RSK Acoustics

Worlds End Solar PV Development

Noise Impact Assessment

Report 2061638-RSKA-RP-001-(03)

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Revision	Description	Date	Prepared	Approved
01	First issue	24.02.23	Nathan Parker, AMIOA	Federico Gottardo, MIOA
02	Minor Comments	07.03.23	Nathan Parker, AMIOA	Jonathan Mart, MIOA
03	Minor Comments	08.03.23	Nathan Parker, AMIOA	Jonathan Mart, MIOA

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1 Introduction

1.1 Overview

RSK Acoustics (RSKA) has been instructed by ADAS Planning, on behalf of BSR Energy Ltd. to undertake a noise assessment to evaluate the operational impact of a proposed 49.9 MW solar photovoltaic (PV) development on land off Worlds End Lane, approximately 4 km south-west of the village of Berkeley, Gloucestershire.

The assessment benefits from a baseline noise survey, undertaken at positions representative of nearest noise sensitive receptors, to determine typical background noise levels during both daytime and night-time periods.

This report describes the assessment methodology and the baseline conditions currently prevailing across the application site to evaluate the suitability of the proposed development.

1.2 Objectives

The aim of this noise assessment is to:

- Quantify and report the prevailing noise climate at nearest receptors to the proposed development;
- Present relevant impact assessment thresholds from local and national guidelines;
- Predict the operational noise from the proposed development at nearest receptors;
- Assess predicted noise levels against the relevant noise impact thresholds; and
- Specify noise mitigation measures where necessary.

1.3 Exclusions

Vibration generation from the operation of the development and its impact on nearby residents would be minimal and therefore has been discounted from the assessment.

2 Legislation and Guidance

2.1 Noise Policy Statement for England (NPSE): 2010

The Noise Policy Statement for England is published by the Department for Environment, Food and Rural Affairs (Defra) and sets out the approach to noise within the Government's sustainable development strategy.

The significance of impacts from noise within the NPSE are defined as follows:

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

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 stated as:

"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."

"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."

"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."

2.2 National Planning Policy Framework (NPPF): 2021

Since its publication by the Department for Environment, Food and Rural Affairs in 2010 the Noise Policy Statement for England (NPSE) has been the Central Government noise policy that has been available to inform the consideration of environmental noise in relation to the consenting of everything from small scale residential development to national infrastructure. The

National Policy Planning Framework (NPPF), as updated by the Ministry of Housing, Communities and Local Government in 2021, has noise aims that are consistent with NPSE.

The noise policy aims as stated in NPSE are:

Noise Policy Aims

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

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

In order to translate these aims into practical guidance the NPSE uses the same terminology as used by the World Health Organisation (WHO), in the Night Noise Guidelines for Europe, 2009 by referring to the Lowest Observed Adverse Effect Level (LOAEL). The NPSE extends this concept to define the level above which significant adverse effects on health and quality of life can be detected, hence the Significant Observed Adverse Effect Level (SOAEL).

The NPSE notes *"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times"*. The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. 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.

Not having quantified effect thresholds in the NPSE means that relevant standards and guidance are used to put forward values for the LOAEL and SOAEL for the proposed development under consideration.

The NPPF states:

"Planning policies and decisions should contribute to and enhance 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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health,

living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

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

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

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). 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."

2.3 BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'

The three-part standard BS 7445 provides the framework within which environmental noise should be quantified. Part 1 provides a guide to quantities and procedures and Part 2 provides a guide to the acquisition of data pertinent to land use. Part 3 provides a guide to the application of noise limits.

BS 7445 also refers to a further standard, BS EN 61672, which prescribes the equipment necessary for such measurements. Whilst BS 7445 does not prescribe the meteorological conditions under which noise measurements should or should not be taken, it does (part 2, paragraph 5.4.3.3) recommend that in order:

"…to facilitate the comparison of results (measurements of noise from different sources), it may be necessary to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable propagation conditions."

These conditions include:

- Wind speed not exceeding 5 m/s (measured at a height of 3 to 11 m above the ground);
- No strong temperature inversions near the ground; and
- No heavy precipitation.

2.4 BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

BS 4142:2014+A1:2019 describes the methods for rating and assessing noise of an industrial or commercial nature applicable for the purpose of assessing sound at existing dwellings, through the determination of a rating level of an industrial or commercial noise source. The standard includes the following:

- Sound for industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from the premises or processes, such as that from forklift trucks, or that from train of ship movements on or around an industrial and/or commercial site.

Where certain acoustic features are present at the assessment location, a character correction should be applied to the specific sound level to give the rating level to be used in the assessment. The difference between the background noise level and the noise rating (including any penalties) is then calculated.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of adverse impact depending on the context.
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

As indicated above, 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. BS4142 states than '*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*'.

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

- The absolute level;
- The character and level of the residual sound; and
- The sensitivity of the receptor and whether dwellings will already (or likely) to incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as: i) façade insulation treatments, ii) ventilation and/or cooling, and iii) acoustic screening.

2.5 World Health Organisation Guidelines for Community Noise, 1999

The World Health Organisation (WHO) Guidelines for Community Noise was published in 1999 as a response to a need for action together with a generic need for improvements in legislation at a national level. Although not legislation, this document provides general guidance and guidelines which have been set for different health effects, using the lowest noise level that produces an adverse health effect in specific human environments.

The guideline levels which are relevant to this assessment are set out in **Table 2.1** below:

Specific Environment	**Critical health effect(s)**	**$L_{Aeq,T}$ (dB)**	**Time base, T (hours)**	**$L_{AF,max}$ (dB)**
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50		
Dining	Speech intelligibility and moderate annoyance, daytime and evening	35	-	-
Dwelling, indoors	Sleep disturbance, night-time	30	16	-
Inside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60[a)]

(a) Should not exceed 45 dB L_{AFmax} more than 10-15 times a night

Table 2.1 – WHO Guidelines for community noise levels

2.6 Local Authority Consultation

Consultation was sought with Stroud District Council via email on 10 January 2023 detailing RSKA's proposed approach to the noise survey and assessment. A positive response was received on 13 January 2023 by Mr. Dave Jackson (Environmental Protection Officer) with no comments made to the proposed methodology and confirming the preference to establish a plant noise target which does not exceed background, depending on context.

The agreed methodology included:

- A baseline noise survey carried out at locations representative of the nearest noise sensitive receptors (or close to where access permits) to establish the existing noise levels at the site. The extent of the survey would allow for up to three unattended noise monitoring positions (for a minimum monitoring period of 96 hours) comprising of environmental noise measurements (background and ambient) aimed to characterise the existing noise environment, encompassing both a typical weekday and weekend periods (daytime and night);

- An assessment of noise from the proposed facility would be undertaken to the requirements of BS 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'*.

- Calculations would be undertaken to enable noise predictions of the proposed facility to be compared against the background noise level ($L_{A90,T}$). Source levels from manufacturers data or a similar solar PV facility would be used as basis of predictions, including any rating penalties to those sources where appropriate. Should the predicted rating noise levels exceed the background level, outline mitigation measures would be identified to offset any adverse impacts.

3 Proposed Development

3.1 Site Location and Description

The proposed development site is located on land off Worlds End Lane, approximately 4 km southwest of the village of Berkeley, Gloucestershire. The site is surrounded by agricultural fields in all compass point directions. In the wider area, the River Severn is located approximately 500 metres to the north-west.

The site is accessed via Worlds End Lane to the east, and further internal tracks within the Worlds End Farm site. These internal tracks comprise of metalled and part metalled surfaces which extend through the agricultural land. In addition, a number of rights of way lie within the vicinity of the site.

3.2 Development Proposals

The proposals include the installation of photovoltaic (PV) panels with a total capacity up to 49.9 MW, mounted to frames which would have a maximum height above ground level of 3.4 m. Appendix A presents the proposed site layout.

The plant shall be capable of operating for a continuous period, with the potential to operate during both daytime and night-time hours, based upon sunlight conditions throughout the year. The proposals consist of the following elements:

- String inverter stations positioned within the solar panel arrays;
- MV Power Stations;
- A sub-station;
- Storage containers;
- Temporary welfare cabins; and
- Security fencing.

3.3 Existing Receptors

Based on online aerial imagery resources and site attendance, the following receptors have been identified for assessment purposes. Receptors have been chosen based on their proximity to the development and where necessary, representative of a wider series of receptors within a settlement.

The wider site boundary and location of the sensitive receptors considered in the assessment are presented in **Table 3.1** and **Figure 3.1** overleaf.

Ref.	Receptor Name	Receptor type	Distance from proposed development boundary (metres approx.)
R1	Severn House Farm	Residential	400 north-west
R2	Worlds End Farm Cottage	Residential	375 east
R3	Worlds End Farm	Residential	325 east
R4	Bilsbury Farm	Residential	575 east
R5	Brick House Farm	Residential	1,000 south-east
R6	Dayhouse Farm	Residential	1,150 south-west

Table 3.1 – Assessment receptor locations

Figure 3.1 – Site location map and assessment receptors

4 Noise Survey Method

4.1 Survey Measurement Details

A baseline noise survey was undertaken from Wednesday 18 January to Wednesday 25 January 2023 with the collection of continuous data at three unattended monitoring locations namely UL1, UL2, and UL3. The survey was undertaken over a representative midweek and weekend period to address typical fluctuations of the local noise environment.

The monitoring locations were selected by considering the site constraints, security and accessibility of the monitoring equipment. It was not possible to install the noise meters within the demise of the nearest sensitive receptors and therefore positions were chosen based on their proximity to these. Observations made during the equipment's installation and collection determined that the noise environment at the selected monitoring positions was representative of the noise environment at the receptor locations. A description of the measurement locations and rationale is provided in **Table 4.1** below:

Measurement Location ref.	Type	Location	Rationale
UL1	Unattended	North-west boundary of the site	To quantify existing ambient and background noise from surrounding transportation sources and agricultural activity.
UL2	Unattended	East of the site	
UL3	Unattended	South-east boundary of the site	

Table 4.1 – Measurement location details

The chosen representative measurement locations to each of the selected receptors is summarised in **Table 4.2** considering the surrounding noise sources, with **Figure 4.1** graphically presenting the positioning of the noise meters. It is understood that R3 – Worlds End Farm has a vested interest in the Solar PV development, and therefore predicted noise levels have been included for indicative purposes only; Worlds End Farm will not be assessed as part of the noise assessment.

Reference	Receptor Name	Representative unattended measurement location
R1	Severn House Farm	UL1
R2	Worlds End Farm Cottage	UL2
R3	Worlds End Farm	UL2
R4	Bilsbury Farm	UL2
R5	Brick House Farm	UL3
R6	Dayhouse Farm	UL3

Table 4.2 – Representative measurement location to each receptor

Figure 4.1 – Baseline monitoring locations

4.2 Survey Observations

The noise environment across the site was observed and comprised the following sources during the equipment installation and retrieval:

- Distant road noise along the local road network;
- Wind through surrounding trees and shrubbery;
- Bird song; and
- Agricultural plant in nearby fields.

4.3 Survey Equipment

Noise monitoring was undertaken using the following equipment, detailed in **Table 4.3**:

Equipment	Type	Serial Number	Calibration date
Class 1 sound level meter	Rion NL-52	453833	18 January 2022
Class 1 sound level meter	Rion NL-52	1021276	30 November 2021
Class 1 sound level meter	Rion NL-52	976247	28 June 2021
Acoustic calibrator	Rion NC-75	34524127	27 June 2022

Table 4.3 – Monitoring equipment

All measurements were undertaken with the microphone positioned at least 3.5 m away from reflecting surfaces and at a height of 1.5 m above the ground, considered to be under free-field conditions, to the requirements of BS 7445.

The calibration of each sound level meter was checked before and after the measurements, using the acoustic calibrator at 94 dB at 1 kHz; no significant calibration drift was noted (+/- 0.3 dB).

The sound level meters used conform to the Class 1 requirements of BS EN 61672-1: 2013 *'Electroacoustics. Sound level meter, Specifications'*. The calibrator used conforms to the requirements of BS EN 60942: 2018 *'Electroacoustics, Sound calibrators'*. The equipment used has a calibration history that is traceable to a certified calibration institution.

4.4 Weather Conditions

Representative weather conditions during the measurement period were obtained from Wunderground (www.wunderground.com), using the weather station closest to the proposed development site (with available historical data), which was judged to be at Upper Wick, Dursley (IDURSL1). The analysis of the continuous weather data indicates that there was minimal rainfall during the daytime period of 21 January 2023 and averaged windspeeds remained below 5 m/s.

The weather data representative of monitoring positions UL1, UL2 and UL3 is summarised in **Table 4.4** below.

Date	Time Period	Temperature High (°C)	Temperature Low (°C)	Wind Speed Average (m/s)	Dominant Wind Direction	Accum. Precipitation (mm)
18.01.23	07:00-23:00	5.6	-1.8	1.6	W	0.0
19.01.23	23:00-07:00	-0.8	-2.6	1.0	E	0.0
	07:00-23:00	6.0	-3.0	1.1	E	0.0
20.01.23	23:00-07:00	1.1	-2.7	0.9	ENE	0.0
	07:00-23:00	7.6	-2.6	0.8	NW	0.0
21.01.23	23:00-07:00	0.8	-3.5	0.5	NE	0.0
	07:00-23:00	0.8	-5.1	0.3	WNW	0.3
22.01.23	23:00-07:00	-1.3	-6.4	0.3	NW	0.0
	07:00-23:00	3.8	-1.3	2.4	SE	0.0
23.01.23	23:00-07:00	2.6	0.1	1.7	SE	0.0
	07:00-23:00	5.7	-2.8	1.1	SE	0.0
24.01.23	23:00-07:00	-2.8	-5.4	0.5	E	0.0
	07:00-23:00	6.7	-5.1	0.3	E	0.0
25.01.23	23:00-07:00	0.2	-0.3	0.5	SE	0.3
	07:00-23:00	6.5	0.2	0.8	SE	0.0

Table 4.4 – Summarised weather data

Analysis of the dataset indicates that neither of the aforementioned events had any significant effect on the measured noise levels. All data has therefore been included to inform subsequent assessment.

Based on the above data, weather conditions during the noise monitoring survey are deemed suitable for environmental noise monitoring.

5 Noise Survey Results

5.1 Long Term Measurements

Analysis of the dataset accounting for the 16-hour daytime period (07:00 – 23:00) and 8-hour night-time period (23:00 – 07:00) is provided in **Tables 5.1 to 5.3**.

A summary of the measured noise levels at position UL1 is presented in Table 5.1. Due to a SD card formatting error, data for the full monitoring period at this location was unavailable.

Date	Time period (T)	Measured Noise Levels, dB [(a)]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
18.01.23	13:45 – 23:00	40	78	29	40
	23:00 – 07:00	34	51	25	34
19.01.23	07:00 – 23:00	41	68	31	42
	23:00 – 07:00	35	55	28	36
20.01.23	07:00 – 12:30[(b)]	40	65	33	42
Resultant Noise Level	**07:00 – 23:00**	**40**	**78**	**31**	**41**
	23:00 – 07:00	**35**	**55**	**26**	**35**

(a) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period
(b) No further data available due to SD formatting issue

Table 5.1 – Noise measurement results – UL1

A summary of the measured noise levels at position UL2 is presented in **Table 5.2**.

Date	Time period (T)	Measured Noise Levels, dB [a]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
18.01.23	15:30 – 23:00	39	69	29	38
18.01.23	23:00 – 07:00	42	76	25	35
19.01.23	07:00 – 23:00	46	72	32	45
19.01.23	23:00 – 07:00	41	75	29	37
20.01.23	07:00 – 23:00	44	78	31	42
20.01.23	23:00 – 07:00	41	68	29	35
21.01.23	07:00 – 23:00	42	76	27	37
21.01.23	23:00 – 07:00	32	72	24	29
22.01.23	07:00 – 23:00	46	85	30	41
22.01.23	23:00 – 07:00	39	66	25	31
23.01.23	07:00 – 23:00	42	73	31	41
23.01.23	23:00 – 07:00	39	78	28	33
24.01.23	07:00 – 23:00[b]	44	77	32	40
Resultant Noise Level	**07:00 – 23:00**	**43**	**85**	**30**	**40**
	23:00 – 07:00	**39**	**78**	**27**	**33**

(a) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period
(b) No further data available due to a battery power issue

Table 5.2 – Noise measurement results – UL2

A summary of the measured noise levels at position UL3 is presented in **Table 5.3**.

Date	**Time period (T)**	**Measured Noise Levels, dB** [a]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
18.01.23	14:45 – 23:00	41	76	28	37
18.01.23	23:00 – 07:00	33	54	24	33
19.01.23	07:00 – 23:00	42	73	30	42
19.01.23	23:00 – 07:00	34	57	27	35
20.01.23	07:00 – 23:00	39	76	29	38
20.01.23	23:00 – 07:00	31	48	29	33
21.01.23	07:00 – 23:00	33	68	26	31
21.01.23	23:00 – 07:00	27	54	24	27
22.01.23	07:00 – 23:00	37	70	29	37
22.01.23	23:00 – 07:00	28	66	24	28
23.01.23	07:00 – 23:00	37	76	29	37
23.01.23	23:00 – 07:00	29	46	27	30
24.01.23	07:00 – 23:00	36	74	31	36
24.01.23	23:00 – 07:00	27	55	23	28
25.01.23	07:00 – 11:00	40	73	31	40
Resultant Noise Level	**07:00 – 23:00**	**38**	**76**	**29**	**37**
	23:00 – 07:00	**30**	**66**	**25**	**30**

(a) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period

Table 5.3 – Noise measurement results – UL3

5.2 Derivation of Representative Background Sound Levels

Given the development has potential to operate during both daytime and night-time periods, dependant on the sunlight conditions throughout the year, representative background noise levels are provided for day and night-time periods.

Analysis of the representative background noise levels considers the hourly noise levels ($L_{A90,1hour}$) measured during the daytime period (07:00 – 23:00) and those 15-minute samples ($L_{A90,15min}$) measured during the night-time period (23:00-07:00). Such an approach is in line with the requirements of BS 4142 and is considered to suitably provide a representative value for the background noise in the local environment.

A summary of the representative daytime and night-time background levels at the assessment locations (UL1 to UL3) is provided in **Table 5.4**. A graphical representation of the statistical analysis is included in **Appendix C**.

Receptor	**Representative Measurement Location**	**Representative Daytime Noise Level, $L_{A90,\ 1hr}$**	**Representative Night-time Noise Level, $L_{A90,\ 15min}$**
R1 - Severn House Farm	UL1	30	26
R2 - Worlds End Farm Cottage	UL2	26	23
R3 – Worlds End Farm	UL2	26	23
R4 - Bilsbury Farm	UL2	26	23
R5 - Brick House Farm	UL3	26	23
R6 - Dayhouse Farm	UL3	26	23

Table 5.4 – Representative background levels at receptor locations

6 Noise Prediction Model

6.1 Methodology

The predicted noise levels likely to be generated during the operational phase of the proposed solar PV development have been calculated using a noise prediction model. These predictions realise the noise propagation of any plant noise in isolation at the nearest sensitive receptors to the site taking terrain and local topographical features into consideration.

The noise predictions (specific sound levels at noise sensitive receptors) are based on International Standard ISO 9613-2:1996 '*Attenuation of sound during propagation outdoors – general method of calculation*'. ISO 9613 provides a method for the prediction of noise levels in the community from sources of known sound emission.

The ISO 9613-2 method predicts noise levels under meteorological conditions favourable to noise propagation from the sound source to the receiver, such as downwind propagation, or equivalently, propagation under a moderate ground-based temperature inversion as commonly occurs at night.

6.2 Overview

A computer noise model of the proposed development has been constructed using SoundPLAN v8.2, based on the indicative site layout presented in **Appendix A**.

Input data in the form of octave band noise emission levels between 16 Hz and 16 kHz have been assigned to string inverter noise sources, and one-third octave band noise emission levels between 12.5 Hz and 20 kHz have been assigned to all remaining proposed plant items, adjusted to the geometry and nature of the site operations, with the noise data obtained from a combination of noise specification datasheets received from the client, and from similar solar panel planning applications, in agreement with the client.

The noise predictions are based on International Standard ISO 9613-2:1996 '*Attenuation of sound during propagation outdoors – general method of calculation*'. ISO 9613 provides a method for the prediction of noise levels in the community from sources of known sound emission.

The noise prediction method described in ISO 9613 is suitable for a wide range of engineering applications where the noise level outdoors is of interest. The noise source(s) may be moving or stationary and the method considers the following major mechanisms of noise attenuation:

- Geometrical divergence (also known as distance loss or geometric damping);
- Atmospheric absorption;
- Ground effect;

- Reflection from surfaces; and
- Screening by obstacles, barriers and buildings.

6.3 Modelling Parameters

An overview of the modelling parameters is given in **Table 6.1** below.

Item	Setting
Algorithms	International Standard: ISO 9613-2
Ground Absorption	Acoustically hard (assumed 0.1 coefficient) – built-up areas and water surface. Acoustically soft (assumed 0.7 coefficient) – undeveloped and vegetation areas.
Meteorological Conditions	10 degrees Celsius; 70% humidity; and Wind from source to receiver.
Façade Corrections	Calculations are free-field. No façade corrections have been applied
Receptor Height	Ground floor 1.5 metres and first floor 4 metres above ground.
Source Modelling	See Section 6.4
Terrain	LiDAR DTM with a 2-metre resolution has been imported into the model.
Site Layout	Digitised based on site layout no. ISS11, (drawing reference: 1650-0201-00) dated 07.12.22.06.22 included in Appendix A

Table 6.1 – Modelling parameters

6.4 Operational Source Noise Data

Inverter Stations (Array Location)

Previous solar panel planning applications completed by RSK Acoustics concluded that the primary source of noise emission is the operation of the inverter stations, which are proposed to be positioned at a variety of locations across this development. The role of an inverter station is to convert DC (direct current) generated from a cluster of solar panels into AC (alternating current) for National Grid and domestic use.

The following noise levels have been assigned to the inverter stations:

Type	Noise Level (Lp) at 1 m dB(A)
Huawei SUN2000-185KTL (point source propagation)	65

Table 6.2 – Inverter Reference Noise Level

The inverter element has been calibrated using a receiver positioned at 1 m distance from the source, and at 1.5 m height relative to the ground level to achieve the reference noise levels summarised above. All plant items have been incorporated as an outdoor source continuously in operation (steady state regime with 100% operational capacity).

Due to the absence of spectral frequency data for the assumed string inverter unit, spectral test data for an alternative string inverter (Sungrow 250X) has been scaled to meet the specified noise level at 1 m for the assumed inverter unit.

Transformer Stations (Array Locations)

These plant items would be distributed at either side along the access roads, as illustrated in **Appendix 1**.

A sound power of 64 dB L_{WA} corresponding to a 3150 kVA unit according to DIN EN 50588 has been calibrated based upon the technical drawings detailing the transformer stations.

The transformer stations have been modelled with the noise sources to be emitting from the two louvred areas on the corresponding surfaces as detailed within the technical drawings. The transformer station element was introduced at 3.7 m above ground levels. The transformer stations have been incorporated as outdoor sources continuously in operation (steady state regime with 100% operational capacity).

Item	Noise Level (L_{WA})
Transformer Stations	64

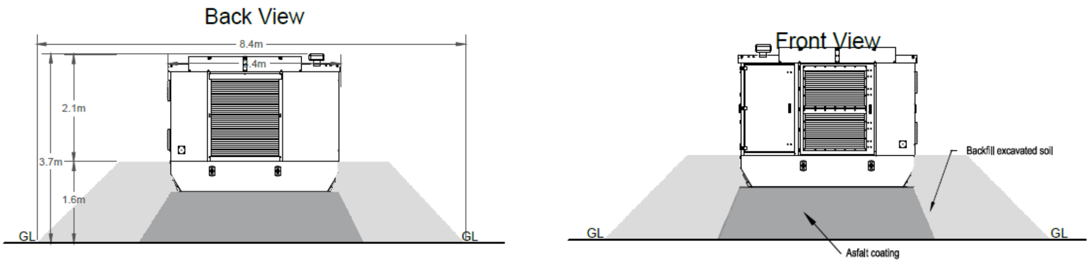


Table 6.3 – Transformer stations technical drawing

The transformer station element has been calibrated using a receiver positioned at 1 m distance from the source, and at 1.5 m height relative to the ground level to achieve the reference noise levels summarised above.

Due to the absence of spectral frequency data for the assumed transformer unit, spectrum levels in close proximity to a similar plant item as measured by RSKA within an electrical substation has been scaled to meet the specified noise level at 1 m for the assumed transformer unit.

Auxiliary Transformer Unit (1 no.)

A noise emission level of 50 dB(A) L_p at 1 m distance has been assumed in agreement with BSR Energy. The transformer stations have been modelled at a total height of 3.7 m, with two louvred areas emitting noise. The elements have been incorporated as outdoor sources continuously in operation (steady state regime with 100% operational capacity).

Item	Noise Level (Lp) at 1 m dB(A)
Auxiliary Transformer Unit	50

Table 6.4 – Auxiliary transformer unit reference noise levels

The auxiliary transformer station element has been calibrated using a receiver positioned at 1 m distance from the source, and at 1.5 m height relative to the ground level to achieve the reference noise levels summarised above.

Due to the absence of spectral frequency data for the assumed auxiliary transformer unit, spectral data as measured by RSKA within an electrical substation has been scaled to meet the specified noise level at 1 m for the assumed auxiliary transformer unit.

DNO 132/ 33 kV Substation Transformer (1 no.)

As advised by BSR Energy, the dominant noise source within the DNO compound has been assumed to be the associated DNO transformer substation, which would be utilised to facilitate the connection of the proposed development to the National Grid. In the absence of specific noise emission levels for this plant time, and in line with previous RSKA Solar PV project experience, a noise level of 70 dB(A) L_p at 1 metre from the façade has been assigned to each side of a five sided emitter station, at a height of 3.5 m.

Noise emissions from the substation transformer have been calibrated using a receiver positioned at 1 m distance from each emitting surface and at 1.5 m from ground level and 1 m above roof level (roof source).

Due to the absence of spectral frequency data for the assumed transformer unit, spectrum levels in close proximity to a similar plant item as measured by RSKA within an electrical substation has been scaled to meet the specified noise level at 1 m for the assumed transformer unit.

The transformer substation has been incorporated as an outdoor source continuously in operation (steady state regime with 100% operational capacity). Reference noise levels are reproduced below in **Table 6.5**.

Item	Total Noise Level (Lp) at 1 m dB(A)
132/ 33 kV, 49.9 MW Transformer Substation	70

Table 6.5 –DNO Substation transformer reference noise levels

Panel Tracking System

Tracking motors for the solar panels have not been assessed, due to their intermittent and brief operation adjusting the angle of the panels and due to having a low sound power level of around 50 dB $L_{wA.}$

Details of indicative levels presented in **Figure 6.1** overleaf.

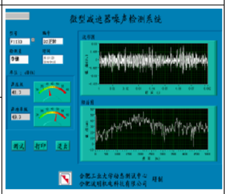
NEXTracker
A Flex Company

NEXTracker Motor Sound Test Summary

Each NEXTracker row uses a small 24V DC motor powered by a NEXTracker controller. To track the row, the motor runs for five to ten seconds every few minutes. The noise level of the motors is tested by the manufacturer. Test reports from the manufacturer show that the sound power level is ~50dB. The sound level produced is very low and essentially inaudible to surrounding site noises such as wind or generators.

Sound testing report

applying date: Sep, 10th, 2017 report NO.: 2014091001

Sample from	Reducer department	P/N	DL-GS150-710/5	Applying department	Quality department
Sample	Motor reducer	NO.	02 (CW)	QTY	2Pcs
purpose	check the sound of motor reducer in no-load condition				
Testing environment	1、anechoic chamber inner size: 2050x2750x2100mm; 2、anechoic chamber LF cut-off frequency about 100Hz; 3、inside background noise during work below 26dB(A)以下; 4、outside vibration transmission less than 5%; 5、motor reduce was under no-load condition when testing.				
level	Conform to standard GB/T3767-1996、ISO3744-1994				
oscillogram / spectrogram					

Testing result (away from sound source by 1 meter) unit:db(A)

Sound power level	49.30

Manufacturer sound test report

Inverse distance law for acoustics shows sound decrease with distance:

Distance	Sound Level	Equivalent sound
3 m (9.8 ft)	~ 40 dB	Library
30 (98 ft)	~20 dB	Rustling leaves
300 m (980 ft)	~0 dB	Inaudible

Figure 6.1 – Indiciatve tracker motor sound power level

7 Operational Noise Impact

7.1 Specific Noise

Predicted specific noise levels from the cumulative operation of the plant items associated with the proposed development (i.e. discounting rating penalties), are provided in **Table 7.1** along with the existing residual noise levels at each receptor measured as part of the baseline survey (daytime levels are referenced to the evaluation at ground floor height of 1.5 m and nigh-time levels are reference to the evaluation at first floor height of 4 m).

Receptor	Floor	Predicted Specific Noise Level, dB L_{As}	Residual Daytime Noise Level, dB $L_{Aeq,T}$	Residual Night Noise Level, dB $L_{Aeq,T}$
R1 - Severn House Farm	GF	27	40	--
	F1	28	--	35
R2 - Worlds End Farm Cottage	GF	26	43	--
	F1	28	--	39
R3 – Worlds End Farm*	GF	29	43	--
	F1	31	--	39
R4 - Bilsbury Farm	GF	24	43	--
	F1	25	--	39
R5 - Brick House Farm	GF	15	38	--
	F1	19	--	30
R6 - Dayhouse Farm	GF	20	38	--
	F1	22	--	30

*Receptor included for indicative purposes only it has a vested interest in project.

Table 7.1 – Predicted specific noise levels

Specific noise levels at all receptors are predicted to be comfortably below the residual noise at all receptors during daytime and night operation of the development. Excluding Worlds End Farm, the highest noise levels are predicted at Worlds End Farm Cottage and Severn House Farm, with levels of 26 and 27 dB L_{As} at ground floor and 28 dB L_{As} at first floor.

7.2 Acoustic Correction

According to BS 4142:2014+A1: 2019, where certain features of the specific noise level can increase the significance of impact of a sound level, a character correction is applied to provide a rated noise level. The characteristics of a sound that are likely to cause an increase in the significance of impact are tonality, impulsivity, intermittency or other characteristic features such as an identifiable 'hiss'.

BS 4142 discusses the addition of rating penalties (to the specific noise) as a factor of 'perceptibility', where the prominence of tonal or impulsive sound from a source can be readily distinguishable over the residual sound. For this assessment, the addition of rating penalties has considered the numerical comparison of the specific noise against the baseline residual noise level at each receptor derived from the results presented in **Table 7.1** above.

Given the low noise environment, the lack of substantive existing noise sources in the immediate area of the development site and the uncertainty on the spectral emission data for the final plant to be installed, a conservative approach has been adopted at those receptor locations which account for predicted specific noise levels up to 10 dB below the residual night noise level with the adoption of a +2 dB penalty for tonal characteristics being 'just perceptible' to the following receptors during the night period only:

- R1 - Severn House Farm
- R6 - Dayhouse Farm

Consideration to other acoustic features such as impulsive or intermittent components associated with the proposed plant items have been given:

- Impulsivity - The character of the sound and the operational regime from the proposed plant items will generally be of a low level and constant, with no rapid change in the level or character of noise. It is therefore considered unnecessary to apply an impulsive correction; and
- Intermittency – Due to the nature of the proposed installation it is considered that the plant items will not have identifiable on/off conditions, with items operating at varying loads relative to both the intensity of the sunlight incident upon the solar panels and the air temperature. It is therefore considered unnecessary to apply a correction due to intermittent components to the sound.

7.3 Operational Assessment

The rated noise level (inclusive of penalty corrections) from site activity has been predicted as the contribution (energetic sum) of all active sources within the proposed development. This scenario provides a conservative interpretation of the resulting noise levels at receptor.

An assessment of predicted rated noise levels, against the representative background noise at closest residential receptors are summarised in **Table 7.2 and 7.3** below.

Operational noise contours are provided in **Appendix B**.

Receptor	Rated Noise Level, dB L_{Ar}	Representative Background Noise Level, dB $L_{A90, 1hr}$	Excess of Rating Level over Background, dB
R1 - Severn House Farm	27	30	-3
R2 - Worlds End Farm Cottage	26	26	0
*R3 – Worlds End Farm**	*29*	*26*	*+5*
R4 - Bilsbury Farm	24	26	-2
R5 - Brick House Farm	15	26	-11
R6 - Dayhouse Farm	20	26	-6

*Receptor included for indicative purposes only, Worlds End Farm has vested interest in project.

Table 7.2 – Daytime operational noise assessment

Receptor	Rated Noise Level, dB L_{Ar}	Representative Background Noise Level, dB $L_{A90, 15min}$	Excess of Rating Level over Background, dB
R1 - Severn House Farm	30	*26*	+4
R2 - Worlds End Farm Cottage	28	*23*	+5
*R3 – Worlds End Farm**	*33*	*23*	*+10*
R4 - Bilsbury Farm	25	*23*	+2
R5 - Brick House Farm	19	*23*	-4
R6 - Dayhouse Farm	24	*23*	+1

*Receptor included for indicative purposes only, Worlds End Farm has vested interest in project.

Table 7.3 – Night-time operational noise assessment

Excluding Worlds End Farm from the assessment, the highest rated noise level of 27 dB L_{Ar} is predicted at ground floor of Severn House Farm during daytime hours, this is 3 dB below the representative background noise. The lowest difference between the rating level over background during daytime hours is 0 dB which is predicted at Worlds End Farm Cottage.

During night operations, the highest rated noise level of 30 dB L_{Ar} is predicted at first floor of both Severn House Farm, and Worlds End Farm Cottage resulting in an excess over the representative background noise of +4 dB, and +5 dB respectively. Excluding Worlds End Farm, the highest excess of the rating level over the adopted night-time background level is 5 dB predicted at Worlds End Farm Cottage. In accordance with BS 4142, a difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

7.4 Context Evaluation

In line with BS 4142, where the initial estimate of impact needs to be modified due to the context, a number of pertinent factors should be taken into consideration, including the absolute level of sound, character of the sound against the residual environment and the sensitivity of the receptor (and existing design measures).

Absolute Sound Level

With regards to the contextual assessment relating to the absolute level of sound, BS 4142 states,

"For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

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".

Although "low" noise levels are not explicitly defined in the most recently issued version of the standard, reference can be made to other standards on noise levels at night. Earlier versions of BS 4142 (1997 – superseded) noted that background noise levels below 30 dB and rating levels below about 35 dB are considered to be very low. Such an approach to the description of the term "low" in the context of background sound levels is discussed within the Acoustics and Noise Consultants (ANC) Technical Note to BS 4142: 2014+A1: 2019 (Version 1.0, dated March 2020) which states that, *"…….similar values [in terms of the definition of low background sound levels] would not be unreasonable in the context of BS 4142……..".*

In the context of absolute noise, rated noise levels would not exceed 35 dB L_{Ar}, nor would they exceed a background sound level of 30 dB $L_{A90,T}$. Furthermore, specific noise levels would be 8 dB below the residual noise (as a worse case) at night resulting in a noise level change of 1 dB which is not considered significant due to the masking effect of the prevailing environment.

Character

Although the proposed development would undoubtedly introduce new sources to the local noise environment, the nature and magnitude of predicted noise levels at nearest receptor locations and the unlikely presence of intermittent or impulsive components is an indication that the acoustic characteristics are unlikely to be prominent and therefore unlikely to have an adverse impact.

Receptor Design Considerations

The context of the noise during night-time operations should also reasonably include the existing design measures of the building fabric. WHO recognises the impact of an open window in reducing noise levels (from external to internal) and specifies a widely accepted reduction of 15 dB(A). By adopting an open window scenario, the highest rated noise levels associated with the proposed development would not exceed nor contribute to an exceedance of an external level of 45 dB(A) (accounting for an internal level of 30 dB(A)) for sleep disturbance in accordance with WHO. This is a positive indication that the development would not adversely impact those residents during respite hours while allowing the use of open windows for ventilation purposes.

Based on the application of context to the initial assessment, it is considered that the operation of the proposed development within the existing environment is likely to have a low impact at all receptors considered.

7.5 Conservatism in the Assessment

Whilst the solar panels emit no noise, they would act as a partial noise barrier in reducing plant emission levels from the inverters and substations across the site. The actual level of noise reduction would be dependent on the positioning and angle of the panels and for this reason, the panels were not included in the noise model.

Operation of the inverters, power stations and the sub-station would be dependent on the level of sunlight incident on the panels, and at times when no sunlight is present, no plant items would be in operation, except for the auxiliary transformer. Noise is therefore unlikely to be emitted from these items during most of the night-time period, with noise emissions of the auxiliary transformer deemed negligible. During the periods of the year where sunlight is anticipated within the night-time period (i.e. during the height of summer), it would be unlikely the plant items would reach 100% capacity during these hours. It would also be expected that the background noise levels within the area during this time of year would be greater than those assessed against, due to effects such as the dawn chorus, and increased human agricultural activity. For the purposes of the assessment full operation of the plant items at night has still been included, with the assessment accounting for operation of all fixed plant items simultaneously.

RSKA's experience of similar projects and power generation schemes would indicate that operation of the power stations and sub-stations is only likely after discharge to the grid. For the purposes of the assessment however, these items have been modelled assumed continuous operations.

Given the conservatism outlined above, it is reasonable to assume that operational noise levels associated with the development are likely to be an over-prediction of the realistic noise levels experienced at sensitive receptors.

7.6 Uncertainty

BS 4142:2014+A1: 2019 requires that the assessment considers the level of uncertainty in the data and associated calculations. Consideration of the uncertainty can enable a more informed decision regarding the likely significance of impact, within the context of assessment.

It is accepted that uncertainty may arise from all levels of measurement and assessment and reasonably practicable steps have been made at all stages with the aim of reducing uncertainty.

The following measures have been taken to reduce uncertainty:

- Background sound level measurements have been obtained at representative assessment locations over a maximum duration of 7 days to fully characterise the existing residual environment during the intended operational hours of the proposed development;

- The assessment has considered a full operational scenario, with all plant items operating 24 hours a day during daytime and night. Representative background levels obtained at daytime and night have been utilised to inform the assessment;

- Use of monitoring equipment in accordance with section 5 of BS 4142: 2014+A1: 2019, using Class 1 instrumentation;

- Measurement procedures followed in accordance with section 6 of BS 4142: 2014+A1: 2019 with all precautions taken to minimise interference; and

- Specific sound levels have been calculated to the requirements of ISO 9613-2: 1996 which is the widely accepted procedure for the calculation of sound propagation (including favorable wind conditions from source to receiver). The development has yet to be built therefore, the assessment is informed by comparison of the predicted rated noise levels against the representative background levels at each receptor in accordance with section 7 of BS 4142: 2014+A1: 2019.

Given the measures outlined above and the magnitude of predicted operational levels in the context of the existing local noise environment, it is considered that the uncertainty does not have any significance on the outcome of the assessment.

8 Construction Noise and Vibration

It is anticipated that the impacts from construction noise would be assessed within a separate Construction Noise and Vibration Management Plan (CNVMP). As part of the CNVMP, it would be expected that the contractor shall implement best practicable means (BPM) as part of their working methodology, as defined by the Control of Pollution Act 1974. This will serve to minimise and control the potential for noise and vibration impacts at receptors in the vicinity of the construction works.

Though specific construction details are to be confirmed at a later stage within the project cycle, it is understood that auger piling methods (i.e CFA) will be preferred as opposed to impact or vibratory methods. This method of piling is inherently less intrusive. In addition, construction times would likely be confined to daytime core hours only.

The following details a number of mitigation measures and best practice which are recommended be utilised during construction activities in order to control noise and vibration impacts:

- Contact shall be made with local authorities, where required to ensure that planned designated routes are set in place to minimise disturbance;
- Site speed limits shall be set to minimise noise and vibration levels;
- Deliveries should be carried out within the time limits set by relevant consented conditions and local agreements;
- The use of acoustic enclosures to fixed plant items (where applicable);
- The procurement and use of lower emitting plant and machinery (for example, use of CFA piling methods instead of impact or vibratory methods);
- All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum; and
- Appropriate notification be made to neighbours of the construction activities, including programme of works and contractor point of contact.

9 Conclusion

A noise impact assessment has been undertaken based on the proposed solar photovoltaic (PV) development on land off Worlds End Lane, Gloucestershire. The assessment focuses on the operational impact of the development at nearest residential receptors to the requirements of BS 5228-1:2009+ A1: 2014 and BS 4142: 2014+A1: 2019.

A baseline noise survey encompassing the analysis of continuous data has been used to determine representative background noise levels at those closest existing receptors to the site, through statistical analysis.

A computer noise model has been developed which incorporates the proposed operational plant items, including several inverters, power stations and a sub-station. Predictions account for the cumulative operation of all plant items simultaneously during a worse-case night-time assessment period.

Predicted rated noise levels during night-time operation of the development would likely exceed the representative background sound level at nearby sensitive receptors (excluding Worlds End Farm) in up to 5 dB. In accordance with BS 4142 and the contextual considerations of the site such as its locality, the existing baseline conditions and the magnitude of absolute noise levels predicted at receptor, the proposals would not significantly change the existing noise environment, nor contribute to the exceedance of the criteria for internal and external noise levels for residential property within WHO guidelines. This is a positive indication that noise from the proposed development would have a low impact.

In summary, the assessment concludes that the proposed development is considered feasible for the intended use in line with relevant standards and guidance.

End of Section

References

1. British Standard 4142: 2014+A1:2019, 'Methods of rating industrial and commercial sound' British Standards Institution.

2. British Standard 5228-1: 2009+ A1: 2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'. British Standards Institution

3. British Standard 7445-1: 2003, 'Description and measurement of environmental noise – Part 1: Guide to quantities and procedures'. British Standards Institution.

4. ISO 9613-2:1996 'Attenuation of sound during propagation outdoors – general method of calculation'. International Organization for Standardization.

5. National Planning Policy Framework – Department for Communities and Local Government. March 2012 (as amended July 2021)

6. Noise Policy Statement for England (NPSE). DEFRA, 2010.

7. World Health Organization (WHO), 'Guidelines for Community Noise', 1999.

End of Section

Glossary of Acoustic Terms

Lp - Sound Pressure Level

The basic unit of sound measurement is the sound pressure level, which is measured on a logarithmic scale and expressed in decibels (dB). The logarithmic scale makes it easier to manage the large range of audible sound pressures, and also more closely represents the way the human ear responds to differences in sound pressure:

Lp = 20 log10 (p/po)

where p = RMS (root mean square) sound pressure; and

p0 = reference sound pressure 2 x 10-5 Pa.

Frequency Weighting Networks

Frequency weighting networks, which are generally built into sound level meters, attenuate the signal at some frequencies and amplify it at others. The A-weighting network approximately corresponds to human frequency response to sound. Sound levels measured with the A-weighting network are expressed in dB(A). Other weighting networks also exist, such as C-weighting which is nearly linear (i.e. unweighted) and other more specialised weighting networks. Variables such as L_p and L_{eq} that can be measured using such weightings are expressed as L_{pA} / L_{pC}, L_{Aeq} / L_{Ceq} etc.

Time Weighting

Sound level meters use various averaging times for the measurement of RMS sound pressure level. The most commonly used are fast (0.125 s averaging time), slow (1 s averaging time) and impulse (0.035 s averaging time). Variables that are measures with time weightings are expressed as LAFmax etc.

LAeq – Equivalent Continuous Sound Pressure Level

Sound levels tend to fluctuate, and as such an ‘instantaneous’ measurement like sound pressure level cannot fully describe many real-world situations. A summation can be made of the measured sound energy over a certain period, and a notional steady level can be calculated which would contain the same total energy as the fluctuating sound. This notional level is termed the equivalent continuous sound level Leq. Leq can be determined over any time period, which is indicated as Leq,T where T is the time period (e.g. Leq,24h).

Lmax - Maximum Sound Pressure Level or Maximum Noise Level

This is the maximum RMS sound pressure level occurring within a specified period. The time weighting is usually specified, such as in L_{max}.

Ln - Percentile or Statistical Levels

It is useful to calculate the level which is exceeded for a certain percent of a total period. Background noise is often defined as the A-weighted sound pressure level exceeded for 90% of the specified period T, expressed L90,T. Road traffic noise is often characterised in terms of LA10

T - Reference Time Interval

The specified interval over which the specific sound level is determined.

Ambient sound

totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. The ambient sound comprises the residual sound and the specific sound when present.

Residual sound

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific sound source

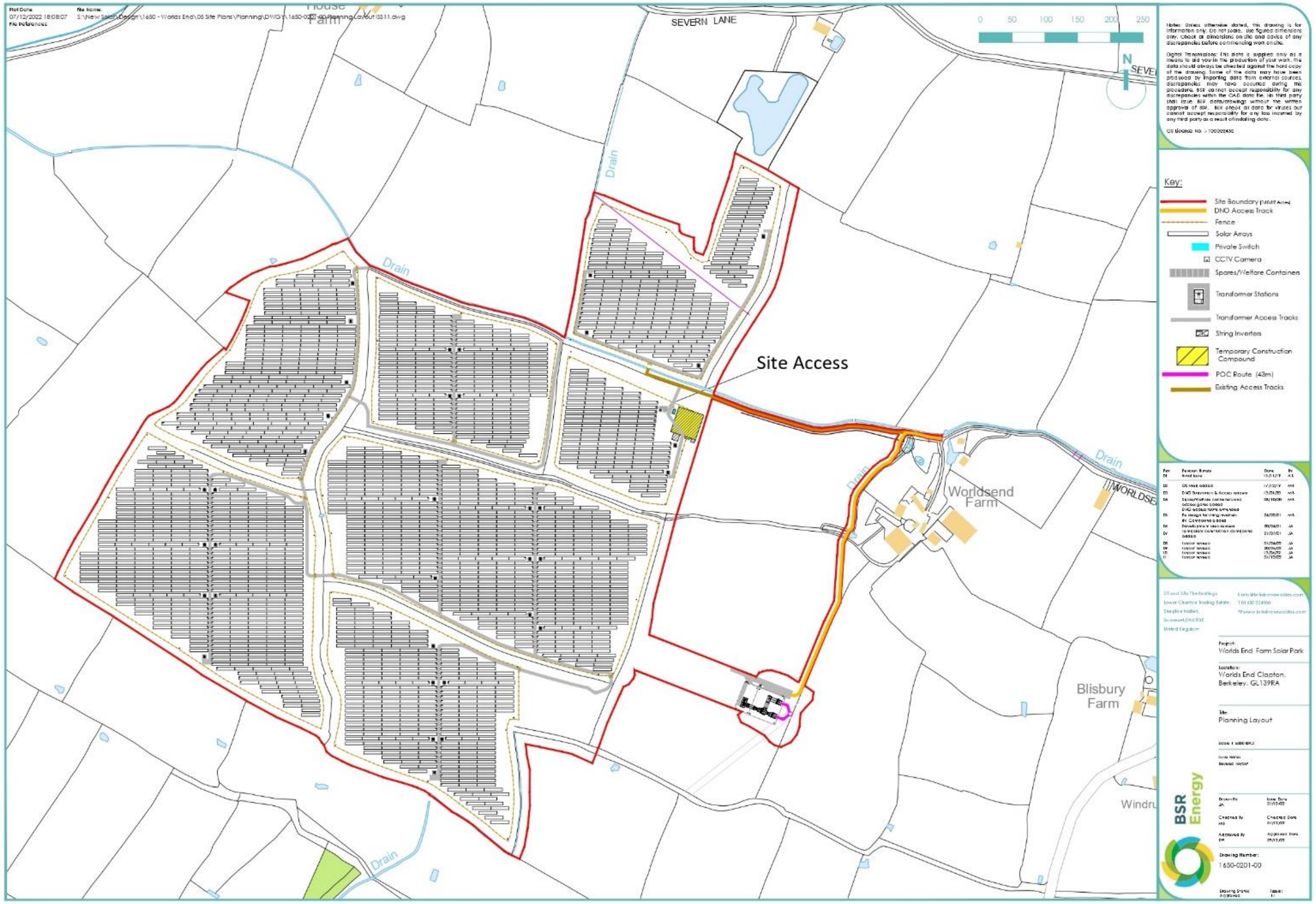
Sound source being assessed.

LAr,Tr – Rating level

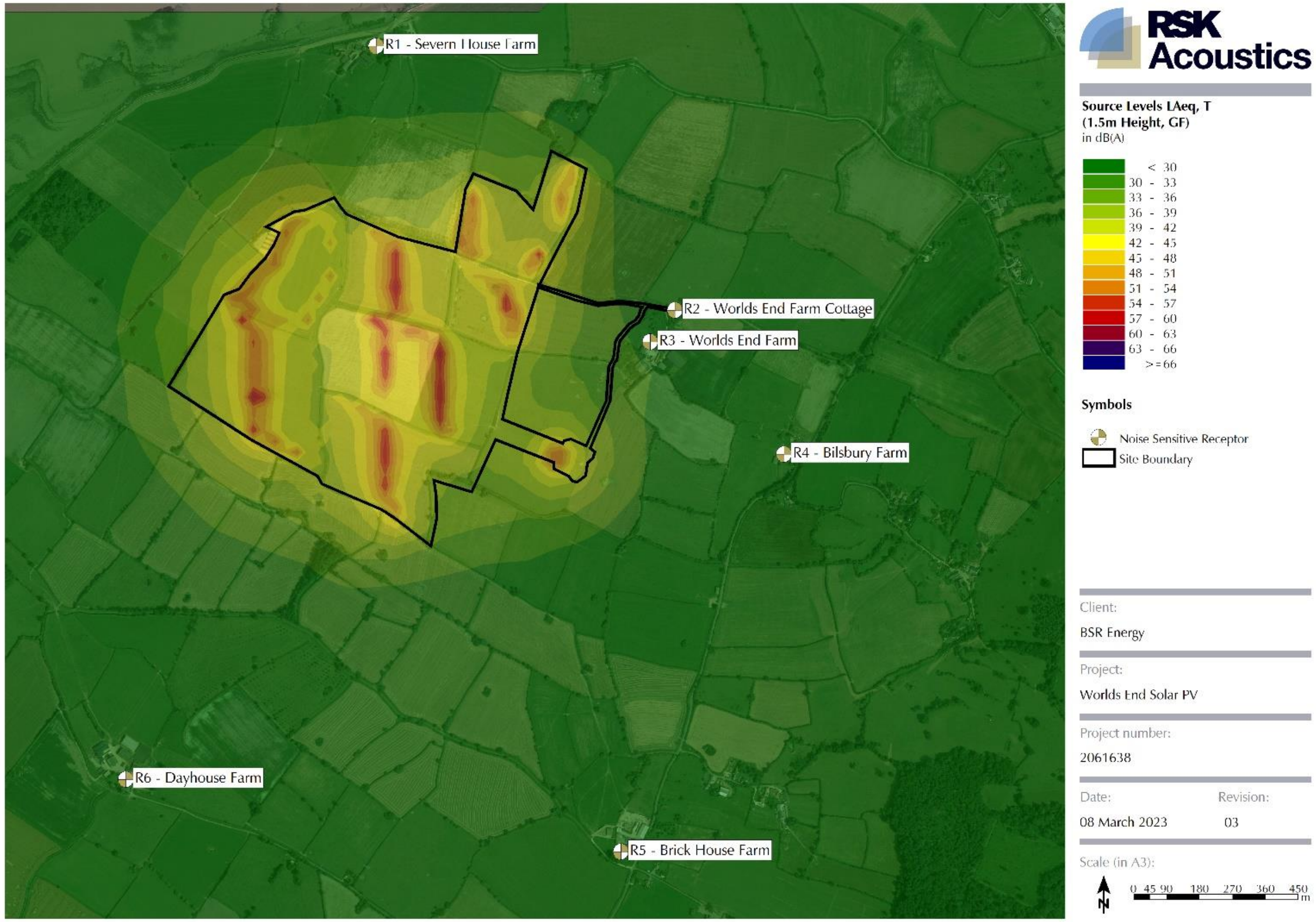
Specific sound level plus any adjustment for the characteristic features of the sound as per BS 4142:2014+A1:2019. Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level, for example: tonality, impulsivity, intermittency or other sound characteristics that are readily distinctive against the residual acoustic environment.

End of Section

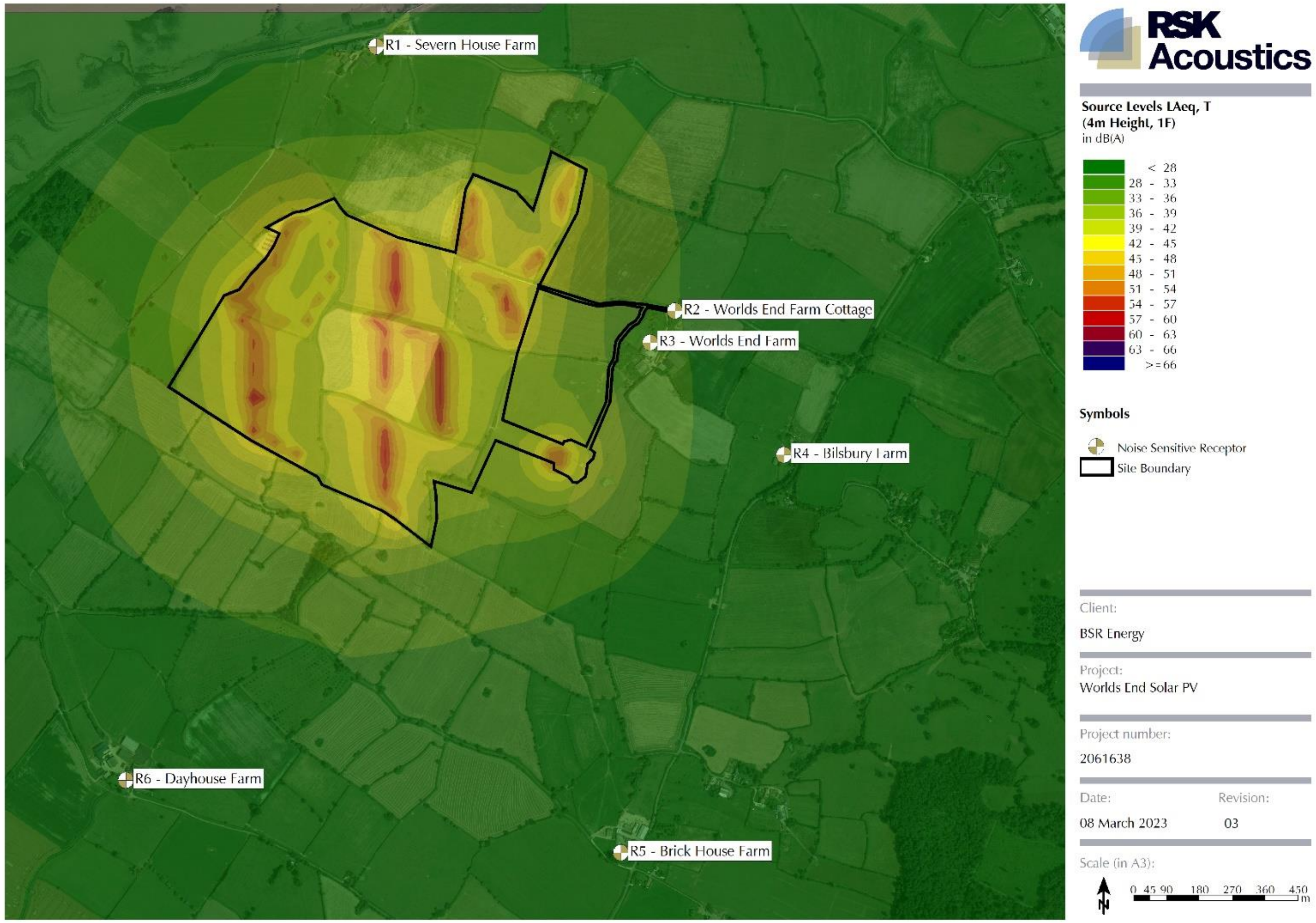
Appendix A: Proposed Site Layout



Appendix B: Operational Noise Contour Map (1.5 m Calculation Height)



Appendix B: Operational Noise Contour Map (4 m Calculation Height)



Appendix C: Measured Noise Levels and Background Noise Level Graphs

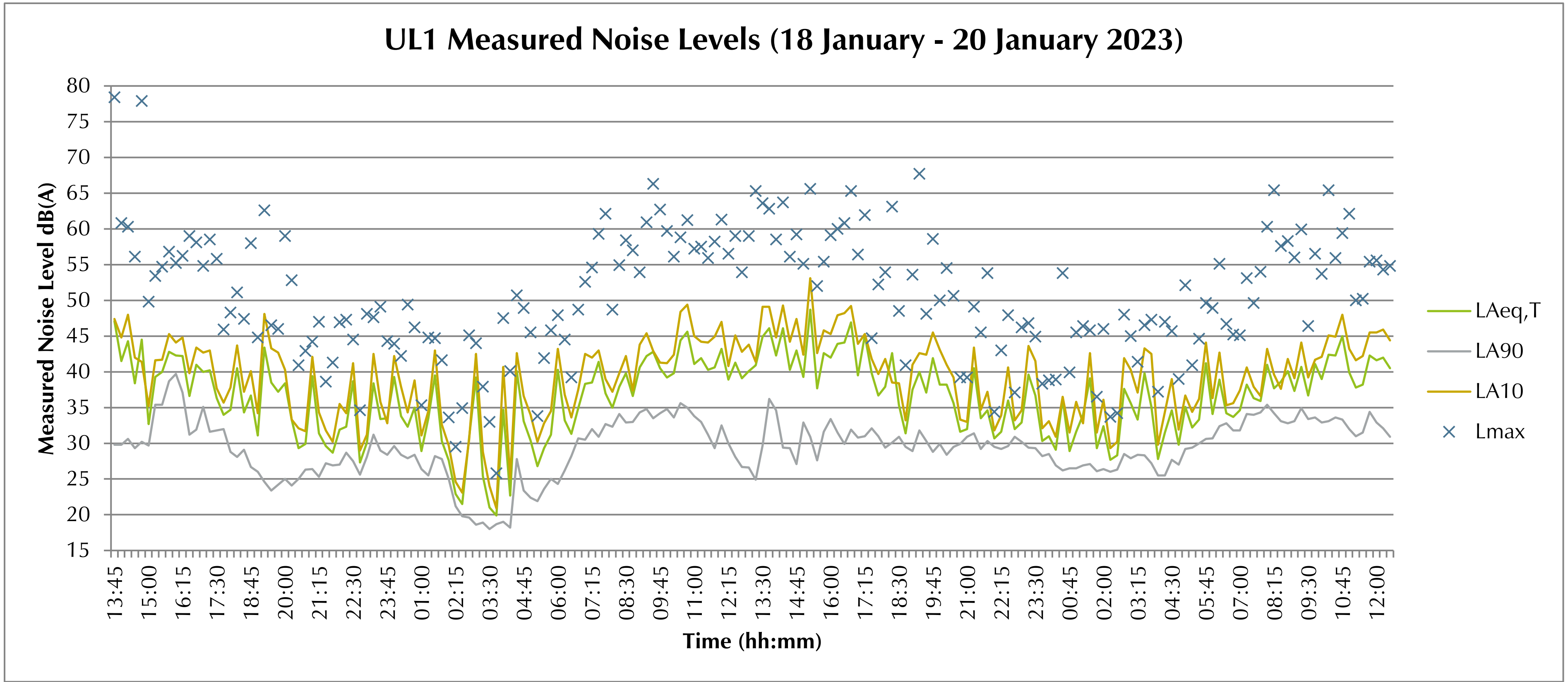


Figure C.1 – Graphical output, baseline data at UL1

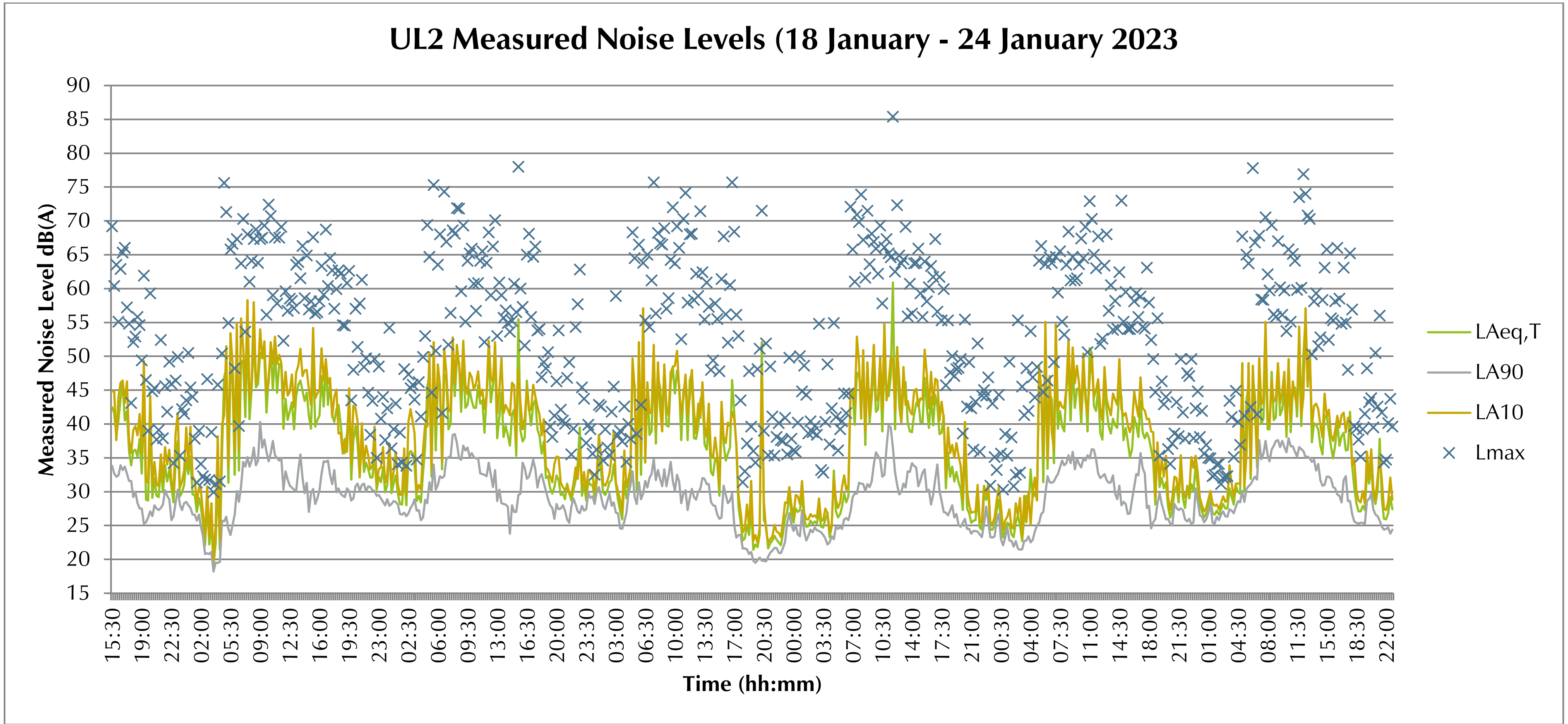


Figure C.2 – Graphical output, baseline data at UL2

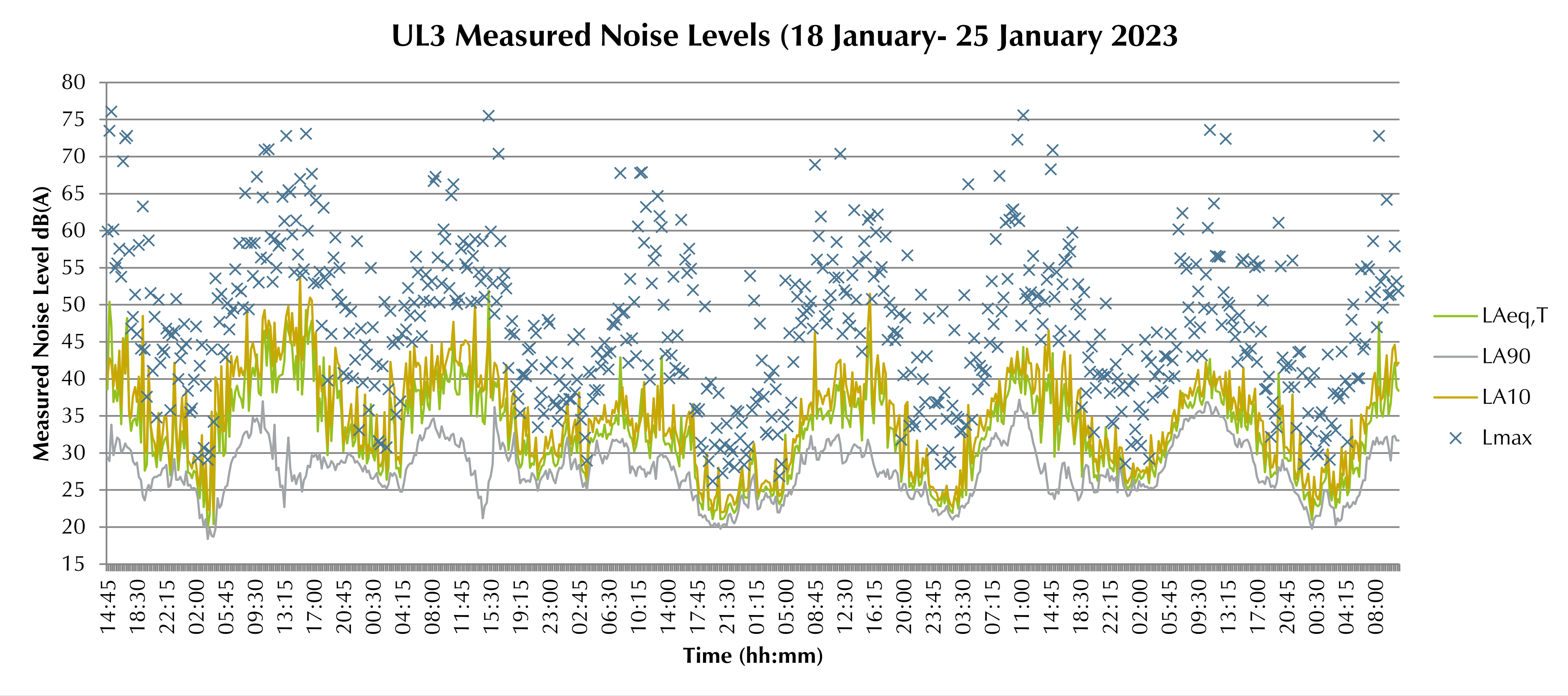


Figure C.3 – Graphical output, baseline data at UL3

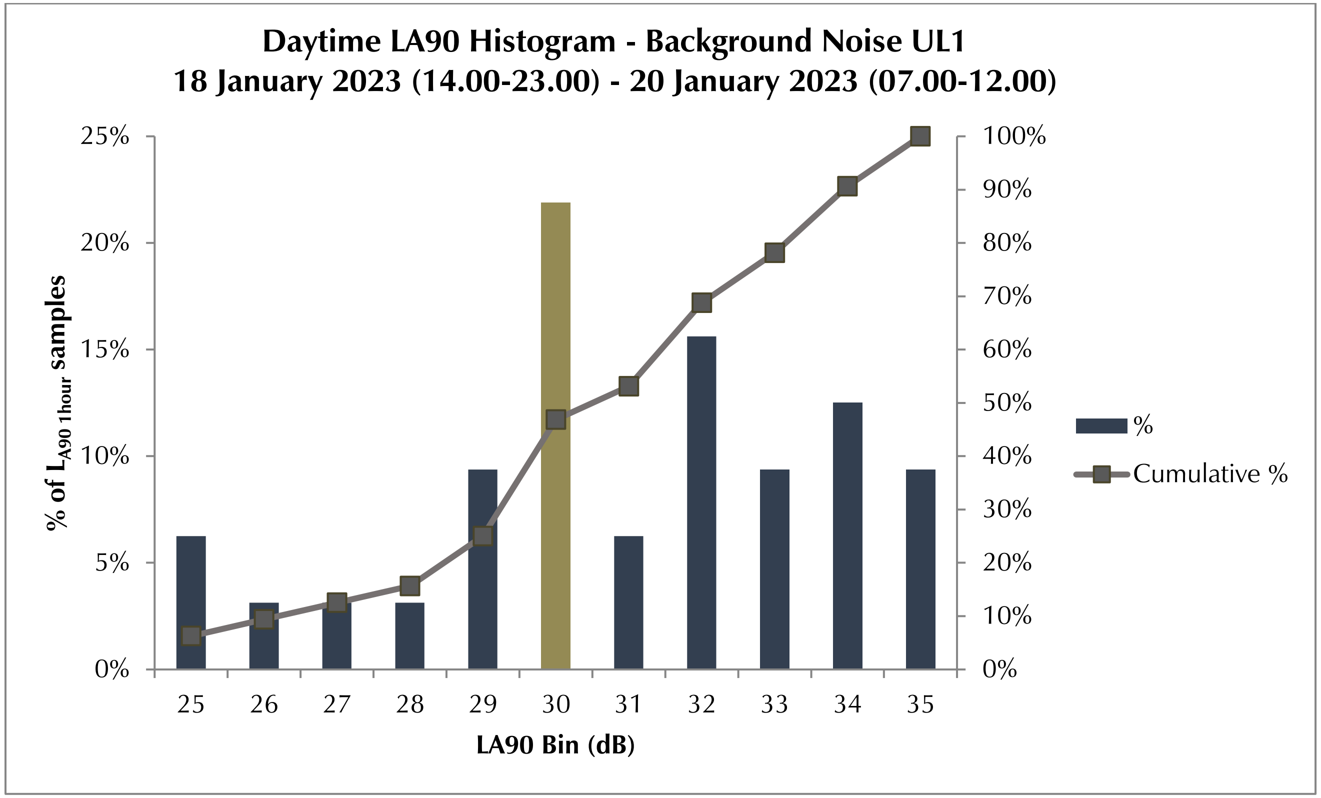


Figure C.4 – Statistical analysis of daytime background noise levels – UL1

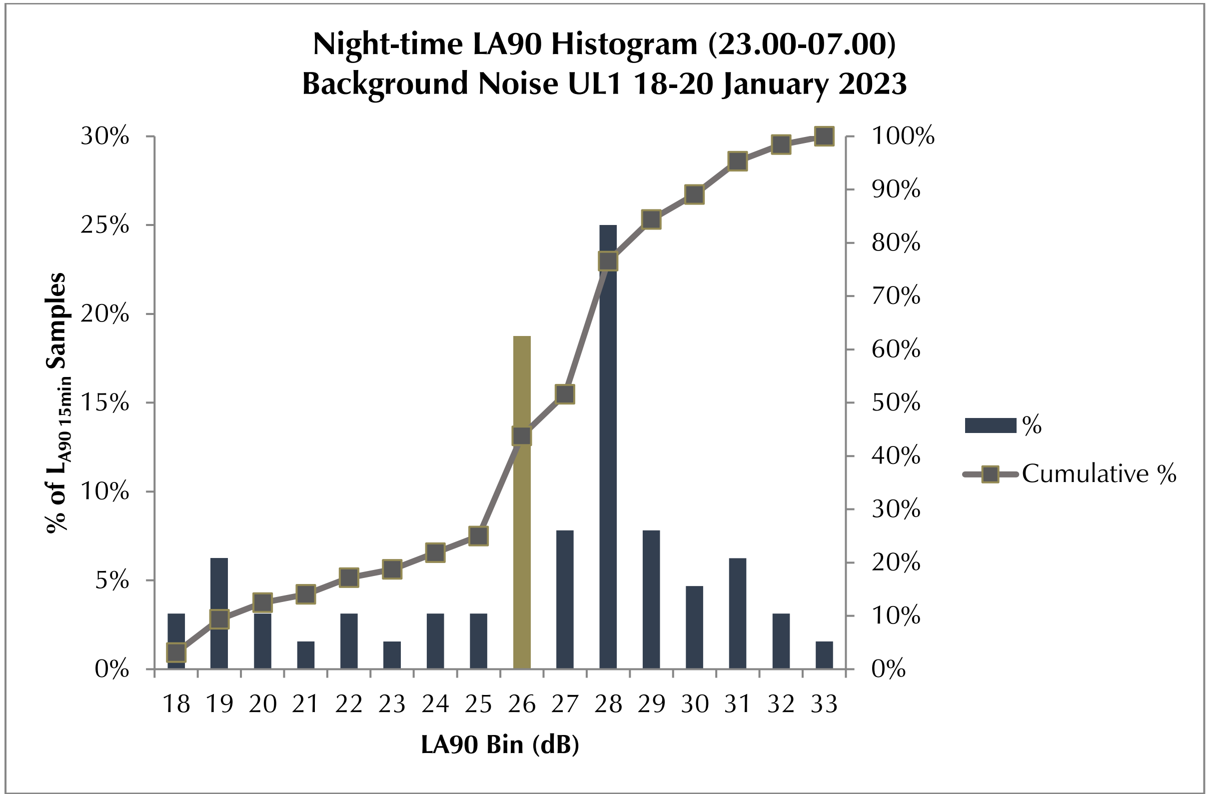


Figure C.5 – Statistical analysis of night-time background noise levels – UL1

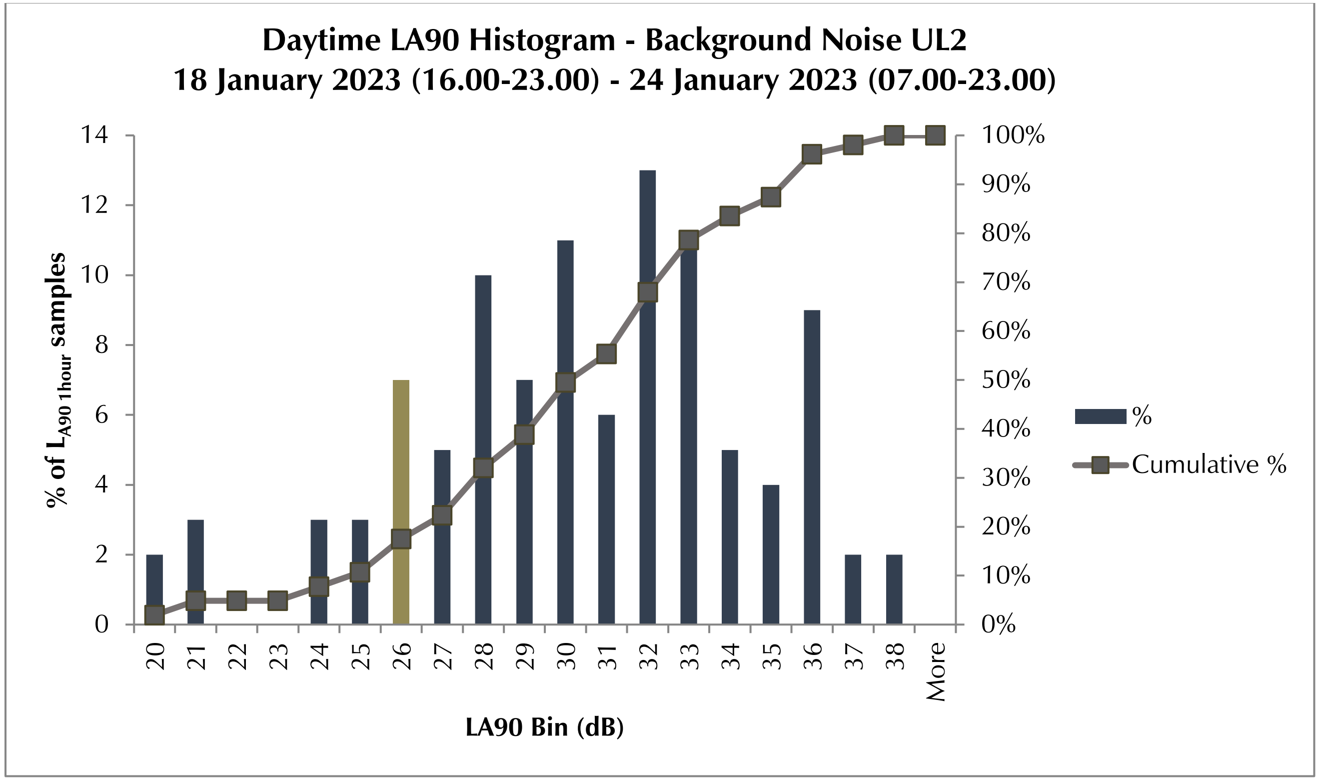


Figure C.6 – Statistical analysis of daytime background noise levels – UL2

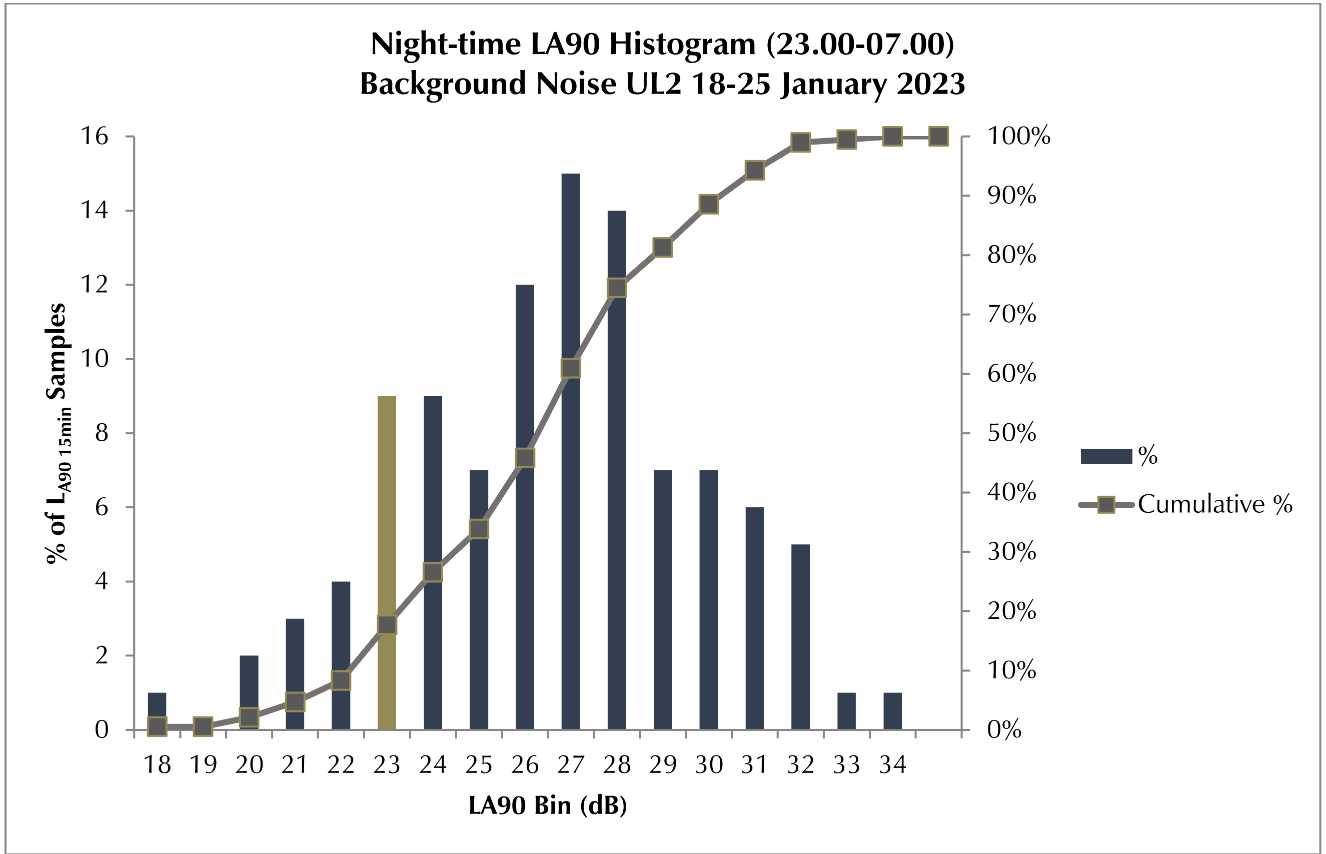


Figure C.7 – Statistical analysis of night-time background noise levels – UL2

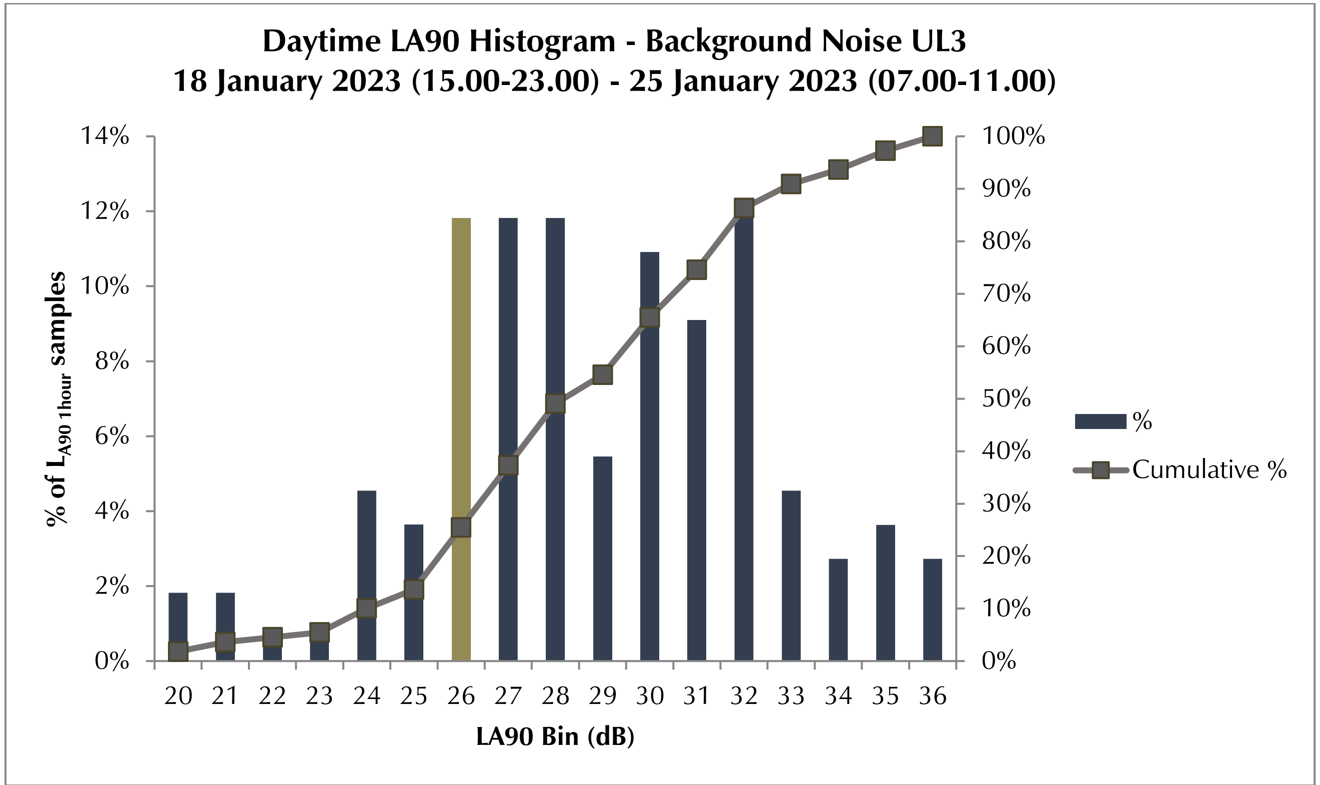


Figure C.8 – Statistical analysis of daytime background noise levels – UL3

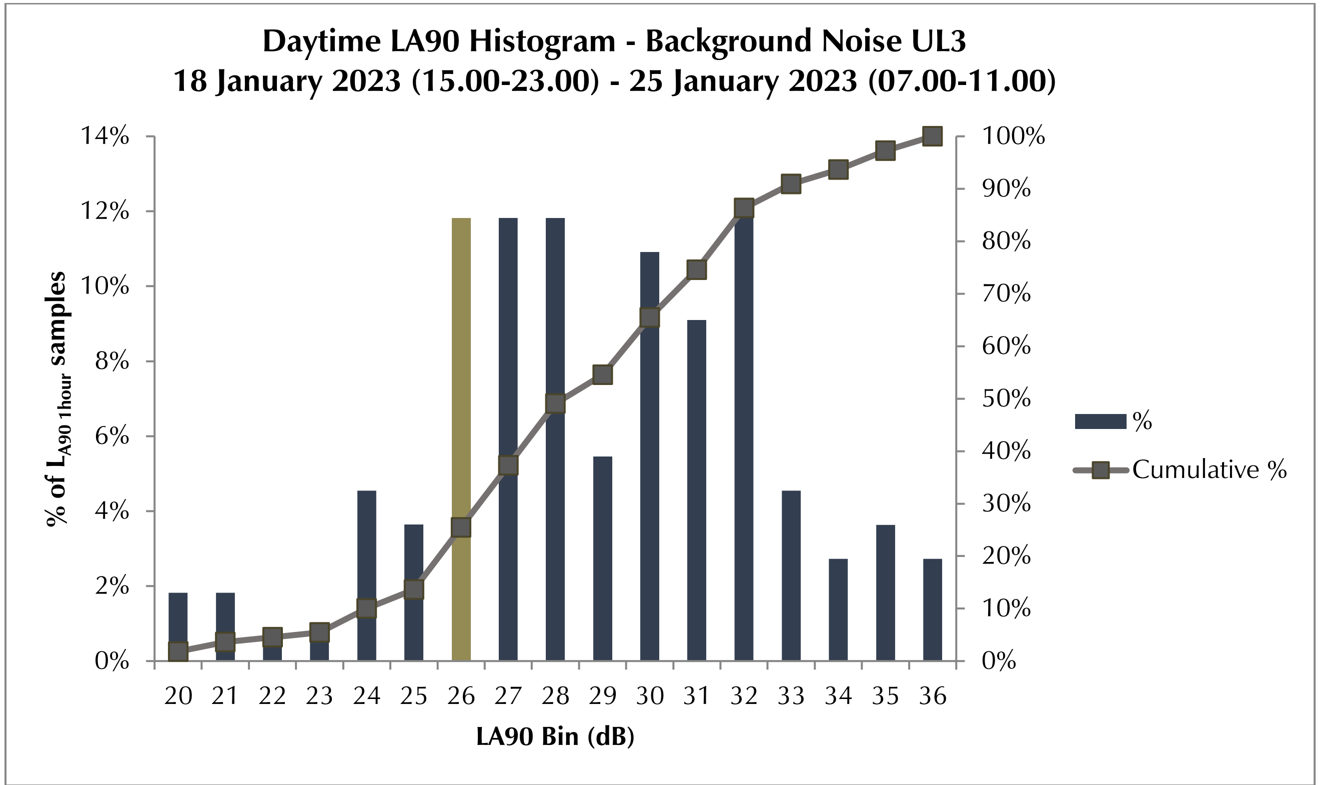


Figure C.9 – Statistical analysis of night-time background noise levels – UL3