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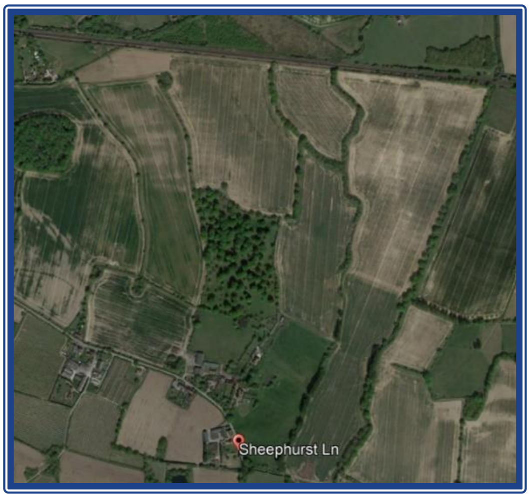

Technical Report:

Noise Impact Assessment for an Energy Storage System off Sheephurst Lane, Marden, Kent

Project Ref: 10253

Noise Impact Assessment

Date of Issue:	25th April 2023
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Contents

Rev 1	Draft version for approval	8th September 2021
Rev 2	New Site layout and new equipment information	28th February 2022
Rev 3	Local Authority comments	27th March 2023
Rev 4	Revised Model Inputs	25th April 2023

1. Executive Summary

1.1. The noise emission from planning application 22/501335/FULL at land to the north of Sheephurst Lane, Marden in Kent was assessed at two receptor locations, NSR1 8 Little Sheephurst Cottages and NSR2 Willow Cottage using BS 4142 and NANR45 methodology and guidance guidance.

1.2. As part of a Solar Farm development there will be 6no. Smart transformer stations (Huawei STS-3000K-H1), 130no. String Inverters (Huawei SUN2000-215KTL-H0) and an HV compound will have a new 132/33kV 40MVA transformer surrounding by a steel palisade fence.

1.3. The ambient and background sound levels were measured at representative locations of the receptors, P1 and P2, between the 20th and 23rd August 2021.

1.4. From the monitoring, representative background sound levels at P1 were determined as 32dB $L_{A90,15min}$ during the day and 24dB $L_{A90,15min}$ at night.

1.5. At P2 the background sound levels were 31dB $L_{A90,15min}$ during the day and 19dB $L_{A90,15min}$ at night.

1.6. The rating levels for assessment of the proposed equipment were 31dB(A) (day) and 26dB(A) (night) at NSR1 and 33dB(A) (day) and 9dB(A) (night) at NSR2 .

1.7. The BS 4142 assessment indicated a low impact during the day and night at both NSR1 and NSR2.

1.8. The worst-case scenario noise emission from the development is unlikely to cause any sleep disturbance at NSR1 and NSR2.

1.9. The NANR45 assessment indicates that at night low frequency noise is unlikely to cause any disturbance inside both NSR1 and NSR2.

1.10. dBC has ensured that the Local Authority EHO comments on previous reports for this development have been fully addressed in paragraphs 3.15 to 3.17 and Section 7 and 8.

2. Introduction

2.1. Statkraft propose the installation of HV compound as part of a wider Solar Farm development at land to the north of Sheephurst Lane, Marden in Kent.

2.2. To accompany the planning application dBC were appointed by Origin Power Services to undertake a full BS 4142:2014 noise impact assessment.

2.3. To assist the determination of noise levels at the receptor locations dBC constructed a noise model of the site. The model was used to investigate noise mitigation measures to reduce the impact to low at the nearest noise sensitive receptors to the compound.

2.4. The site visits and report were undertaken by Mick Lane, Acoustics Director at dB Consultation Limited, a practicing acoustician for over 17 years, Full Member of the Institute of Acoustics (MIOA) and experienced in noise assessment in many industrial and commercial sectors.

2.5. This report has been reviewed by Danny Blacklock BEng(Hons), MSc, CEng, MIET, MIOA Managing Director of dB Consultation Limited, a practicing acoustician for over 25 years, Full Member of the Institute of Acoustics (MIOA) and experienced in noise assessment in many industrial and commercial sectors.

3. Assessment Criteria

BS 4142:2014 A1-2019 Method for rating and assessing industrial and commercial sound

3.1. BS 4142 provides a robust method for 'rating' external noise levels from factories, industrial premises or fixed installations of an industrial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

3.2. The method is based on the difference between the background noise level without the industrial noise and the specific noise level of the industrial noise source at the receiver location.

3.3. The noise level from the industrial source (referred to as the specific noise level) can be weighted to determine a rating level by adding acoustic penalties for tonality, intermittency, impulsivity or acoustic features that make the sound distinctive, penalties are applied for their impact at the receptor location. These methods refer to a sliding scale between +0dB up to +9dB, depending on the severity and can be combined for different acoustical features.

3.4. The background noise level is then subtracted from the rating level (the specific noise level plus any acoustical correction factors) and the difference used to assess the impact, as shown in the Table 1 below;

Difference	Assessment
Around +10dB or more	Indication of Significant Adverse Impact
Around +5dB	Indication of an Adverse Impact
0dB or below	Indication of Low Impact

Table 1: Explanation of BS 4142:2014 assessment terms

3.5. BS 4142 Section 11 Note 2 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*'

DEFRA Guidance NANR45 Procedure for the assessment of low frequency noise (LFN) complaints

3.6. NANR45 provides a guide for Local Authorities on how to investigate low frequency noise complaints. The guidance uses (internal) measurements logged against a criterion curve, subjective observations and interviews to assist Environmental Health practitioners to handle complaints of low frequency noise as efficiently and correctly as possible. In particular, it aims to assist them to distinguish cases where an environmental sound that could account for the disturbance is present.

3.7. The NANR45 criterion curve is shown in Table 3 below.

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
L_{eq} dB	92	87	83	74	64	56	49	43	42	40	38	36	34

Table 2: NANR45 Criterion Curve (LFN)

Note: the criterion curve is linear dB values.

Noise Policy Statement for England (NPSE)

3.8. The NPSE sets out the long-term vision of the Government's policy on noise, which in essence 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.

3.9. The NPSE outlines three aims for effective management and control of environmental, neighbourhood and neighbour noise:

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimize adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health & quality of life.*

3.10. In its aims, the NPSE uses key phrases "significant adverse" and "adverse" and these are related to the following terms which are currently being applied to noise impacts.;

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

3.11. The NPSE notes that it is not possible to have a single objective noise-based measure that defines SOAEL that would be applicable in all situations, consequently the NOEL, LOAEL and SOAEL are likely to change for the location, noise type and times. It is the acoustician who should identify relevant SOAEL levels taking into account the noise source exposures and receptors.

3.12. The following extract from ANC-AVO-Residential-Design-Guide-January-2020-v1.1 describes the general perception of noise as noise rises above each threshold.

Mid Kent Environmental Health – Planning Application 22/501335/FULL (July 2022)

3.13. The noise impact assessment was reviewed by Mid Kent Environmental Health and the following recommendations were made for the noise impact assessment.

RECOMMENDATIONS:

That the application be refused unless further noise data is submitted.

I would recommend that the noise assessment is widened to include 1/3rd Octave Band spectra data (NANR45 and Phon) and BS4142 assessments done for all locations. They can use information from NANR45 and Phon charts to demonstrate impact rather than the generic 30dB level they set as NOEL as this is for non tonal steady traffic type noise which this is not.

Please do not hesitate to contact me for further advice or information in relation to this matter.

John McCullough
John McCullough BSc (Hons) MSc MCIEH CEnvH MIOA.
Senior Environmental Health Officer and Chartered Environmental Health Practitioner

3.14. The Local Authority EHO comments have been addressed in paragraphs 3.15 to 3.17 and in Section 7 and 8 of this report.

3.15. Electrical transformers show distinct tonality due to the magnetostrictive hum at 100Hz, with possible tonality shown at the harmonic frequencies. The HV transformer data for use in the assessment has been provided by the client as an overall (dBA) value. To ensure a robust assessment of overall and low frequency noise dBC will assume that the emission is all at 100Hz.

3.16. The noise emission from the Smart transformer stations and string inverters was supplied as an overall (dBA) value. dBC will assume that the emission is all 100Hz.

3.17. The use of Phon curves is not widespread in the acoustic industry and is unfamiliar to the author. dBC has vast experience of electrical transformer and battery storage noise from our work in the electrical distribution network for National Grid, UKPN, Northern Powergrid, SSE, Siemens and GE. It is our considered opinion that the noise from this development can be adequately assessed given BS 4142 and NANR45 methodology in this case.

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4. Site Description

4.1. The solar farm and HV compound would be located on agricultural land north of Sheephurst Lane Marden, Kent.

4.2. The site, receptors, NSR1 and NSR2 and environmental monitoring, locations P1 and P2 have been marked on Fig. 1.

Fig. 1: Site Location

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4.3. The extent of the solar farm is shown on Fig. 2, drawing no. SCUKX-SHEEP-000-100P (20230331) PV Layout & Overview Plan supplied by the client.

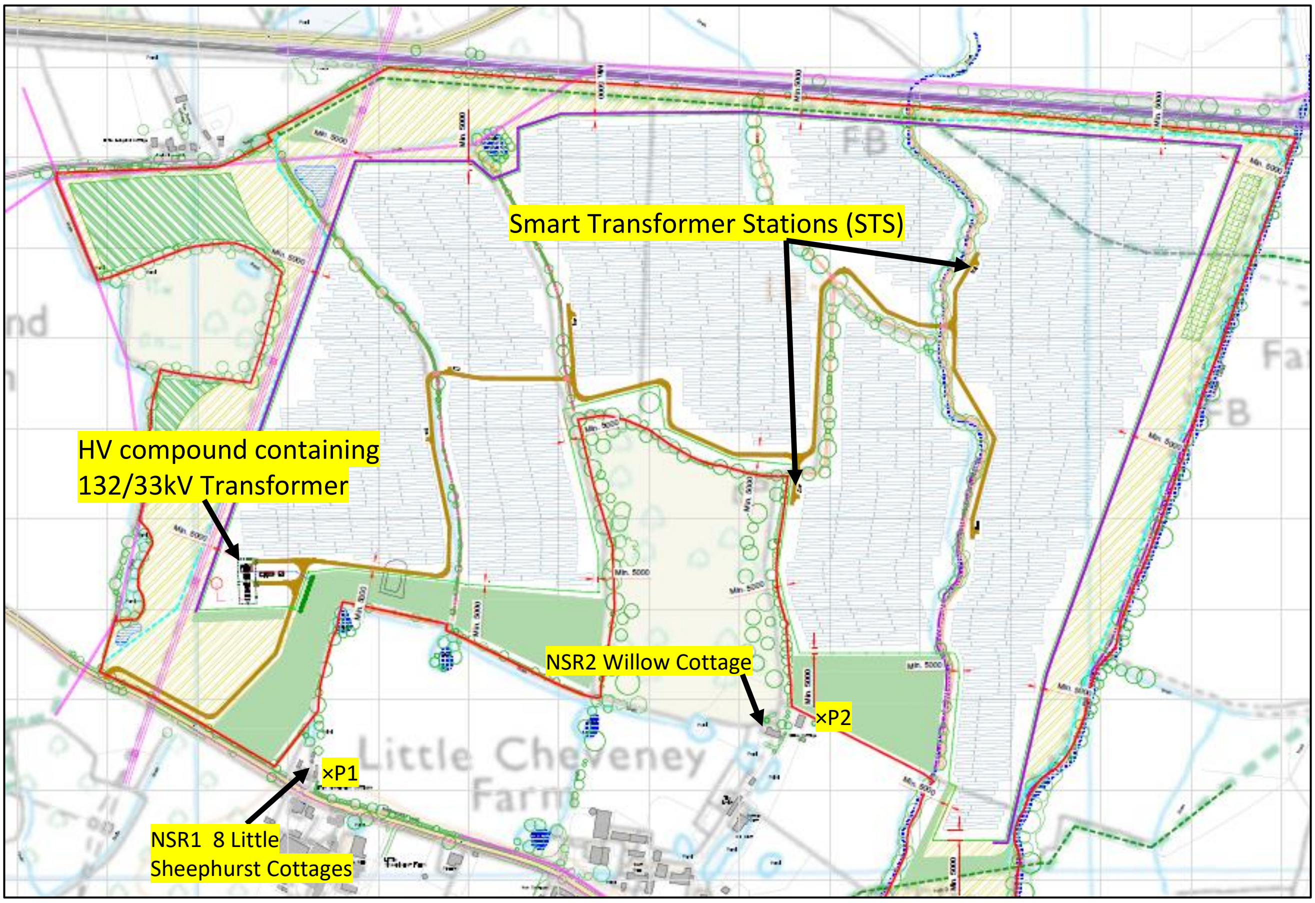

Fig. 2: Extent of Solar Farm

5. Specific Sound Level

5.1. The specific sound level at NSR1 and NSR2 will be sound pressure level determined by noise model calculation from all proposed equipment, 1no. 132/33kV HV Transformer, 6no. Smart transformer stations and 130no. string inverters.

5.2. The overall sound pressure levels at 1m have been supplied by the client.

Component	Quantity	Noise Emission, dB(A)	Distance, m
String Inverter	130	Lp = 62.8	1
Smart transformer station	6	Lp = 64	1
HV substation transformer	1	Lp = 65	1

Table 3: Overall sound pressure levels for the proposed equipment

5.3. The client has provided the operational information for the Solar farm and HV compound. The HV compound transformer can operate continuously day and night where as the Smart transformer stations and string inverters only operate during the day.

5.4. The sting inverters will be distirbuted throughout the solar farm with the number in each of the 7 field areas determined by the number of PV arrays in that area.

5.5. A noise model was used to determine the worst-case scenario specific sound level at NSR1 and NSR2 for both the day (all equipment) and night (HV compound transformer only). Noise model images are shown in Section 9.

5.6. Table 5 shows the overall L_p dB(A) and $L_{p\,(100Hz)}$ at NSR1 and NSR2 during both day and night.

NSR	Time of Day	Specific Sound Level dB(A)	100 Hz dB
1	Day	25	44
	Night	20	39
2	Day	27	46
	Night	9	28

Table 4: Specific sound level

5.7. To gain a rating level for assessment, the specific sound level is corrected for tonality, impulsivity, intermittency and other acoustic characteristics assessed at the receptor location.

5.8. The noise sources are not impulsive or intermittent given the definitions in BS 4142.

5.9. At NSR1 the overall noise emission from the site was dominated by transformer noise from the HV compound both day and night.

5.10. The worst case scenario 100Hz contribution to daytime level was $L_{p\ (100Hz)}$ 44dB and 39dB at night. These levels would be above the existing 100Hz noise levels measured at P1 for most of the day and night-time periods. Given electrical transformer knowledge and experience this 100Hz level is likely to be highly perceptive at NSR1 so a 6dB penalty will be added to the specific sound to gain a rating level.

5.11. NSR2 is generally quieter than NSR1 and despite lower night-time noise at NSR2, the 100Hz would remain distinct against the background so a 6dB penalty will be added for the day.

5.12. At night, the overall and 100Hz levels are very low and it would be difficult for any hum to be distinct against the background at NSR2 so dBC will not add any penalty to specific sound to gain a rating level.

5.13. The rating levels for assessment are shown in Table 5.

NSR	Time of Day	Rating Level dB(A)
1	Day	31
	Night	26
2	Day	33
	Night	9

Table 5: Rating Levels in dB

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6. Background Sound levels

6.1. The ambient and background sound levels were measured at two locations representative of the nearest noise sensitive receptors, NSR1 and NSR2, to the compounds. The monitoring locations are shown in Fig. 1 on page 7 and further described in Table 5 below.

Location	Photo	Noise Sources
P1 1.5m high on a field boundary, adjacent to NSR1 (8 Little Sheephurst Cottages). The HV compound will be 125m to the north of NSR1		Local and distant road traffic, rail traffic, air traffic, wildlife and domestic activity
P2 1.5m high adjacent to a field boundary, adjacent to NSR2 (barn next to Willow Cottage) the BEES compound is 250m east of NSR2		Local and distant road traffic, rail traffic, air traffic, wildlife, domestic and farm activity

Table 5: Monitoring Locations

6.2. The monitoring took place between 20th and 23rd August 2021.

6.3. The monitoring kit details are shown in Table 6 below. The sound level meters and calibrator have been calibrated in a UKAS accredited laboratory within the last two years. Certificates are available upon request.

Location	Equipment	Type	Serial Number
P1	Sound Level Meter	Nor140	1403454
	Calibrator	Nor1251	34682
	Outdoor microphone	GRAS-41 AL#06	44949
P2	Sound Level Meter	Nor140	1403455
	Calibrator	Nor1251	34682
	Outdoor microphone	GRAS-41 AL#07	42111

Table 6: Monitoring kit

6.4. The weather during the monitoring period has been summarised below.

Date	Time	Weather	Temperature °C	Wind Speed ms^{-1}	Wind Direction
20th August	Day 07:00 – 23:00	Cloudy, sunny intervals	16-19	2.7-4.0	SW/SSW
20th/21st August	Night 23:00 – 07:00	Clear	14-16	3.1-4.0	SSW/SSE
21st August	Day 07:00 – 23:00	Sunny intervals	16-19	3.1	SSE
21st/22nd August	Night 23:00 – 07:00	Cloudy	13-16	4.0	SSW
22nd August	Day 07:00 – 23:00	Cloudy, sunny intervals	15-20	1.8-4.0	NW
22nd/23rd August	Night 23:00 – 07:00	Clear	14-16	1.8	NW
23rd August	Day 07:00 – 23:00	Cloudy, sunny intervals	14-19	3.6-4.5	N

Table 7: Weather

6.5. The sound level meters were set up to measure in 15min periods.

6.6. The parameters measured were overall $L_{\mathrm{Aeq},15min}$ and $L_{\mathrm{A90},15min}$.

6.7. Graphs 1 to 4 show the statistical analysis of the day and night background sound levels, $L_{\mathrm{A90},15min}$ at P1 and P2.

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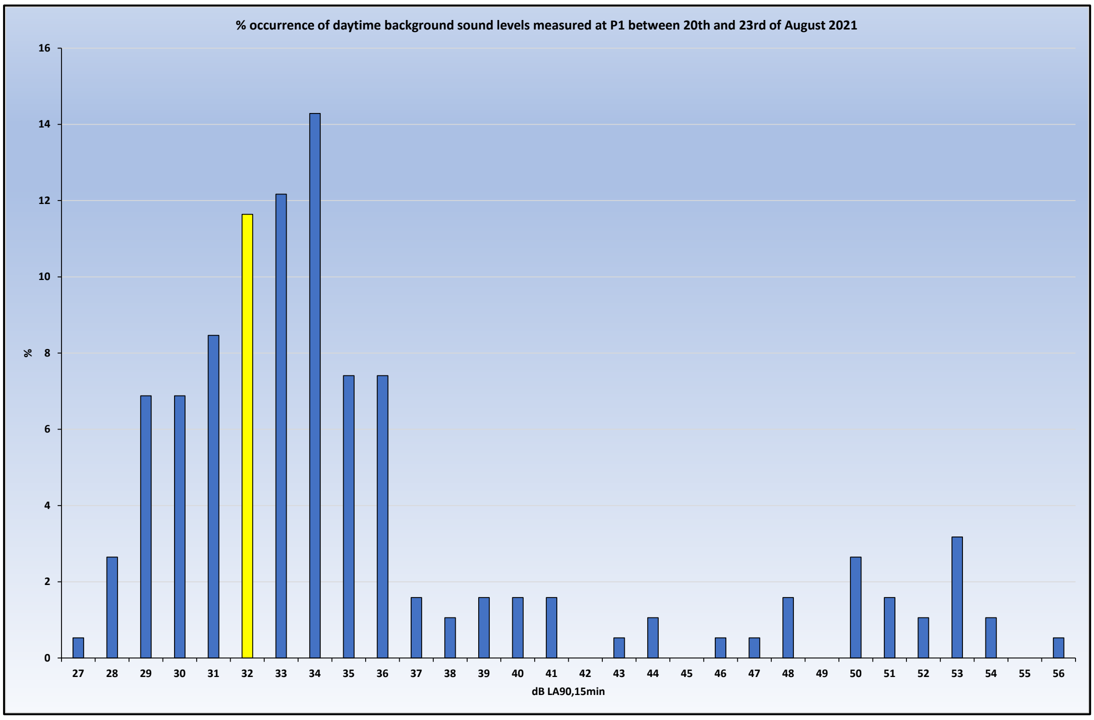
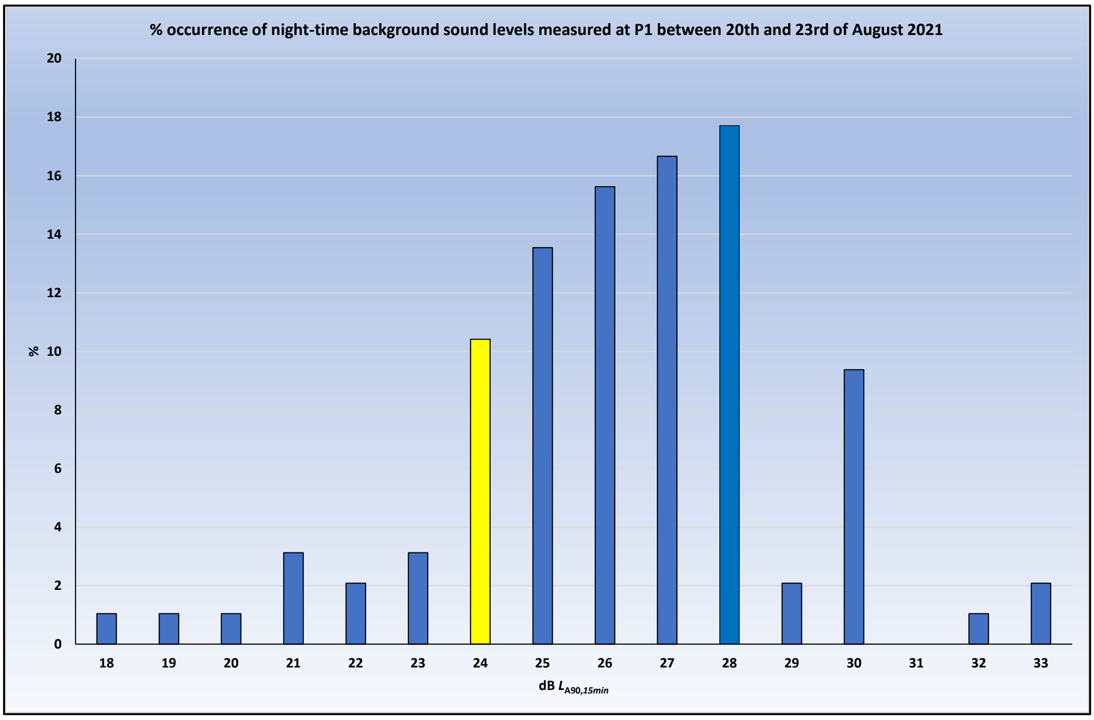


Graph 1: Statistical Analysis of the daytime background sound levels at P1



Graph 2: Statistical Analysis of the night-time background sound levels at P1

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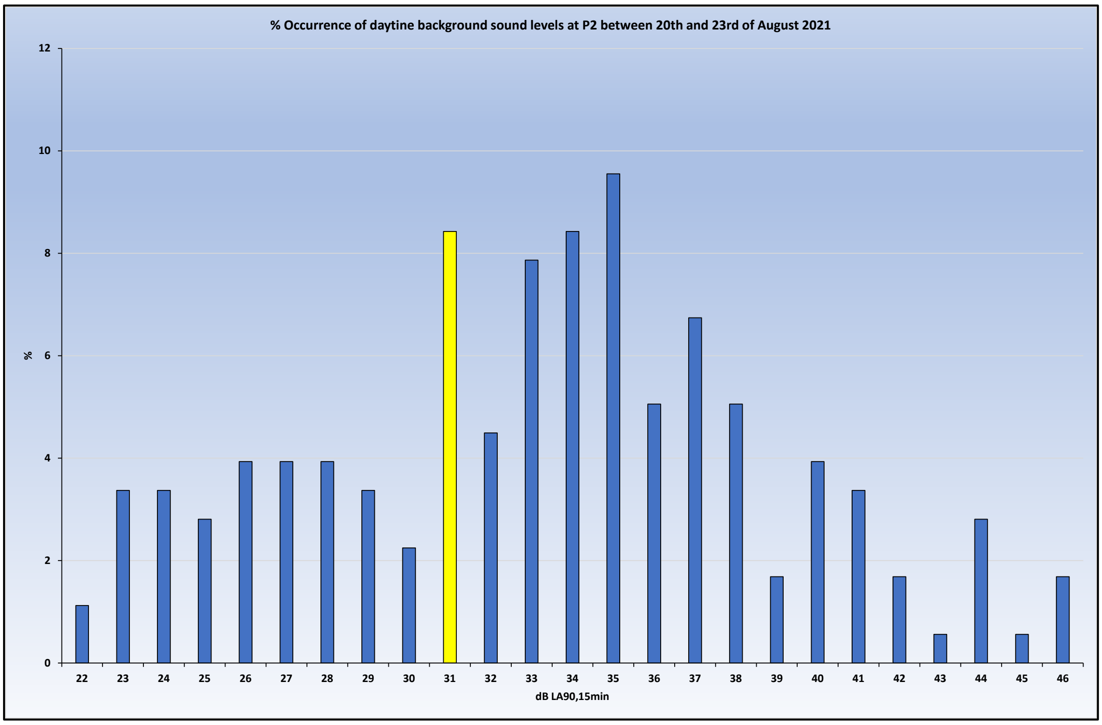
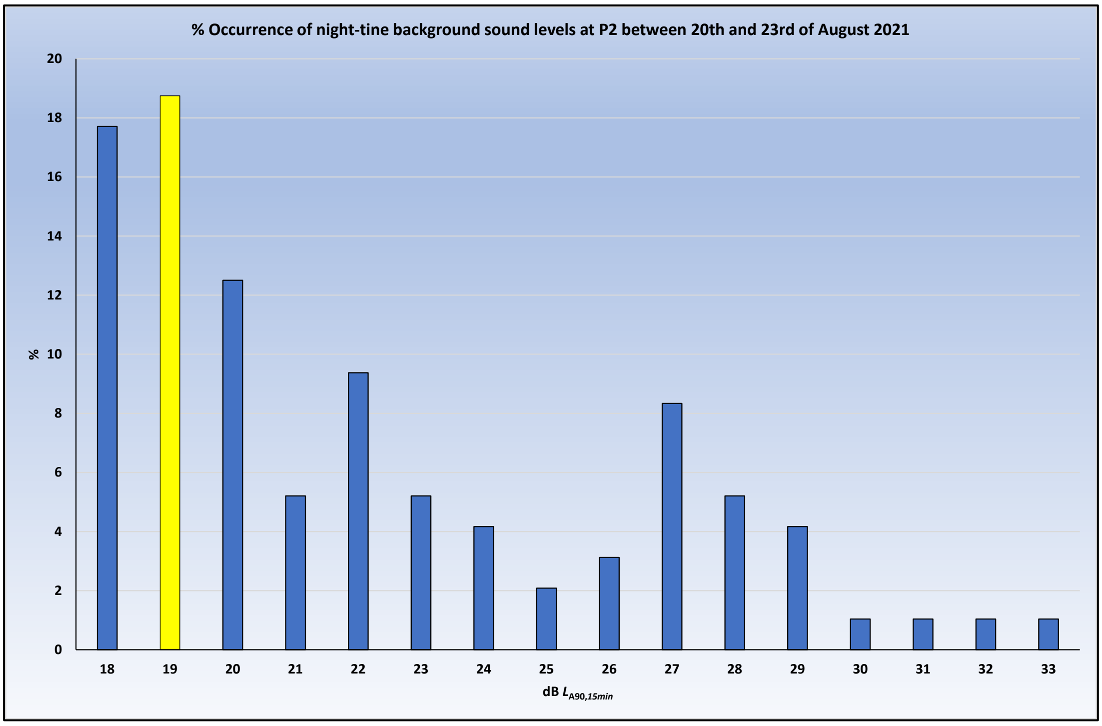


Graph 3: Statistical Analysis of the daytime background sound levels at P2



Graph 4: Statistical Analysis of the night-time background sound levels at P2

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6.8. From Graphs, dBC has determined the following representative background sound levels to be used in the assessment.

Location	Day 07:00 – 23:00		Night 23:00 – 07:00	
	Background	(modal) Ambient	Background	(modal) Ambient
P1	32dB $L_{A90,15min}$	49dB $L_{Aeq,15min}$	24dB $L_{A90,15min}$	37dB $L_{Aeq,15min}$
P2	31dB $L_{A90,15min}$	39dB $L_{Aeq,15min}$	19dB $L_{A90,15min}$	28dB $L_{Aeq,15min}$

Table 8: Background Sound Levels

6.9. For the daytime assessment 15min levels were assumed to be equivalent to 1hr levels.

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7. BS 4142 Assessment

7.1. A summary of the BS 4142 assessments for the noise emission from the proposed development is shown in Tables 9 and 10.

Location	Daytime 07:00 – 23:00				
	Specific Sound Level dB(A)	Rating Level dB(A)	Background Sound Level dB(A)	Rating – Background	BS 4142 Assessment
NSR1	25	31	32	-1	Low Impact
NSR2	27	33	31	+2	Low Impact

Table 9: Daytime BS 4142 Assessment

Location	Night-time 07:00 – 23:00				
	Specific Sound Level dB(A)	Rating Level dB(A)	Background Sound Level dB(A)	Rating – Background	BS 4142 Assessment
NSR1	20	26	24	+2	Low Impact
NSR2	9	9	19	-10	Low Impact

Table 10: Night-time BS 4142 Assessment

7.2. The day and night-time assessments for the worst-case scenario 100Hz noise emission from the proposed development show a low impact at both NSR1 and NSR2.

7.3. No Local Authority criteria for the development noise emission has been received by dBC at this stage. So, no conclusion of compliance can be made at his time.

7.4. Despite the marginal excess (+2) of the rating level over the background at NSR1 (night) and NSR2 (day), the development is unlikely to be a cause disturbance during the day or night.

7.5. At night the development is unlikely to disturb sleep.

7.6. In our considered opinion, no mitigation measures are required for the development.

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8. Low Frequency Noise Assessment

8.1. **To predict an internal night-time noise level at NSR1 and NSR2 the external level would be attenuated 8dB at 100Hz through an open window.**

8.2. It is more likely that disturbance would occur at night when ambient sound levels have fallen to their lowest levels, therefore a night-time assessment has been undertaken.

8.3. Table 11 compares 100Hz noise levels at NSR1 and NSR2 with the NANR45 criterion curve. No other 1/3 octave bands have been considered.

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
NSR1											31		
NSR2											20		
L_{eq} dB	92	87	83	74	64	56	49	43	42	40	38	36	34

Table 11: NANR45 Assessment in dB

8.4. Table 11 shows that at NSR1 and NSR2 internal levels are below the curve and so internal disturbance is unlikely.

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9. *Glossary of Acoustic Terminology.*

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter can be used to duplicate the ear's variable sensitivity to sound across a spectrum of frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the average ear. This is called an "A-weighting filter". Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

$L_{eq,T}$

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level Leq. The Leq is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period (T).

$L_{10,T}$

This is the minimum level exceeded for not more than 10% of the time period (T). This parameter is often used as a "not to exceed" criterion for noise.

$L_{90,T}$

This is the minimum level exceeded for not more than 90% of the time period (T). This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{fmax}

This is the maximum sound pressure level that has been measured over a period using a fast time constant.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combine, on a logarithmic scale, to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 3 identical sources produce a 5dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.