

The Drovers Solar Farm

Appendix 10.2: Noise Survey

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6.4 ES Appendix 10.2 Noise Survey

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1. Glossary of Acoustics Terminology

| Terminology | Description |
|--|---|
| A-weighting | A filter that down-weights low frequency and high frequency sound to better represent the frequency response of the human ear when assessing the likely effects of noise on humans |
| Acoustic character | One or more distinctive features of a sound (e.g. Tones, whines, whistles, impulses) that set it apart from the background noise against which it is being judged, possibly leading to a greater subjective effect than the level of the sound alone might suggest |
| Acoustic screening | The presence of a solid barrier (natural landform or manmade) between a source of sound and a receiver that interrupts the direct line of sight between the two, thus reducing the sound level at the receiver compared to that in the absence of the barrier |
| Ambient noise | All-encompassing noise associated with a given environment, usually a composite of sounds from many sources both far and near, often with no particular sound being dominant |
| Annoyance | A feeling of displeasure in this case evoked by noise |
| Attenuation | The reduction in level of a sound between the source and a receiver due to any combination of effects including distance, atmospheric absorption, acoustic screening, the presence of a building façade, etc. |
| Audio frequency | Any frequency of a sound wave that lies within the frequency limits of audibility of a healthy human ear, generally accepted as being from 20 Hz To 20,000 Hz |
| Background noise | The noise level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night-time periods (for the majority of the population of the UK the lower limiting noise level is usually controlled by noise emanating from distant road, rail or air traffic) |
| dB | Abbreviation for ‘decibel’ |
| dB(A) | Abbreviation for the decibel level of a sound that has been a-weighted |
| Decibel | The unit normally employed to measure the magnitude of sound |
| Directivity | The property of a sound source that causes more sound to be radiated in one direction than another |
| Equivalent continuous sound pressure level | The steady sound level which has the same energy as a time varying sound signal when averaged over the same time interval, t, denoted by $L_{Aeq,t}$ |
| External noise level | The noise level, in decibels, measured outside a building |
| Filter | A device for separating components of an acoustic signal on the basis of their frequencies |
| Frequency | The number of acoustic pressure fluctuations per second occurring about the atmospheric mean pressure (also known as the ‘pitch’ of a sound) |
| Frequency analysis | The analysis of a sound into its frequency components |
| Ground effects | The modification of sound at a receiver location due to the interaction of the sound wave with the ground along its propagation path from source to receiver |

| Terminology | Description |
|---------------------------------|--|
| Hertz | The unit normally employed to measure the frequency of a sound, equal to cycles per second of acoustic pressure fluctuations about the atmospheric mean pressure |
| Impulsive sound | A sound having all its energy concentrated in a very short time period |
| Instantaneous sound pressure | At a given point in space and at a given instant in time, the difference between the instantaneous pressure and the mean atmospheric pressure |
| Internal noise level | The noise level, in decibels, measured inside a building |
| L_{Aeq} | The abbreviation of the a-weighted equivalent continuous sound pressure level |
| L_{A10} | The abbreviation of the 10 th percentile noise indicator, often used for the measurement of road traffic noise |
| L_{A90} | The abbreviation of the 90 th percentile noise indicator, often used for the measurement of background noise |
| Level | The general term used to describe a sound once it has been converted into decibels |
| Loudness | The attribute of human auditory response in which sound may be ordered on a subjective scale that typically extends from barely audible to painfully loud |
| Noise | Physically: a regular and ordered oscillation of air molecules that travels away from the source of vibration and creates fluctuating positive and negative acoustic pressure above and below atmospheric pressure. Subjectively: sound that evokes a feeling of displeasure in the environment in which it is heard, and is therefore unwelcomed by the receiver |
| Noise emission | The noise emitted by a source of sound |
| Noise immission | The noise to which a receiver is exposed |
| Noise nuisance | An unlawful interference with a person's use or enjoyment of land, or of some right over, or in connection with it |
| NSR | Abbreviation for 'noise sensitive receptor' |
| Octave band frequency analysis | A frequency analysis using a filter that is an octave wide (the upper limit of the filter's frequency band is exactly twice that of its lower frequency limit) |
| Percentile exceeded sound level | The noise level exceeded for n% of the time over a given time period, t, denoted by $L_{An,t}$ |
| Receiver | A person or property exposed to the noise being considered |
| Residual noise | The ambient noise that remains in the absence of the specific noise whose effects are being assessed |
| Sound | Physically: a regular and ordered oscillation of air molecules that travels away from the source of vibration and creates fluctuating positive and negative acoustic pressure above and below atmospheric pressure Subjectively: the sensation of hearing excited by the acoustic oscillations described above (see also 'noise') |
| Sound level meter | An instrument for measuring sound pressure level |
| Sound pressure amplitude | The root mean square of the amplitude of the acoustic pressure fluctuations in a sound wave around the atmospheric mean pressure, usually measured in pascals (Pa) |

| Terminology | Description |
|-------------------------|---|
| Sound pressure level | A measure of the sound pressure at a point, in decibels |
| Sound power level | The total sound power radiated by a source, in decibels |
| Spectrum | A description of the amplitude of a sound as a function of frequency |
| Standardised wind speed | Values of wind speed at hub height corrected to a standardised height of ten metres using the same procedure as used in wind turbine emission testing |
| Threshold of hearing | The lowest amplitude sound capable of evoking the sensation of hearing in the average healthy human ear (0.00002 Pa) |
| Tone | The concentration of acoustic energy into a very narrow frequency range |

2. BS 4142 Background Noise survey

2.1 Identified noise-sensitive receptors

A selection of the nearest noise sensitive receptor (NSR) locations, which was determined as representative of dwellings around the Site (rather than an exhaustive list of all dwellings), is shown in **Figure 10.2.1** below.



Figure 10.2.1 – Measurement locations and representative NSRs and assessment locations near the site redline boundary (Google Satellite Image).

A detailed list of representative receptors and their minimum separation distance from the Project boundary is set out in **Table 10.2.1**.

Table 10.2.1 - Representative noise sensitive assessment locations identified and min distance to development boundary

| Receptor Name | Easting | Northing | Minimum distance to Development Boundary (m) |
|-----------------------------|---------|----------|--|
| The Splashes Traveller Site | 581960 | 310288 | 13 |
| Glebe Cottages | 581171 | 314108 | 35 |
| Finger Hill Cabin | 580218 | 313765 | 45 |
| Keepers Cottage | 579578 | 312937 | 50 |
| South Acre Hall | 580792 | 314285 | 88 |

| Receptor Name | Easting | Northing | Minimum distance to Development Boundary (m) |
|-----------------------------|---------|----------|--|
| The Off Barn, South Acre Rd | 582585 | 312356 | 429 |
| Hall Farm, Narford | 577327 | 312772 | 466 |
| 12 West Acre Road | 577370 | 312881 | 500 |
| Silver Drift | 579019 | 310403 | 1215 |

Given the distance of more than 1 km from Site boundary to Silver Drift, this receptor has been removed from further assessment.

2.2 Noise Monitoring Locations

A survey has been completed to define background noise levels for the purposes of an assessment in accordance with BS 4142. The acoustic survey included two long-term unattended measurements and four short-term attended measurements at locations representative of the nearest potential noise sensitive residential receptors.

The unattended survey measurements were undertaken from 21 November 2024 to 4 December 2024, under free-field conditions. The attended survey measurements were undertaken during the daytime on 4 December 2024 to supplement the longer-term data acquired.

The long-term logger equipment was installed at locations representative of Keepers Cottage (LT-1) and South Acre Hall (LT-2). A rain gauge was installed on site with the long-term logger at LT-1, measuring rainfall every 15-minute period for the duration of the measurement survey. Detailed information on the long-term measurement locations, equipment, and noise perimeters is presented in **Table 10.2.2** and **Table 10.2.3**.

Table 10.2.2 - Information on the measurement location, equipment and noise data at the long-term logger position LT-1.

| | | | |
|----------------------------------|--|---------------|------------------------|
| Measurement Location Name | LT-1, Keepers Cottage | | |
| Measurement Location Description | <p>The logger was placed to the south-west, slightly away from Keepers Cottage to the south of the large storage shed and close to the edge of the field. This was due to the property having renovations being carried out with moving plant present at site during installation and so was located further away to avoid activity noise. The logger location was considered to be representative of the receptor.</p> <p>The local noise climate was observed to be typical of a rural location, with distant road noise being audible. During setup jets engines could be heard in the distance (RAF Marham is 4 miles to south-west) and during collection distant agricultural vehicle movement was audible at times. Natural sources included occasional low-level birdsong.</p> <p>The climate was cold and dry on both visits.</p> <p>SLM Location: Lat, Long: 52.68363, 0.65387</p> | | |
| Equipment | Type | Serial Number | Last Calibrated (UKAS) |
| Sound Level Meter | Rion NL-52 | 00331821 | 10/05/2023 |
| Pre-amplifier | Rion NH-25 | 21772 | 10/05/2023 |

| Equipment | Type | Serial Number | Last Calibrated (UKAS) | | |
|---|--|---------------|------------------------|-------|----------------------|
| Microphone | Rion UC-59 | 18642 | 10/05/2023 | | |
| Calibrator (install) | Rion NC-74 | 34172705 | 24/06/2024 | | |
| Rain Gauge | Campbell Scientific CR200 Datalogger | 10465 | n/a | | |
| | Davis Instruments 0.2 mm Tipping Bucket Rain Gauge: 7852 | HLA 07 | n/a | | |
| Date / Time Set-up (GMT) | Date / Time Collection (GMT) | Cal Start | Cal End | Drift | Notes |
| 21/11/2024, 16:45 | 04/12/2024, 14:27 | 94.0 | 94.1 | 0.1 | No significant drift |
| Data Exclusions | | | | | |
| A rain gauge was installed on site alongside the logger at LT-1 to gather rain data, which showed several periods of prolonged rainfall during the survey period. For periods of rain, the corresponding data has been removed from the analysis. | | | | | |

Table 10.2.3 - Information on the measurement location, equipment and noise data at the long-term logger position LT-2.

| | | | | |
|----------------------------------|---|---------------|------------------------|--|
| Measurement Location Name | LT-2, South Acre Hall Farm | | | |
| Measurement Location Description | <p>The logger was placed in an adjacent field to the east of South Acre Hall Farm and to the west of Glebe Cottages. This was to be setback from South Acre Hall Farm which is a working farm with large agricultural plant and vehicles. The logger location was considered to be representative of the aforementioned receptors.</p> <p>The local noise climate was observed to be typical of a rural agricultural location. During setup jets could be heard passing overhead (before starting meter). Agricultural vehicle noise was audible from tractors moving around Hall Farm in distance, also audible was engine noise. Cars on local road to north (single lane) passed infrequently. Natural sources included low-level bird song in distance. Otherwise, was quiet. On collection, distant road noise was heard from the A1065 to east, as well as distant agricultural vehicle noise and low-level birdsong.</p> <p>The climate was cold and dry on both visits, with some frost on the soft ground.</p> <p>SLM Location: Lat, Long: 52.69480, 0.67796</p> | | | |
| Equipment | Type | Serial Number | Last Calibrated (UKAS) | |
| Sound Level Meter | Rion NL-52 | 00331819 | 22/02/2024 | |
| Pre-amplifier | Rion NH-25 | 21770 | 22/02/2024 | |
| Microphone | Rion UC-59 | 10813 | 22/02/2024 | |
| Calibrator (install) | Rion NC-74 | 34172705 | 24/06/2024 | |

| Date / Time Set-up (GMT) | Date / Time Collection (GMT) | Cal Start | Cal End | Drift | Notes |
|---|------------------------------|-----------|---------|-------|----------|
| 21/11/2024, 15:45 | 04/12/2024, 15:07 | 94.0 | 94.0 | 0.0 | No drift |
| Data Exclusions | | | | | |
| The corresponding data to periods of rainfall measured at the LT-1 rain gauge has been removed from the analysis. | | | | | |



Figure 10.2.2 - View of the unattended logger monitoring location at LT-1 Keepers Cottage looking north.



Figure 10.2.3 - View of the unattended logger monitoring location at LT-1 Keepers Cottage looking east.



Figure 10.2.4 - View of the unattended logger monitoring location at LT-1 Keepers Cottage looking south.



Figure 10.2.5 - View of the unattended logger monitoring location at LT-1 Keepers Cottage looking west.



Figure 10.2.6 - View of the unattended logger monitoring location at LT-2 South Acre Hall Farm / Glebe Cottages looking north.



Figure 10.2.7 - View of the unattended logger monitoring location at LT-2 South Acre Hall Farm / Glebe Cottages looking east.



Figure 10.2.8 - View of the unattended logger monitoring location at LT-2 South Acre Hall Farm / Glebe Cottages looking south.



Figure 10.2.9 - View of the unattended logger monitoring location at LT-2 South Acre Hall Farm / Glebe Cottages looking west.

3. BS 4142 Background Noise Survey Results

Figure 10.2.10 - Time history plot of the long-term dB(A) levels (A-weighted) measured at LT-1 Keepers Cottage. Periods of adverse weather have been omitted.

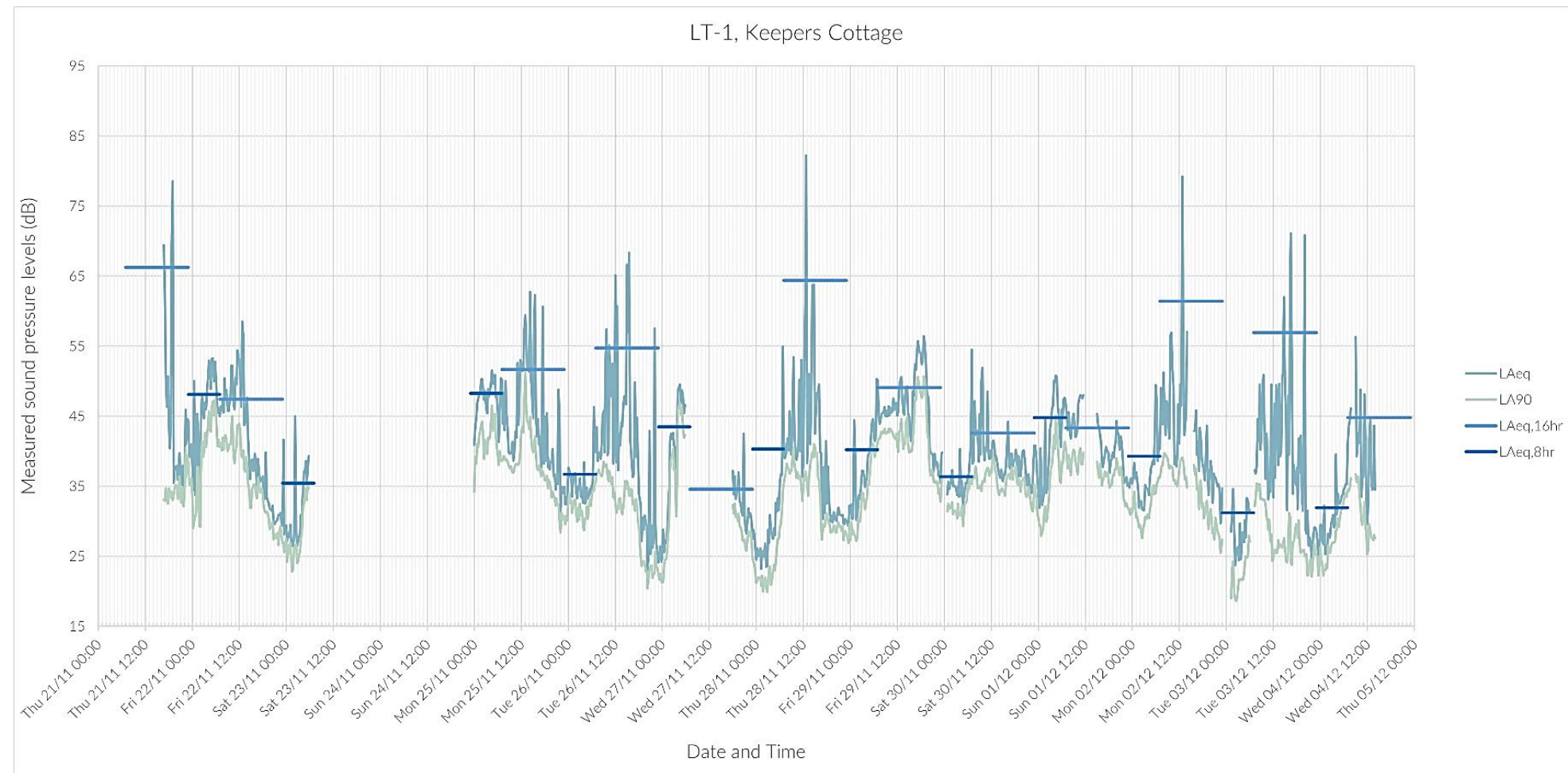
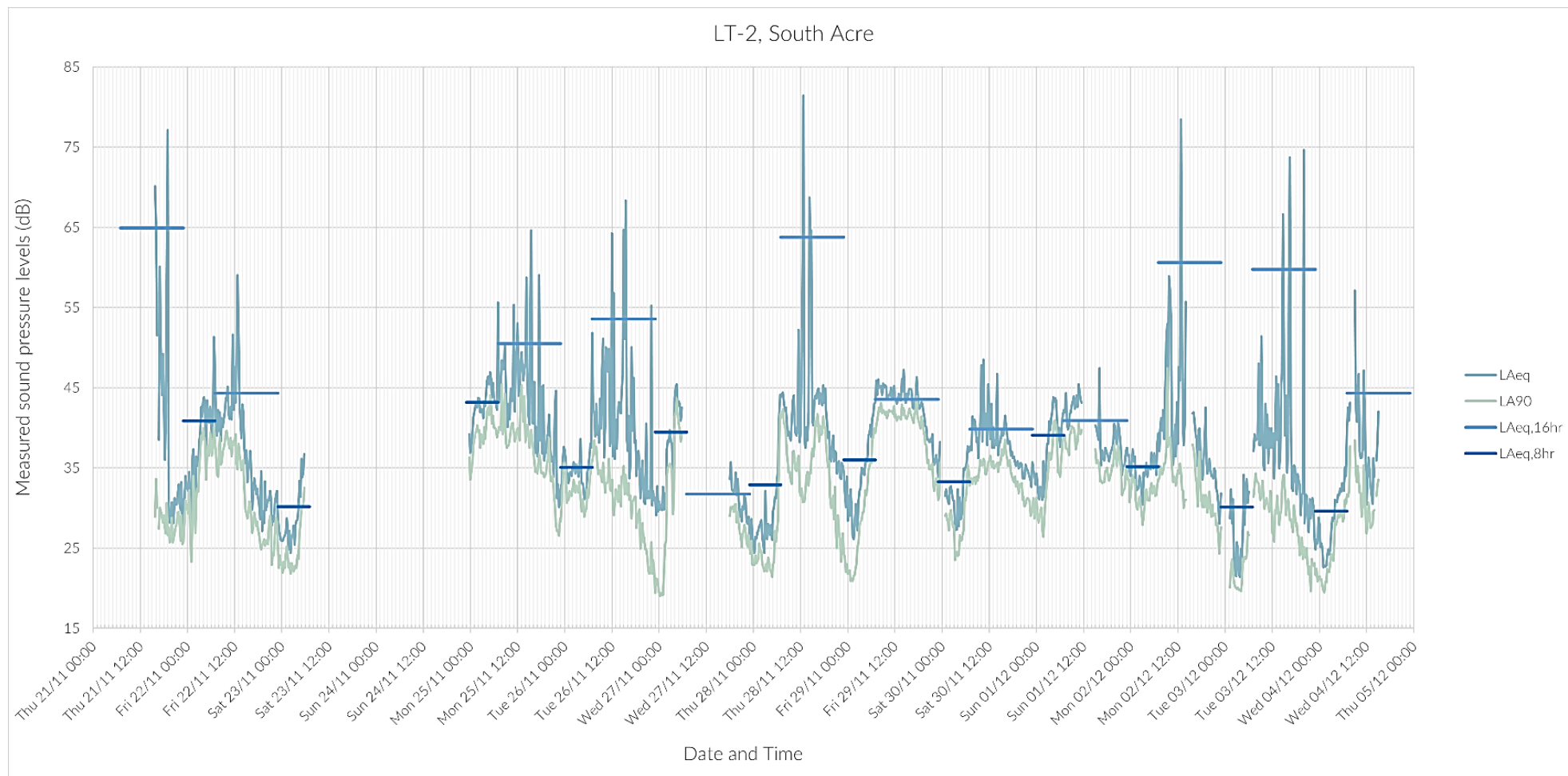


Figure 10.2.11 - Time history plot of the long-term dB(A) levels (A-weighted) measured at LT-2 South Acre. Periods of adverse weather have been omitted.



3.1 Background Sound Levels

In line with the requirements of BS 4142, to “quantify what is typical during particular time periods”, a statistical analysis of the measured background sound levels has been undertaken. The periods of interest have been taken as daytime (07:00 to 23:00) and night-time (23:00 to 07:00). Periodic measurement indices of a duration of 15-minutes are used for both daytime and night-time periods. A single $L_{A90,1h}$ measurement would always be higher than the lowest of the four 15-minute duration background sound levels it comprises. Therefore, use of 15-minute periods represents a precautionary approach.

The standard does not give a definitive method for determining the background sound level but instead, as a commentary, states that “the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods”.

Clause 8.1.4 of the standard, which discusses the monitoring duration, states “there is no ‘single’ background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed”. As a note to this clause the following commentary is given on obtaining a representative background sound level:

“To obtain a representative background sound level a series of either sequential or disaggregated measurements ought to be carried out for the period(s) of interest, possibly on more than one occasion. A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value”.

Figure 10.2.12 to Figure 10.2.17 presents the statistical data as percentage of measure background level ($L_{A90,15min}$) for day and night-time at Keepers Cottage and South Acre locations.

Figure 10.2.12 - Statistical analysis of daytime and night-time background noise levels measured at LT-1 Keepers Cottage.

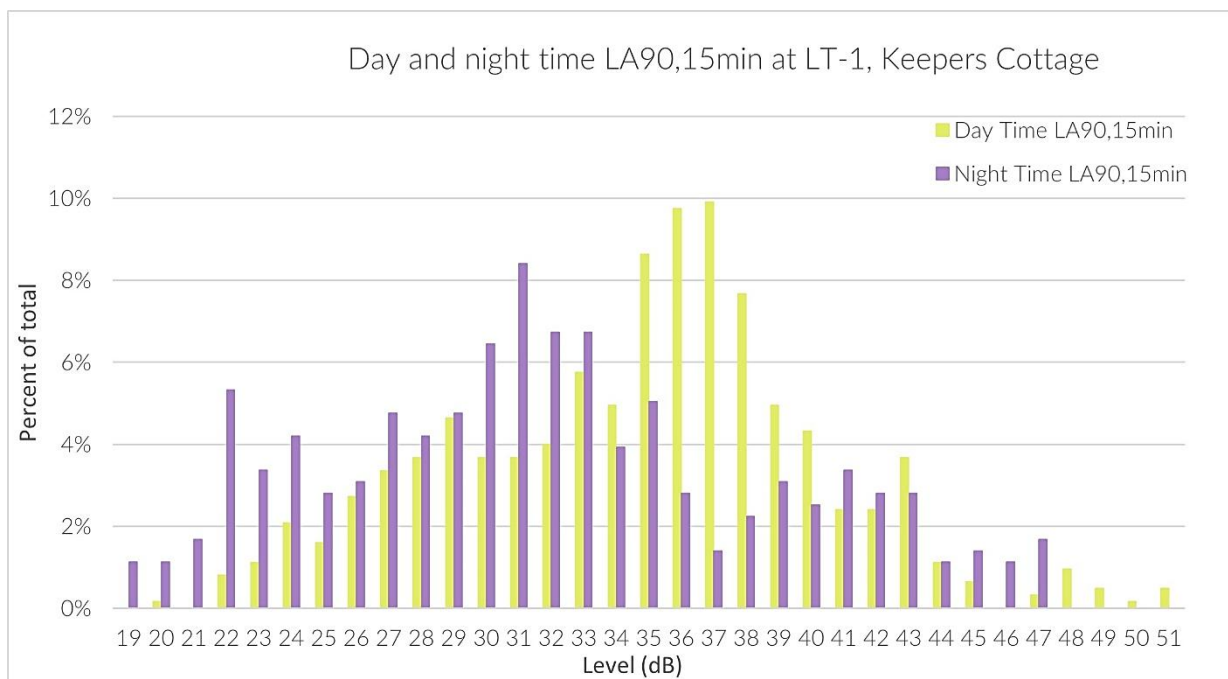


Figure 10.2.13 - Statistical analysis of daytime background noise levels measured at LT-1 Keepers Cottage, showing the frequency distribution and cumulative frequency distribution of the data

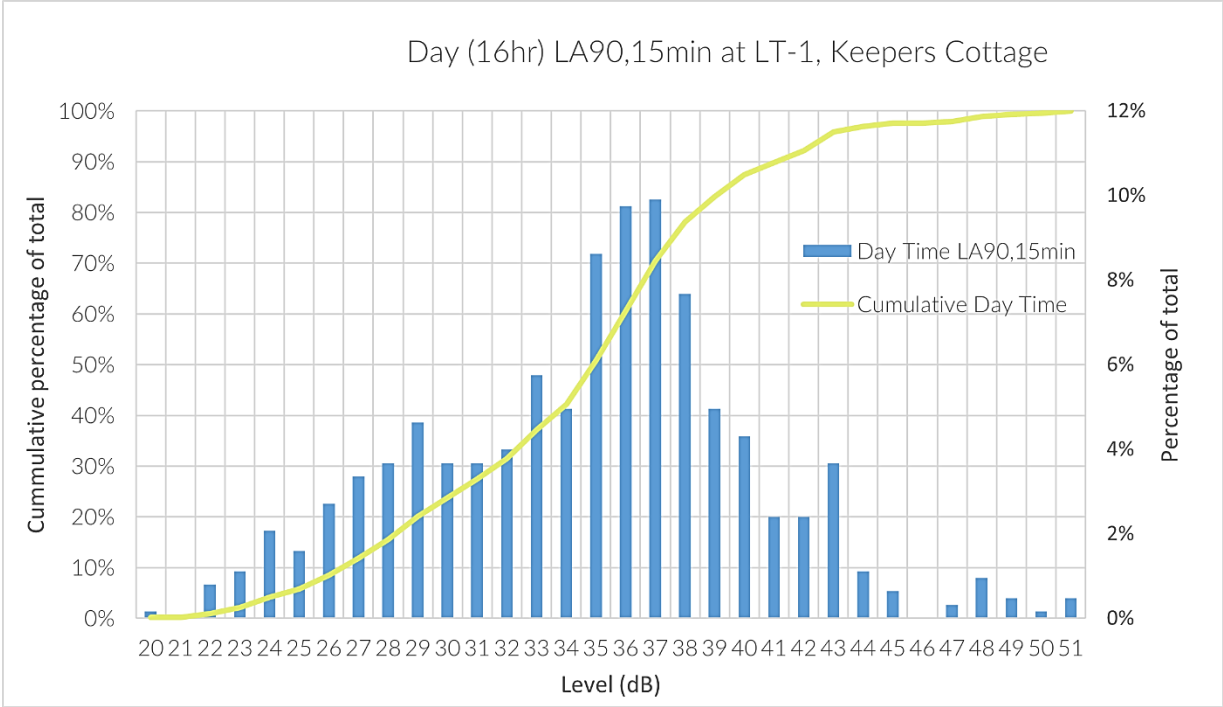


Figure 10.2.14 - Statistical analysis of measured night-time background noise levels at LT-1 Keepers Cottage showing the frequency distribution and cumulative frequency distribution of the data.

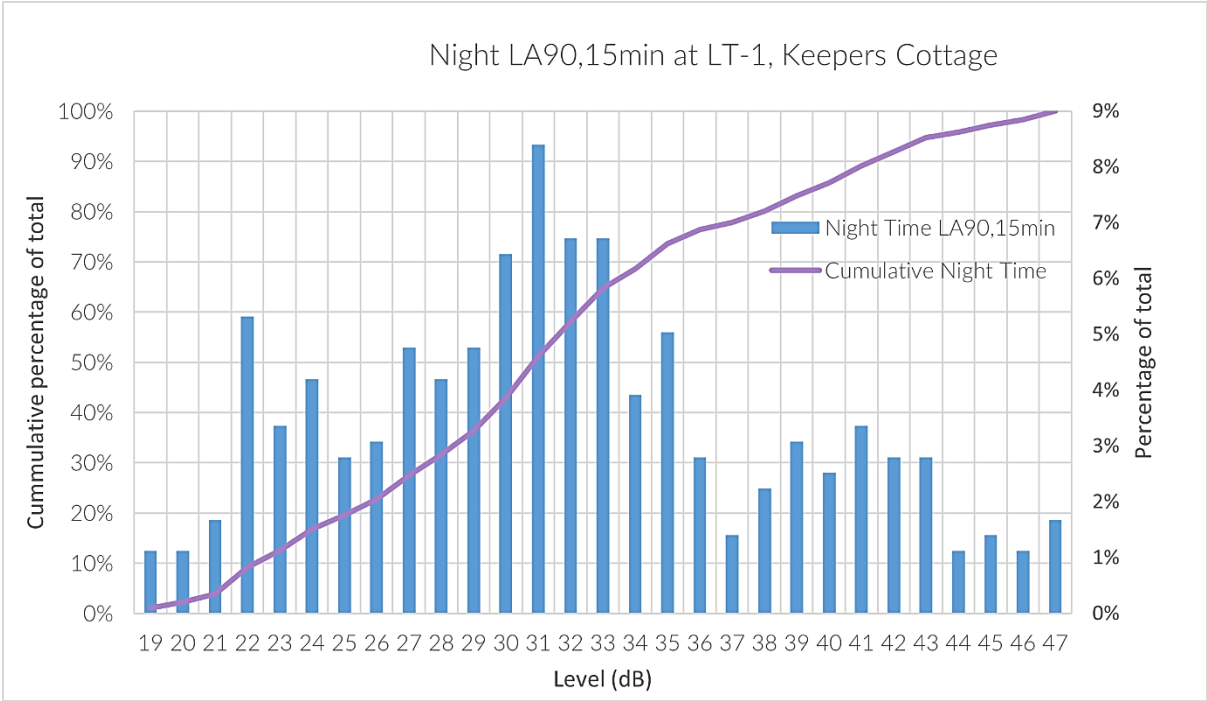


Figure 10.2.15 - Statistical analysis of daytime and night-time background noise levels measured at LT-2 South Acre.

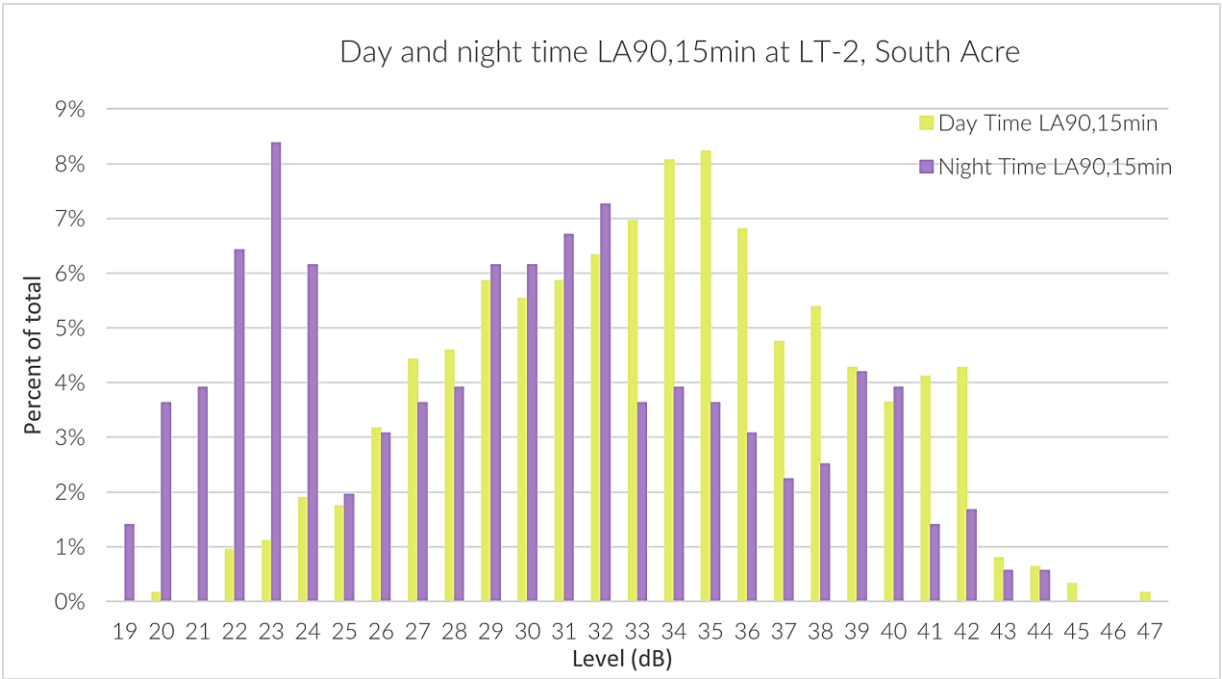


Figure 10.2.16 - Statistical analysis of daytime background noise levels measured at LT-2 South Acre, showing the frequency distribution and cumulative frequency distribution of the data

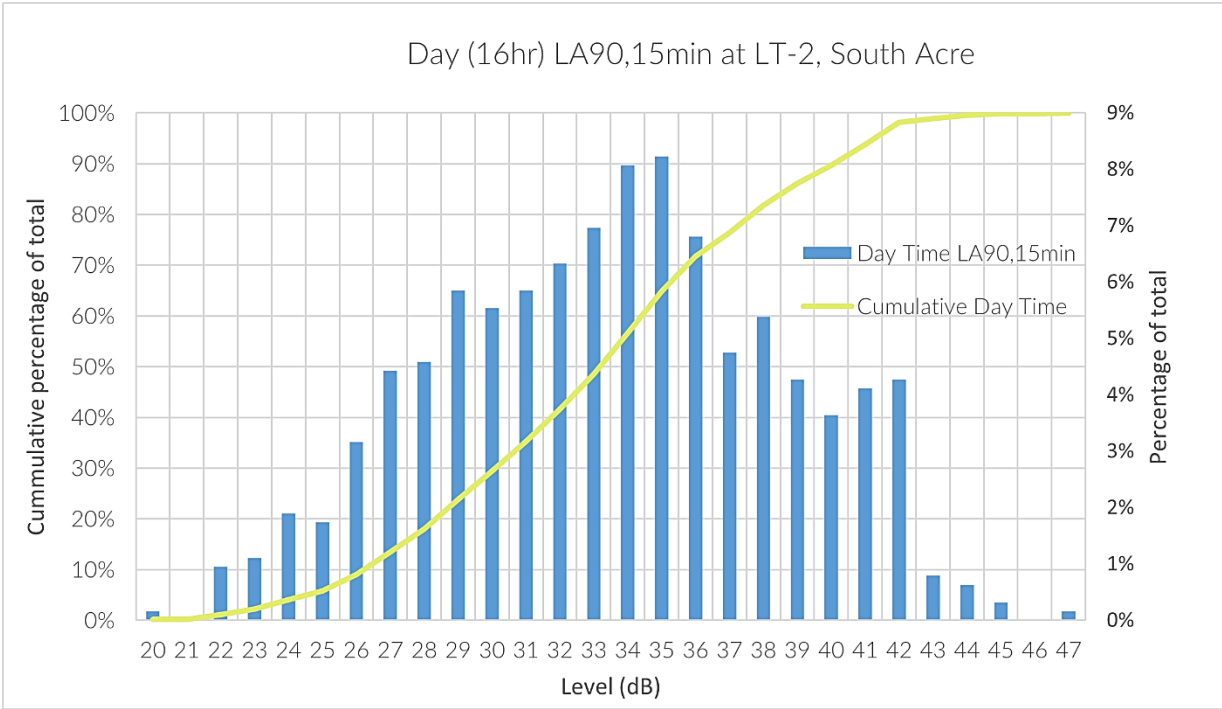
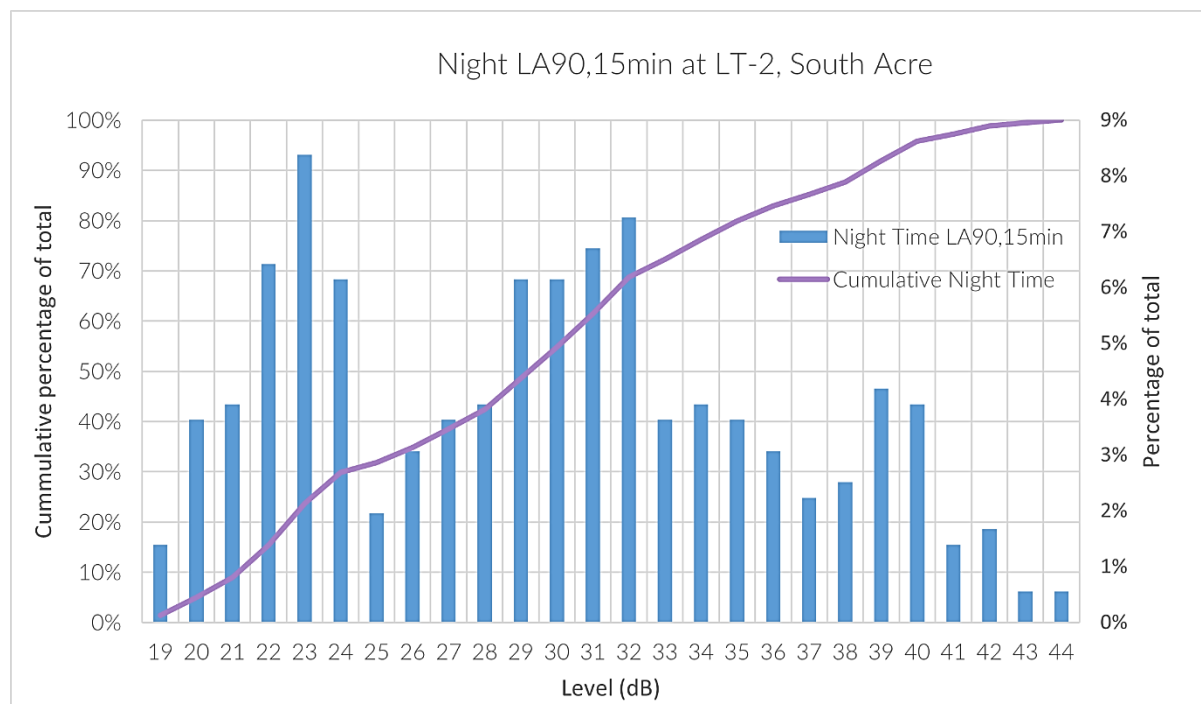


Figure 10.2.17 - Statistical analysis of measured night-time background noise levels at LT-2 South Acre showing the frequency distribution and cumulative frequency distribution of the data.



The distributions of the measured noise levels are set out in the figure above for A-weighted $L_{90,15\text{min}}$ values. Using the above statistical analysis charts which also shows the cumulative occurrence distribution of the data, together with the time history charts, and considering the context of the site, representative background sound levels have been determined to represent each of the periods of interest. Results of this analysis are set out below, based on professional judgement.

Table 10.2.4 - Representative L_{A90} background noise levels.

| Monitoring Location | Representative $L_{A90, 15\text{min}}$ background noise levels (dB) | |
|----------------------|---|-------|
| | Day | Night |
| LT-1 Keepers Cottage | 32 | 28 |
| LT-2 South Acre | 30 | 24 |

3.2 Ambient Sound Levels

The range of ambient sound levels (measured using the $L_{Aeq,15\text{min}}$ noise index) captured over each daytime, evening and night-time measurement period have also been included below for context. The evening period has been included for reference and is typically quieter than the daytime period. The values presented in **Figure 10.2.10** and **Figure 10.2.11** suggest that ambient noise levels are routinely higher than the adopted background noise levels presented in **Table 10.2.4** by large margins, which provides context for the assessment of the potential contribution to ambient noise levels from the specific noise sources on the Scheme.

Table 10.2.5 - Range of measured L_{Aeq} noise levels (A-weighted).

| Monitoring Location | Range of $L_{Aeq, T}$ noise levels (dB) for each measurement period (T) | | |
|----------------------|---|---------|---------|
| | Day | Evening | Night |
| LT-1 Keepers Cottage | 35 – 66 | 31 – 66 | 31 – 48 |

| Monitoring Location | Range of $L_{Aeq, T}$ noise levels (dB) for each measurement period (T) | | |
|---------------------|---|---------|---------|
| | Day | Evening | Night |
| LT-2 South Acre | 34 - 65 | 30 - 65 | 30 - 43 |

3.3 Short-term Attended Measurements

Short-term (ST) attended noise measurements were carried out at four further locations representative of the other nearest noise sensitive residential receptors neighbouring the site (ST1 – ST4). Two 15-minute periods were captured per location during day-time hours on 4 December 2024 during the same time as the long-term unattended measurements for comparison. Monitoring results are set out in **Table 10.2.6**. A comparison of these measurements to the long-term levels suggests that the Off Barn property at West Acre Road, located east of the Site, experiences slightly higher background noise levels compared to the long-term monitoring locations, and that the Splashes properties will experience relatively elevated levels of background noise due to the influence of the A47.

Table 10.2.6 - Short-term attended survey results.

| Attended Measurement position ID | Measurement periods start time | Measured $L_{Aeq, 15min}$ (dB) | Measured $L_{A90, 15min}$ (dB) |
|--|--------------------------------|--------------------------------|--------------------------------|
| ST1 – Finger Hill Cabin (North of site) | 04/12/2024 13:30 | 31 | 27 |
| | 04/12/2024 13:45 | 32 | 27 |
| ST2 – West Acre Road, Narford (West of site) | 04/12/2024 10:45 | 50 | 34 |
| | 04/12/2024 11:00 | 46 | 34 |
| ST3 – The Off Barn (East of site) | 04/12/2024 12:30 | 52 | 39 |
| | 04/12/2024 12:45 | 44 | 37 |
| ST4 – West Acre Rd, near A47 (South of site) | 04/12/2024 11:30 | 59 | 54 |
| | 04/12/2024 11:45 | 58 | 53 |

3.4 Representative Assessed Receptors

Representative background levels for daytime and night-time have been determined for each assessed receptor, shown in **Table 10.2.7**. The representative background levels are based on the derived background levels shown in **Table 10.2.4** from long-term measurements, and the short-term measured data and respective context of each receptor have been compared to determine most representative background level from **Table 10.2.4** long-term background levels.

Table 10.2.7 – Representative Background Levels for Assessed Receptors

| Receptor | Representative Background Level, dB LA90 | | Measurement Reference |
|-----------------------------|---|-------|-----------------------|
| | Day | Night | |
| The Splashes Traveller Site | 53 | 28 | ST4 / LT-1 |
| Keepers Cottage | 32 | 28 | LT-1 |
| Finger Hill Cabin | 30 | 24 | LT-2 / ST1 |
| Glebe Cottages | 30 | 24 | LT-2 / ST1 |
| South Acre Hall | 30 | 24 | LT-2 |
| The Off Barn, South Acre Rd | 32 | 28 | LT-2 / ST3 |
| West Acre Road / Hall Farm | 32 | 28 | LT-2 / ST2 |



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