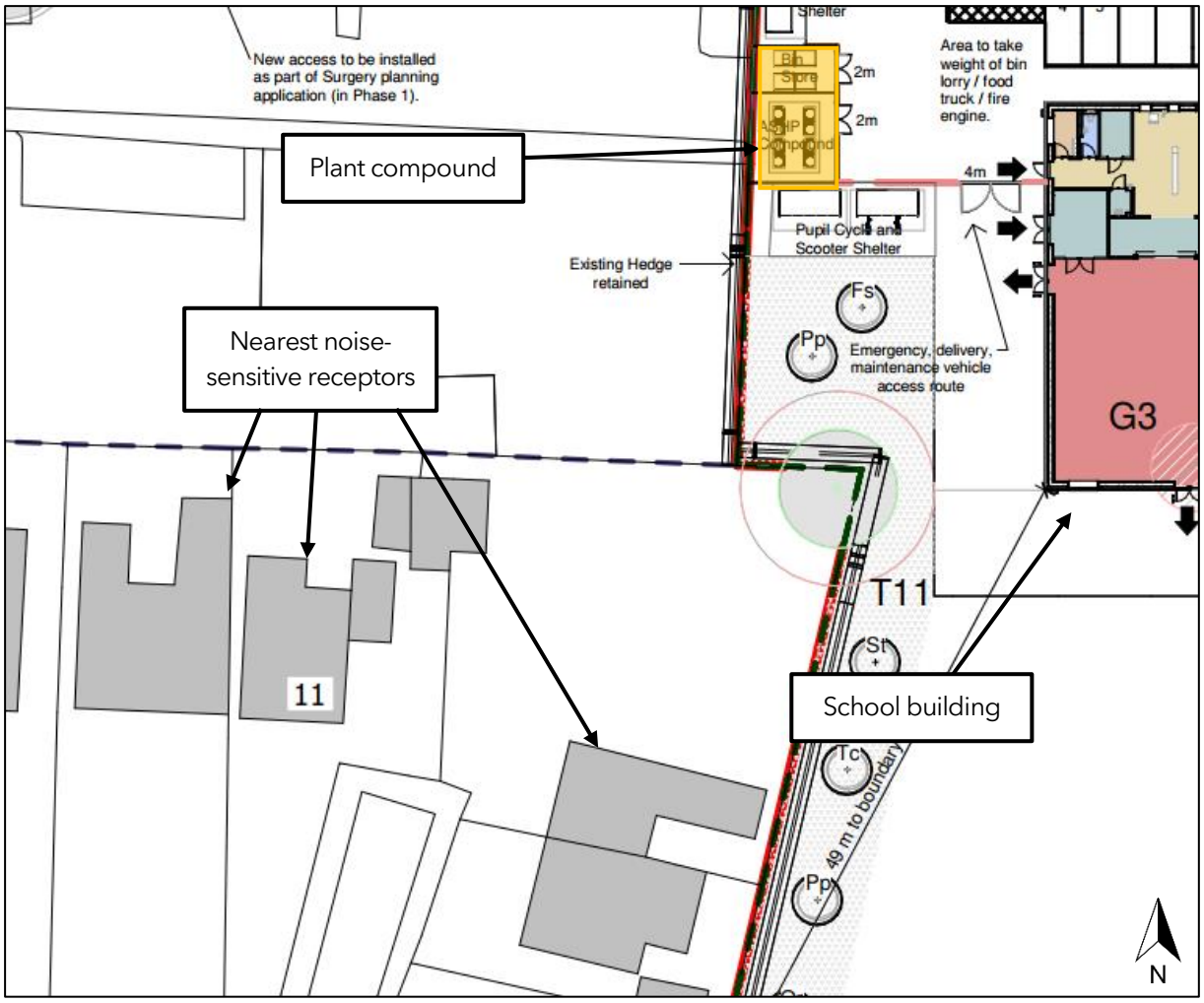

Figure 2 – Annotated plan of site and surroundings

4.2 Description of sound sources

The proposed ASHPs are 4no. Mitsubishi Electric EcoDan CAHV-P500YA-HPB units. Table 2 shows the stated octave-band and A-weighted sound pressure levels at 1 m produced by a single unit when running at full (100%) duty, quoted from the manufacturer datasheet.

Octave-band centre frequency (Hz)	63	125	250	500	1000	2000	4000	8000	A
Sound pressure level at 100% duty (dB)	70	65	61	57	52	47	49	45	**59**
Sound pressure level at 75% duty (dB)	64	62	59	56	50	47	44	39	**57**

Table 2 – Sound pressure levels at 1 m, from manufacturer's datasheet

We understand that the units are expected to run all the time, including at night. We expect that the majority of the operation will be at the 75% duty level, however we have conducted our assessment as a *'worst case'* where the units operate in 100% duty mode all of the time.

5 SOUND MEASUREMENTS

5.1 Introduction

We conducted a noise survey between 7 and 14 October 2020 to establish the lowest representative daytime (07:00–23:00 hrs) and night-time (23:00–07:00 hrs) background sound levels, in accordance with BS 4142. We have used the results of the survey to inform a noise propagation model, and calculate the background sound level at the location of the nearest noise-sensitive receptors.

5.2 Survey methodology

5.2.1 Measurement locations

Our unattended measurement position was in the then-undeveloped green space north of the doctors' surgery car park. The position was approximately 60 m south of the A47, and 60 m north of the row of bungalows on Manor Ridge, which constitute the nearest noise-sensitive receptors. Figure 3 shows an annotated aerial photograph from the time the survey was taken, prior to works on site commencing.

Measurements were taken in the free field with the microphone at a height of approximately 1.5 m above the ground.

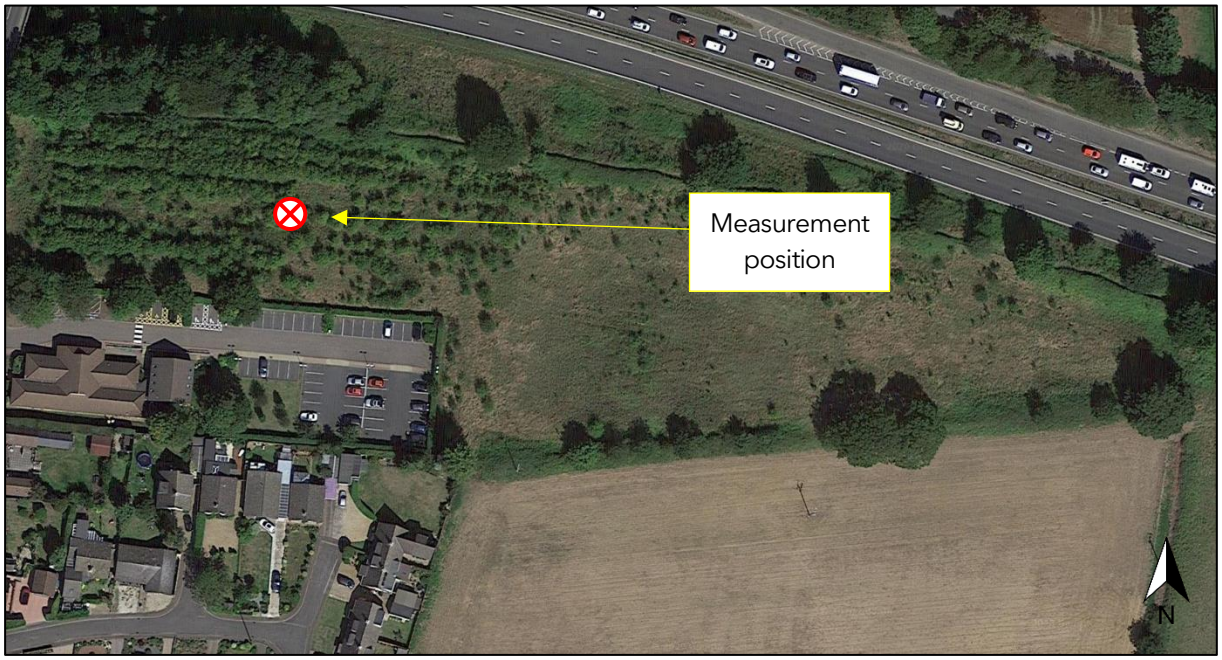

Figure 3 – Annotated aerial photo of measurement positions at the time of the survey
© Google 2020

5.2.2 Instrumentation

The measurement systems were calibrated before and after use using a reference calibrator. Details of the sound measurement systems and calibrator used are presented in Appendix E.

5.2.3 Weather conditions

During the measurement period, regional weather data listed temperatures of 5–17°C with periods of clear skies, cloudy spells, and fog. Average wind speeds were generally around 3–5 m/s. There were some scattered showers, but no prolonged periods of precipitation. In general, the weather conditions were appropriate for a noise survey.

5.3 Survey results

5.3.1 Subjective impressions

The A47 is the dominant source of noise on the site. There is infrequent traffic on the local roads, but this was inaudible from the measurement position. Car doors shutting in the surgery car park and children at the nearby primary school could be heard occasionally. During the night, road traffic on the A47 becomes much less frequent with the underlying noise climate more likely comprising distant vehicles.

5.3.2 Background sound levels

Sound levels were measured over the full survey duration and post-processed to provide $L_{A90,1\ hour}$ levels during daytime periods and $L_{A90,15\ mins}$ levels during the night-time periods. These are the standard assessment periods defined in BS 4142:2014 for assessing plant noise.

The cumulative distribution of measured daytime and night-time background sound levels are shown in Figure 4 and Figure 5 respectively.

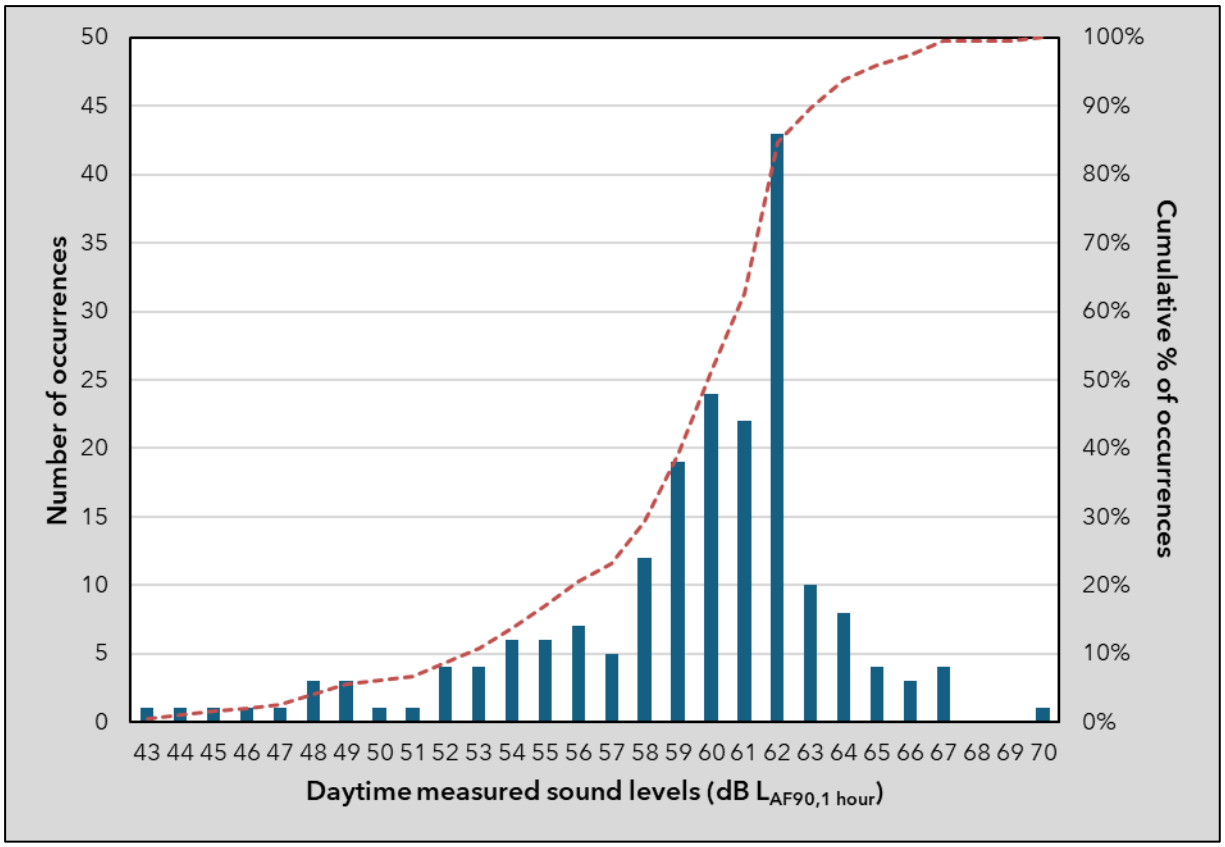

Figure 4 – Histogram of measured daytime background sound levels

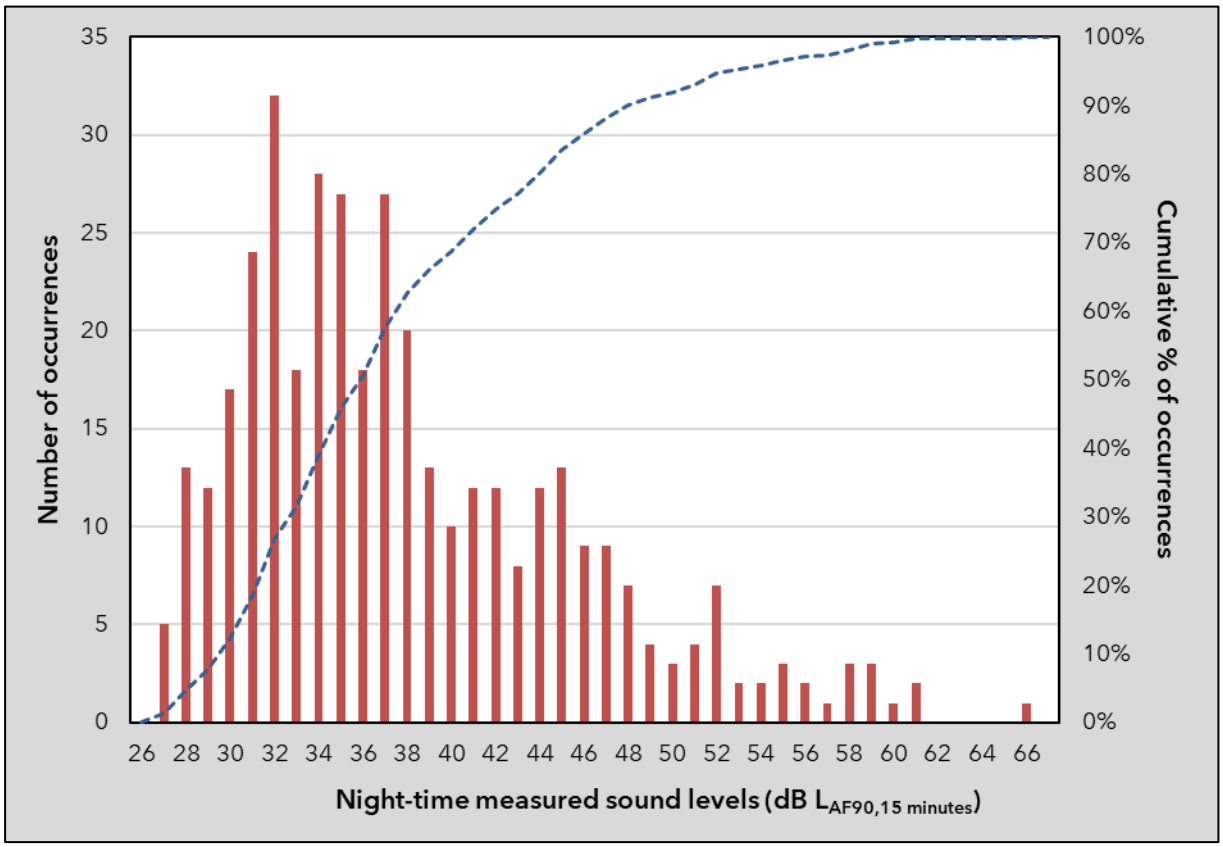

Figure 5 – Histogram of measured night-time background sound levels

6 NOISE MODELLING METHODOLOGY

We created a 3D noise model using CadnaA software to calculate sound propagation from the sources subject to assessment.

The calculation methodology from ISO 9613-2 *'Attenuation of sound during propagation outdoors'* (ISO 9613-2) was adopted (full details of ISO 9613-2 are provided in Appendix D).

Table 3 below sets out the main configuration settings from our CadnaA model which define the correction factors applied according to the ISO 9613-2 calculation method.

The results of the modelling are presented in Section 7.2.

Atmospheric absorption	Ambient temperature	10°C
	Relative humidity	70%
Ground effect	Default ground absorption	1.00 (soft ground)
	Ground absorption of paved areas	0.00 (hard)
Surface reflection and absorption	Freestanding timber barriers	Absorption coefficient: 0.10
	Buildings and masonry walls	Absorption coefficient: 0.05
	Number of reflections calculated	5

Table 3 – ISO 9613-2 correction configurations applied in the CadnaA model

ISO 9613-2 has a calculation tolerance of ±3 dB.

7 BS 4142 ASSESSMENT

7.1 Background sound level

7.1.1 General information

Background sound levels are widely measured using the parameter $L_{AF90,T}$. This is the sound pressure level exceeded for 90% of the measurement period T. For this reason, it is an indication of sound levels during the quieter periods of measurement, and therefore is mostly influenced by the underlying continuous sound in a given situation (e.g. distant traffic noise), and not by shorter-duration higher sound levels occurring in the period.

In practice, there is no single background sound level as this is a fluctuating parameter and the background sound level used should be representative of the period being assessed.

Both BS 4142 and the accompanying Association of Noise Consultants (ANC) technical note state that the representative background sound level(s) used ought to account for the range of background sound levels and should not necessarily be the lowest and/or mode value.

7.1.2 Representative background sound level

The background sound levels at our measurement position were determined from the histograms showing the number of occurrences of each measured level during the assessment periods. These were presented in Section 5.3.2

For the daytime period, there is a small peak in the data at 60 dB $L_{AF90,1\ hour}$, which we consider to representative of a typical background level at that location during the daytime. During the night-time period, sound levels were significantly lower, and show a strong modal peak at 32 dB $L_{AF90,15\ minutes}$, which we consider to be representative of the typical background sound level at night.

Our environmental noise model shows there could be up to a 3 dB difference in background sound levels between the measurement position and the location of the noise sensitive receptors. This is dependent on the frequency of road traffic on the A47 passing the site during the night and in practice the difference is likely to be negligible as we would expect the background sound level to comprise distant road traffic noise. To fairly assess the extent of possible impact, we have presented the representative background sound level as a range including the 3 dB distance attenuation. These are shown in Table 4.

Period	Background sound level
Daytime	57 – 60 dB $L_{A90,\ 1\ hour}$
Night-time	29 - 32 dB $L_{A90,\ 15\ min}$

Table 4 – Representative background sound levels

7.2 Specific sound level

According to BS 4142, the specific sound levels should be determined at the assessment location as a discrete source, free of other influences contributing to the ambient sound.

We calculated the specific sound levels at the nearest receptors using CadnaA noise modelling software, and the manufacturer's noise data for the ASHPs set out in Table 2. The software and any specific calculation considerations are discussed in Section 6.

The results of our model showing the specific sound level across the site is shown in Figure 6.

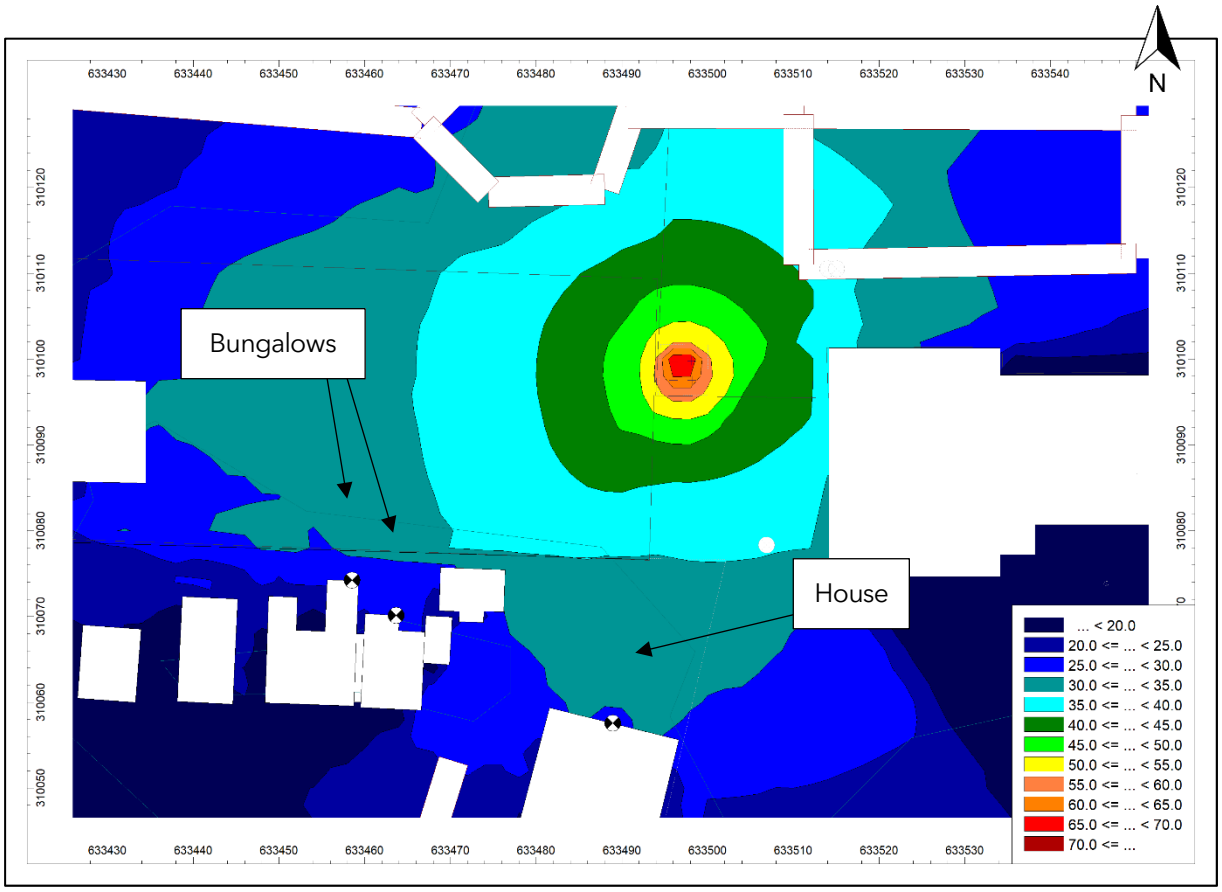

Figure 6 – CadnaA noise model with noise-sensitive receptors highlighted (dB $L_{Aeq,Tr}$)

The specific sound levels with the plant running at 100% duty are predicted to be 29 dB $L_{Aeq,T}$ at the worst-case bungalow, and 30 dB $L_{Aeq,T}$ at the house.

7.3 Rating level

Where the specific sound sources under assessment contain acoustic features which are likely to make it more distinctive at the location of noise-sensitive receptors, BS 4142 states that corrections should be applied to the specific sound level to obtain the rating level.

ASHPs do not typically produce impulsive sound, and since the units would be new, modern models, we do not expect them to exhibit any perceptible tonality, as this typically occurs when plant is older and/or poorly maintained.

We understand that during school hours, these units are to be in constant operation and as such no correction for intermittency is needed.

During the night the units are not in operation and as such, for the majority of the year there should be no impact to the receptors. To prevent pipes from freezing in cold conditions, these units will enter a frost protection mode when temperature drop below a threshold. In this state, operations can become intermittent, and we have added a + 3 dB correction for this feature. The rating levels are set out in Table 5.

7.4 Assessment of impacts

The impact of the specific sound source can initially be estimated by subtracting the representative background sound level from the rating level. Typically, the greater this difference, the greater the magnitude of impact (depending on context).

The results of the BS 4142 assessment are presented in Table 5.

Receptor and Assessment Period	Specific sound level dB $L_{Aeq,Tr}$	Combined feature corrections dB	Rating level dB $L_{Ar,Tr}$	Background sound level dB $L_{A90,T}$	Difference (± dB)
Worst-case bungalow Daytime (07:00–23:00 hrs)	29	0	29	57 to 60	−28 to −31
Worst-case bungalow Night-time 23:00–07:00 hrs	29	+3[1]	32	29 to 32	0 to +3
House Daytime (07:00–23:00 hrs)	30	0	30	57 to 60	−27 to -30
House Night-time 23:00–07:00 hrs	30	+3[1]	33	29 to 32	+1 to +4

Table 5 – Summary of BS 4142 assessment results

[1] This correction is only applicable if the units use a frost protection mode which would likely only occur in the winter.

7.4.1 Daytime impact

In accordance with BS 4142, the above assessment indicates that during the daytime, the sound levels from the new plant at the all the receptors will be significantly lower than the background sound level, indicating a *'low'* impact is likely.

7.4.2 Night-time impact

During the night, rating level at the receptors was between equal to and 4 dB above the background sound level. This is between the thresholds for low and adverse impact, as described in BS4142 and would typically indicate that there may be an adverse impact to the nearest receptors. In this case, it is important to also consider the background sound level. Section 11 of BS 4142 states that:

> *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

The standard does not specify thresholds below which background sound and rating levels should be considered low. However, the Association of Noise Consultants BS 41`42 *'Technical Note'* states that:

> *"The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$.*
>
> *"The [working group] suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate."*

In this case, both background and rating levels are *'low'* by these measures, and so the assessment should also consider the specific levels in absolute terms, rather than the degree to which they exceed the background sound level.

Considering both the relative levels and absolute levels of plant noise, we consider that a *'low'* impact is likely.

7.5 Context

In many ways, the assessment of impact summarised in Section 7.4 is a worst-case assessment. Viewing this in isolation we still consider that the level of impact to the nearest noise sensitive receptors is likely to be low. In further support of this view, there are other factors that should be considered when assessing this project in context.

- A rating level correction was applied to the air source heat pumps for intermittency. This would likely only apply during the winter.
- The background sound level is presented as a range due to potential distance attenuation between the measurement position and the nearest receptors. It is likely that the background sound level is comprised of distant road traffic and would therefore be very similar in both locations.

- Our assessment is based on the units of plant operating at 100% duty. In practice this would rarely be the case, if ever.

7.6 Uncertainty

Certain aspects of the field measurement method in this case introduce uncertainty. BS 4142 recommends that any significant uncertainties are reported, potential effects highlighted and, where practicable, reasonable steps taken to reduce the effects.

7.6.1 Uncertainty of measured values

- The survey was undertaken approximately 3 years prior to this assessment. We are not aware of significant changes to the flow of road traffic on the A47 since this date and would therefore expect the background sound level to still be relevant.
- Our noise survey was conducted in October 2020, during the Covid-19 pandemic, when levels of traffic were reduced due to public health guidelines. Data sources show that traffic levels were reduced to up to 30% at times, this could equate to up to 2 dB(A) lower than normal conditions. We have not taken this into account and would not expect results to differ to this extent during the night. This then represents a worst-case assessment.
- The measurement position was 60 m from the nearest noise-sensitive receptors. We have used a range of values for the background sound levels to account for this.
- Noise levels were measured on-site over a period of 7 days. Whilst we consider this to be a reasonable duration to provide representative data, the survey can only capture information for that sample period. Any other noise sources not in operation during the survey period would not be recorded. We are not aware of any other sources and would expect our data to be representative.

7.6.2 Uncertainty in calculations

- The sound power level data was provided by the manufacturer. Our calculations are therefore reliant on the validity of the data and assume that the measurements were made scientifically with a robust methodology (which is outside our control).
- We used noise data for the plant running at 100% duty at all times. In reality, it is reasonable to assume that the plant would run at a lower duty level, and the noise levels would consequently be reduced (as shown in Table 2).
- We have made assumptions regarding the character of the sound emitted by the ASHPs, based on our extensive experience of this type of plant.
- CadnaA uses the methodology of ISO 9613-2, which has a calculation tolerance of ±3 dB.

8 CONCLUSIONS

- The installation of four air-source heat pumps (ASHPs) is proposed as part of the construction of a new school in Blofield, Norfolk.
- We took unattended sound level measurements to ascertain the lowest typical daytime and night-time background sound levels at the nearest noise-sensitive receptors (the nearest house and bungalows on Manor Ridge)
- We used the manufacturer's data to calculate the sound levels from the ASHPs at the façades of these receptors. Predicted rating levels are significantly below the background sound level during the day.
- At night, the rating level at the worst-case receptor is predicted to be between 1 to 4 dB above the background sound level. However, both the background sound level and the rating level were very low and based on guidance in BS4142 and associated documents, we would still expect the likelihood of impact to be low.
- We expect that most of the time, the rating level will fall below the background sound level, and where it does not, the absolute sound levels will be low enough to not cause a significant impact. We therefore expect that, in accordance with BS 4142, a low impact is likely.
- We therefore see no noise-related reason why the planning condition should not be discharged for the installation of these units.

APPENDIX A
TECHNICAL TERMS AND UNITS RELEVANT TO THIS REPORT

A1 General acoustic terminology

Decibel (dB) – This is the unit used to measure sound level. The range of human hearing from the quietest detectable sound to the threshold of pain is very large. If a normal linear scale of measurement were used, it would have to range from 20 μPa to 200,000,000 μPa. Using such large figures would be unmanageable and for this reason sound pressure levels are expressed on a logarithmic scale, which corresponds to the almost logarithmic response of the ear and which compresses the range to a manageable 0 dB to140 dB.

Sound Pressure Level (L_p or SPL) – This is a function of the source and its surroundings and is a measure in decibels of the total instantaneous sound pressure at a point in space. The SPL can vary both in time and in frequency. Different measurement parameters are therefore required to describe the time variation and frequency content of a given sound.

Frequency – This refers to the number of complete pressure fluctuations or cycles that occur in one second. Frequency is measured in Hertz (Hz). The rumble of thunder has a low frequency, while a whistle has a high frequency. The sensitivity of the ear varies over the frequency range and is most sensitive between 1 kHz and 5 kHz.

Octave and One-Third Octave Bands – The human ear is sensitive to sound over a frequency range of approximately 20 Hz to 20,000 Hz and is more sensitive to medium and high frequencies than to low frequencies. To define the frequency content of a sound, the spectrum is divided into frequency bands, the most common of which are octave bands. Each band is referred to by its centre frequency, and the centre frequency of each band is twice that of the band below it. Where it is necessary for a more detailed analysis octave bands may be divided into one-third octave bands.

'A' Weighting – A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used is the 'A' weighting. The A-weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single-figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content. The addition of the subscript 'A' to any of the indices described above indicates that these have been measured using the A-weighting (*e.g.* $L_{Aeq,T}$ or L_{Amax}).

Statistical Analysis – These figures are normally expressed as L_N, where L is the sound pressure level in dB and N is the percentage of the measurement period. The L_N figure represents the sound level that is exceeded for that percentage of the measurement period. L_{90} is commonly used to give an indication of the background level or the lowest level during the measurement period. L_{10} may be used to measure road traffic noise.

A2 BS 4142-specific terminology

Acoustic environment - Sound from all sources as modified by the environment.

Ambient sound level, LA = $L_{Aeq,T}$ – Totally encompassing sound, usually composed of many sources. Comprises the residual sound and specific sound when present.

Background sound level, $L_{A90,T}$ – A weighted SPL exceeded by the residual sound for 90% of the a given time interval, T and rounded to the nearest whole dB.

Measurement time interval, T_m – Total time over which measurements are taken. May be the sum of multiple non-contiguous, short-term intervals.

Rating level, $L_{Ar,Tr}$ – Specific sound level plus adjustment for characteristic features

Reference time interval, T_r – Specified interval over which the specific sound level is determined, *i.e.* 1 hour during the day (07:00–23:00 hrs) and 15 minutes at night (23:00–07:00 hrs).

Residual sound level, $L_r = L_{Aeq,T}$ – Ambient sound remaining when specific sound source does not contribute

Specific sound level, $L_S = L_{Aeq,Tr}$ – Level produced by specific sound source over reference time interval, Tr. Can also be calculated and/or predicted.

APPENDIX B
NATIONAL PLANNING POLICY AND GUIDANCE

B1 National Planning Policy Framework

The latest version of the National Planning Policy Framework (NPPF) was released in February 2019 and was last updated in December 2023.

The NPPF does not set out quantitative criteria for assessing noise affecting proposed developments, but in paragraph 180 states that planning policies and decisions should actively contribute to the enhancement of the natural and local environment by:

> *"preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability."*

According to paragraph 191, planning policies and decisions should also ensure new development is appropriate for its location, particularly considering the likely effects on health and living conditions. Planning policy and decision makers should aim to:

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

The 'agent of change principle' has been part of the NPPF since the July 2018 revision. This principle means that a person or business (i.e. the agent) introducing a new land use is responsible for managing the impact of that change. Paragraph 193 states:

> *"Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."*

B2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) published by DEFRA in March 2010 sets out the Government's policy on noise, which is:

> *"to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."*

The NPSE also introduces concepts from toxicology currently being applied to noise impacts by the World Health Organisation. These are:

- NOEL – No Observed Effect Level: This is the level below which no effect can be detected.
- LOAEL – Lowest Observed Adverse Effect Level: This the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

The three aims of the NPSE are in alignment with the categories described above.

These aims are:

1. *"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*
2. *Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*
3. *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."*

B3 National Planning Practice Guidance

Guidance on interpretation of the policy aims of the NPPF and NPSE is provided in the online National Planning Practice Guidance (NPPG) published in March 2014.

It reiterates the guidance within the NPPF, stating that:

> *"Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment."*

The NPPG provides advice regarding how to determine the impact of noise, including whether or not a significant adverse effect or adverse effect is occurring or likely to occur and whether or not a good standard of amenity can be achieved.

The NPPG proposes a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in Table 6.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect Lowest Observed Adverse Effect Level	No specific measures required
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect Significant Observed Adverse Effect Level	Mitigate and reduce to a minimum
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 6 – Noise exposure hierarchy from the NPPG

APPENDIX C
TECHNICAL STANDARDS AND GUIDANCE

C1 BS 4142:2014+A1:2019

C1.1 Introduction

British Standard 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'* (BS 4142) describes appropriate technical methodology for the rating and assessment of sound of an industrial and/or commercial nature.

Sound of an industrial and/or commercial nature includes industrial and manufacturing processes, fixed mechanical and electrical plant installations, the unloading of goods and materials at industrial and/or commercial premises and sound from mobile plant that is an inherent part of the overall sound from industrial and/or commercial premises.

BS 4142 is applicable for the purposes of:

- Investigating complaints;
- Assessing sound from proposed, new, modified, or additional source(s) of sound from an industrial and/or commercial nature; and
- Assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 is not intended to be applied to the rating and/or assessment of sound from recreational activities (including motorsport), music and other forms of entertainment, shooting grounds, construction/demolition, domestic animals, people, public address systems and any other sources falling within the scope of other standards/guidance.

C1.2 Summary of BS 4142 assessment methodology

The BS 4142 assessment methodology can be summarised as follows:

1. Determine the background sound level (dB LA90,T) at the nearest noise sensitive receptor(s) of interest.
2. Determine the specific sound level of the source under assessment (dB LAeq,T) (T = 1 hour for day or 15 minutes at night) at the receptor location(s).
3. Apply a rating level acoustic feature correction if the sound source has tonal, impulsive, intermittent or other characteristics which attract attention.
4. Compare the rating level (dB LAr,Tr) with the background sound level; typically, the greater this difference, the greater the magnitude of impact.

Differences of around +10 dB are likely to be an indication of significant adverse impact, depending upon the context; a difference of +5 dB is likely to be an indication of adverse impact, depending upon the context. Where the rating level (dB $L_{Ar,Tr}$) does not exceed the background sound level ($L_{A90,T}$) at the nearest receptor of interest, the indication is that the specific sound source will have a low impact, depending upon the context.

Note: Adverse impacts include but are not limited to sleep disturbance. Not all adverse impacts will lead to complaints and not all complaints are proof of an adverse impact.

C1.3 Acoustic features

Certain acoustic features (which include tonality impulsivity and/or intermittence) can also increase the significance of impact. Where such features are present a *"character correction"* should be added to the specific sound level to obtain the rating level.

The recommended BS 4142 character corrections are presented in Table 7.

Characteristic	Perceptibility		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	+2 dB	+4 dB	+6 dB
Impulsivity	+3 dB	+6 dB	+9 dB
Intermittency	0 dB	+3 dB	+3 dB
Other	0 dB	+3 dB	+3 dB

Table 7 – Summary of BS 4142:2014 character corrections

BS 4142:2014 describes suitable subjective methods for assessing character features, plus additional objective (one-third octave and reference) methods for tonality.

C1.4 Context

BS 4142 places emphasis on context. Section 11 of the standard states that:

> *"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."*

Contextual factors to be considered include:

- The absolute level of sound.
- 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 sensitive premises will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as glazing/ventilation/screening etc.

C1.5 Low sound levels

Where background sound and rating levels are low, Section 11 of BS 4142 states that:

> *"absolute sound levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

The ANC Technical Note on BS 4142 (March 2020) states that:

> *"BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$."*

C1.6 Uncertainty

The BS 4142 methodology also requires that the level of uncertainty in the technical data and/or calculations is reported. Where uncertainty could affect the conclusion, reasonable, practicable steps should be taken to reduce uncertainty. If appropriate, the level and potential effects of any identified uncertainty should also be reported.

APPENDIX D
ISO 9613-2 '*ATTENUATION OF SOUND DURING PROPAGATION OUTDOORS*'

ISO 9613-2 *'Attenuation of sound during propagation outdoors'* sets out an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict downwind environmental noise levels at distance from a variety of sources.

As well as accounting for the distance between each source and receiver, the ISO 9613-2 method also includes the following factors:

- **Geometrical divergence, A_{div}**

  Accounts for spherical spreading in the free field from a point sound source.

- **Atmospheric absorption, A_{atm}**

  Depends primarily on the frequency of the sound, the ambient temperature and relative humidity of the air.

- **Ground effect, A_{gr}**

  Mainly the result of sound reflected by the ground surface interfering with the sound propagating directly from source to receiver.

- **Screening by obstacles, A_{bar}**

  Screening obstacles (often called barriers) must have a closed surface (without large cracks or gaps) and have a surface density of at least 10 kg/m².

- **Reflections**

  Reflections off horizontal or vertical surfaces (such as the facades of buildings) which can increase the sound pressure levels at the receiver.

- **Meteorological correction, C_{met}**

  Only applied where local meteorological conditions vary from those which are favourable to propagation for several months or a year. This is rarely applied.

ISO 9613-2 has a calculation tolerance of +/− 3 dB.

APPENDIX E
MEASUREMENT SYSTEMS AND CALIBRATION

Job reference and title:	12746c – New School, Blofield – Plant noise
Measurement location:	See Section 5 of this report
Measurement date(s):	7–14 October 2020

Equipment used on survey:

Equipment description / serial number	Type number	Manufacturer	Date of calibration expiration	Calibration certificate number
Precision sound level meter serial no. A2A-08643-E0	XL2-TA	NTi Audio	08/11/2020	30033
Microphone serial no. 9185	MC230	NTi Audio	08/11/2020	30032
Microphone pre-amplifier serial no. 3489	MA220	Neutrik	08/11/2020	30033
Microphone calibrator serial no. 25993	NOR-1251	Norsonic	08/11/2020	30031

Other information:

Persons in charge of measurements:	Pete Erskine TechIOA George Moore AMIOA
Measurement parameters	Octave-band and A-weighted $L_{F90,T}$

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