APPENDIX 12-3

BESS OPERATIONAL NOISE REPORT

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Technical Appendix 12-3

Battery Energy Storage System (BESS) Noise Report

Seskin Wind Farm, Co. Carlow

EDF Renewables Ireland

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COMMERCIAL IN CONFIDENCE

EDF renewables

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Contents

TABLES

APPENDICES

1 Introduction

TNEI was commissioned by MKO on behalf of EDF Renewables Ireland Ltd to undertake a Noise Impact Assessment (NIA) for the operation of a Battery Energy Storage System (BESS) and associated plant, which forms part of the Proposed Seskin Wind Farm (hereinafter referred to as 'the Proposed Project').

The method of assessment of operational noise for a BESS is very different from that used for the assessment of operational wind turbine noise and the two assessment types cannot be combined. Accordingly, the assessment of operational noise attributable to the BESS is presented here in this report, and the operational wind farm noise assessment is provided in a separate report, Appendix 12-2.

The BESS is to be located within an area east of The Butts, at approximate ITM grid coordinates 663789, 669366. The land surrounding the proposed BESS is rural in nature, predominantly consisting of forested areas. A small number of residential properties are located within the area, the nearest of which is approximately 950m to the west and east.

The aims of this NIA are to:

- Identify the potential noise sensitive receptors in the vicinity of the proposed BESS;
- Identify the primary sound sources associated with the operation of the BESS;
- Calculate the likely levels of operational noise at the identified receptors to determine the noise impacts associated with the operation of plant within the BESS; and
- Indicate any requirements for mitigation measures, if required, to provide sufficient levels of protection for all noise sensitive receptors.

1.1 Nomenclature

Please note the following terms and definitions, which are used throughout this report:

- **Emission** refers to the noise level emitted from a noise source, expressed as either a sound power level or a sound pressure level;
- **Immission** refers to the sound pressure level received at a specific location from a noise source;
- **SWL** indicates the sound power level in decibels (dB);
- **SPL** indicates the sound pressure level in decibels (dB);
- **NML** (Noise Monitoring Location) refers to any location where baseline noise levels have been measured;
- **NSRs** (Noise Sensitive Receptors) are all identified receptors which are sensitive to noise; and
- **BNAL** (BESS Noise Assessment Location) refers to any location where the noise immission levels are calculated and assessed.

A Glossary of Terms is also provided as Annex 1 of this report.

All figures referenced within the report can be found in Annex 5.

Unless otherwise stated, all sound levels refer to free field levels i.e. sound levels without influence from any nearby reflective surfaces.

All grid coordinates refer to the Irish Transverse Mercator (ITM) coordinate system using ITM X and ITM Y, unless stated otherwise.

2 Proposed Project Description

2.1 Description of the Proposed BESS Compound

The proposed BESS compound would introduce new sound sources to the local area in the form of externally located fixed plant. The BESS is expected to consist of a number of liquid cooled battery cubes, which would be connected into a series of Power Conversion Units (PCS), each consisting of a pair of inverters and a medium voltage (MV) transformer. It is also assumed that a High Voltage (HV) Grid Transformer will be located within an adjacent substation. Some auxiliary plant and switch gear may be associated with the operation of the HV transformer but would be insignificant in noise output in comparison to the HV transformer itself.

Specifically, the dominant sound sources considered within this assessment are assumed as follows :

- 64 x Fluence Cubes;
- 2 x Chint Electric MV Transformer;
- 4 x PE HEMK PCSK Inverter; and
- 1 x HV Grid Transformer

An indicative layout plan provides an overview of the proposed BESS in Annex 2.

2.2 Study Area

Noise Sensitive Receptors (NSRs) considered in this assessment are nearby residential properties. The study area for this assessment has been defined through the identification of the closest NSRs to the Proposed Project infrastructure . The closest NSR is located approximately 950 m to the west and with other receptors at similar or greater distances. Figure A5.1 in Annex 5 details location of the proposed BESS in context of the closest NSRs considered within the assessment.

The assessment of noise attributable to the proposed BESS considers the nearest NSRs only, on the assumption that if sound levels at the closest receptors are within the defined limits, then sound levels at NSRs at greater distances from the Proposed Project should also be within acceptable levels.

3 Assessment Methodology

3.1 Legislation and Policy Context

There is no published statutory Irish guidance which contains a detailed method for the assessment of industrial noise sources such as this proposed BESS. The assessment has therefore been undertaken following guidance from British Standard BS 4142 Method for rating and assessing industrial and BS 8233 Guidance on sound insulation and noise reduction for buildings.

3.2 Assessment Methods

Typically, assessments of environmental noise are based on a comparison of likely noise levels against either 'context' based limits or a set of fixed limits.

Context based limits are set relative to the existing noise environment and may also consider the characteristics of the noise source(s), whilst fixed limits are usually set regardless of the existing noise environment or type of noise source(s).

3.2.1 'Context' Based Limits (BS 4142:2014 +A1:2019)

BS 4142:2014+A1:2019 is commonly used to assess the potential impacts of new industrial sound sources on nearby receptors.

The BS 4142 form of assessment is based on the predicted or measured levels of an assessed sound source compared to the measured background sound levels without the specific sound source present and uses, *"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"*.

BS4142 uses the following definitions;

- **Ambient Sound**: Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, both near and far. Described using the metric, $L_{Aeq\ (t)}$.
- **Specific Sound Level**: Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *Tr*. Described using the metric $L_{Aeq\ (t)}$. Also referred to in this Appendix as the *Immission Level*.
- **Residual Sound Level**: Equivalent continuous A-weighted sound pressure level of the residual sound without the specific sound source(s) present at the assessment location over a given time interval, *T*. Described using the metric $L_{Aeq\ (t)}$.
- **Background Sound Level**: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting *F* and quoted to the nearest whole number of decibels. Described using the metric $L_{A90\ (t)}$.
- **Rating Level**: The Specific Sound Level adjusted for the characteristics of the sound. The Rating Level is calculated by adding a penalty or penalties (if required) to the Specific Sound Level when the sound source contains audible characteristics such as tonal, impulsive or intermittent components. Described using the metric, $L_{Aeq\ (t)}$.

3.2.2 Fixed Guideline Levels (BS 8233:2014)

BS 8233 '*Guidance on sound insulation and noise reduction for buildings*' (1) presents guideline noise levels for daytime and night-time periods for a number of different building types; for residential areas these are based on guidelines issued by the World Health Organisation (WHO). Specifically, the

Standard states; *"In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4."* Table 4 is reproduced here as Table 3-1.

Table 3-1: Indoor Ambient Noise Levels for Dwellings (*BS 8233:2014 Table 4*)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq(16hour)}$	-
Dining	Dining room/area	40 dB $L_{Aeq(16hour)}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq(16hour)}$	30 dB $L_{Aeq(8hour)}$

A typical 13 dB attenuation value can be assumed for a partially opened window in accordance with the Acoustics, Ventilation and Overheating Guide (AVO) Appendix C (January 2020, published by the Association of Noise Consultant). This can be used as a reasonable value in order to convert between internal and external sound levels and limits. Therefore, an assessment of external noise levels can assume an external noise level limit of 13 dB above those values detailed within Table 3-1 (i.e. to achieve an internal night-time level of 30 dB $L_{Aeq(8hour)}$ with windows open the external sound level must not exceed 43 dB $L_{Aeq(8hour}$)

3.3 Calculation Method

3.3.1 Noise Propagation Model (ISO 9613-2:2996)

To predict the noise immission levels attributable to the proposed BESS a noise propagation model was created using the propriety noise modelling software CadnaA. Within the software, complex models can be produced to simulate the propagation of noise according to a wide range of international calculation standards.

For this assessment noise propagation was calculated in accordance with ISO 9613 '*Acoustics – Attenuation of Sound During Propagation Outdoors* (2) using the following input parameters:

- Temperature is assumed to be 10 °C and relative humidity as 70%;
- A ground attenuation factor of 0.5 (semi-soft ground) has been used; and
- Receiver heights have been set to 4m.

3.3.2 Uncertainties and Limitations

The noise propagation model is designed to give a good approximation of the specific sound level and the contribution of each individual sound source; however, it is expected that measured levels are unlikely to be matched exactly with modelled values and the following limitations in the model should be considered:

- In accordance with ISO 9613, all assessment locations are modelled as downwind of all sound sources and propagation calculations are based on a moderate ground-based temperature inversion, such as commonly occurs at night. These conditions are favourable to noise propagation;
- Table 5 of ISO 9613 estimates overall accuracy for broadband noise predictions of ± 3 dB, with average source to receiver heights <5m, at distances of up to 1,000m;

- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for; and,
- The model assumes all sound sources are operating continuously, simultaneously and at maximum noise output.

Modelled sound sources represent candidate plant only and an indicative site layout. The noise output of individual items of plant may vary from what is presented in this report after final plant specification and procurement.

4 Baseline Sound Level Monitoring

TNEI also undertook an operational wind turbine noise assessment for the Proposed Wind Farm. As part of the study, TNEI undertook background noise monitoring for an extended period between 26th January 2023 and 5th of April 2023 at seven neighbouring properties.

Table 4-1 details all seven Noise Monitoring Locations (NMLs), which are being used in this assessment. The NMLs are also shown in Figure A5.1 included within Annex 5.

Table 4-1: Baseline Noise Monitoring Locations

NML	Approximate Distance and bearing to BESS plant (m)	Coordinates (ITM X, Y)	
NML01	1100 m north east	664333	670281
NML02	1000 m north east	664721	669755
NML03	1750 m south east	665105	668234
NML04	2200 m south	663548	667162
NML05	1670 m south west	662658	668128
NML06	1200 m west	662547	669183
NML07	1500 m north west	662653	670357

The noise monitoring equipment installed at the NMLs consisted of Rion NL-31's, Rion NL-32's and a Rion NL-52 Sound Level Meter (SLM), fitted with appropriate environmental wind shields. All noise monitoring equipment (calibrator, SLM and microphones) used for the study are categorised as Class 1, as specified in IEC 61672-1 *'Electroacoustics. Sound level meters. Specifications'* (3). The equipment was calibrated onsite at the beginning and end of each measurement period with no significant deviations noted.

Wind speed and direction data was measured continuously during the noise survey using a LIDAR unit, which was temporarily installed within the Proposed Project site. For operational wind farm noise assessments, the measured noise data is organised into wind speed 'bins' in order to determine wind-speed specific noise limits. In contrast, BS 4142 states, *"Exercise caution when making measurements in poor weather conditions, such as wind speeds greater than 5 m/s."* Accordingly, the noise data was filtered to remove any data points that were measured during periods of high wind speeds and rain. In this particular case, all noise data measured with wind speeds at or above $5ms^{-1}$ has been removed. It should be noted that the wind speed data used in this assessment is based on measurements made at wind speeds at 10m height (standardised).

Table 4-2 details the representative background sound levels, $L_{A90\ (10mins)}$, which have been determined after considering the distribution of data for each measurement period. Typically, baseline sound level measurements made in accordance with BS 4142 are undertaken in 15-minute periods. However, as the baseline data was measured as part of the operational wind turbine noise assessment, a 10-minute measurement period was adopted for use as part of this assessment. Annex 3 contains the statistical and distribution analysis charts used to ascertain the representative background sound levels.

Table 4-2: Representative Background Sound level, dB $L_{A90(10mins)}$

NML ID	Daytime $L_{A90(10mins)}$	Night-time $L_{A90(10mins)}$
NML01	25	20
NML02	27	22
NML03	32	25
NML04	36	21
NML05	33	23
NML06	29	22
NML07	32	22

5 Operational Noise Impacts

5.1 Modelling of Individual Sound Sources

The noise model considers all of the sound sources detailed within Section 2.1 and the following paragraphs describe how each sound source has been incorporated into the noise model.

Noise modelling is based on candidate plant typical for the size and class of the Proposed Project and, where possible, data sheets for candidate items of plant have been provided within Annex 4. It should be noted that final plant specifications will vary during detailed design and the tendering process.

The sound sources considered within this assessment are assumed as follows:

- 64 x Fluence Cubes;
- 2 x Chint Electric MV Transformer;
- 4 x PE HEMK PCSK Inverter; and
- 1 x HV Grid Transformer

These plant items have been located in a noise model according to the layout included in Annex 2.

5.1.1 Fluence Cube and MV Transformer

TNEI have used noise data for a Fluence Cube, offered by the supplier, Fluence.

Each Fluence Cube includes a number of internally and externally located sound sources, most notably the HVAC and chiller units, which are housed within the Cube.

Chint Electric MV Transformers and Power Electronics (PE) E HEMK PCSK Inverter were also assumed.

The noise data for the Cubes, MV Transformers and Inverters has been provided to TNEI under a Non-Disclosure Agreement and as such detailed noise level data cannot be provided in this report. TNEI would be happy to discuss this data in more detail with the Planning Authority, if required.

5.1.2 High Voltage (HV) Grid Transformer

A HV Grid Transformer near the proposed BESS compound has been assumed. The model assumed within the noise model is a ONAF (Oil Natural, Air Forced) Ganz HV transformer with a broadband sound pressure level (SPL) value of 68 dBA at 2m, which is approximately equivalent 82 dBA SWL.

No spectral data is available for this candidate, however, typical HV transformer spectra is well documented and 1/3 Octave Band SWL data for a similar unit has been input into the noise model and transposed to equal a broadband SWL of 82 dBA. Table 5-1 details the resulting SWL used within the noise model and the relevant data sheets are included within Annex 4.

Table 5-1: 1/3 Octave Band SWL, dBA used to model the HV Grid Transformer

	Frequency (Hz)								
Hz	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
dBA	-	-	-	58	42	49	66	62	72
Hz	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**

	Frequency (Hz)								
dBA	68	70	74	71	71	73	72	71	68
Hz	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
dBA	66	64	62	61	61	59	56	54	52

5.2 Noise Character

5.2.1 Tonality

Power transformers are inherently tonal at source in the 100 Hz frequency band, therefore it is important to consider whether a 100Hz tone might be audible at the receptors. Based on TNEIs experience of similar developments and given the relatively large distance between source and receiver, we do not expect a tone to be perceptible at either BESS Noise Assessment Location (BNAL). As such, no tonal penalty has been applied.

5.2.2 Impulsivity

Impulsivity is not considered to be a relevant sound characteristic of a transformer or BESS when operational, as the noise level will be predictable and consistent.

5.2.3 Intermittency

As with impulsivity, intermittency is not considered to be a relevant sound characteristic in this case. Once operational, the proposed BESS compound and associated plant will be operational for extended durations and will only likely shut down for maintenance purposes. Therefore, the noise is predictable and consistent and not considered to be intermittent.

5.2.4 Overall Character Correction

With due regard to the above, no character corrections are required.

5.3 Calculated Immission Levels

Noise immission levels have been calculated at 18 BESS Noise Assessment Locations (termed BNALs), which have been selected to represent the closest NSRs. The BNALs have been set on the side of the property facing the proposed BESS compound, representing the closest point of the property's amenity area. The BNALs are detailed in Table 5-2 and shown on Figure A5.1 within Annex 5.

Table 5-2: BESS Noise Assessment Locations (BNALs)

BNAL ID	ITM X	ITM Y
BNAL01	662730	670033
BNAL02	662612	670155
BNAL03	663257	670292
BNAL04	663822	670342

BNAL ID	ITM X	ITM Y
BNAL05	664335	670302
BNAL06	664472	670214
BNAL07	664688	669900
BNAL08	664705	669725
BNAL09	664928	669208
BNAL10	664824	668894
BNAL11	664698	668149
BNAL12	664248	667759
BNAL13	663159	667611
BNAL14	662682	668090
BNAL15	662840	669042
BNAL16	662569	669160
BNAL17	661841	668376
BNAL18	662639	667483

The immission levels are calculated assuming all plant is operating continuously and concurrently. The levels are detailed in Table 5-3 as dB $L_{Aeq(t)}$. No time period is specified as the model assumes that noise levels will not fluctuate and will remain the same for all time periods.

Table 5-3: Predicted Immission Levels, dB $L_{Aeq(t)}$

Noise Assessment Location, BNAL ID	Immission Level, dB $L_{Aeq(t)}$
BNAL01	26
BNAL02	25
BNAL03	29
BNAL04	29
BNAL05	28
BNAL06	28

Noise Assessment Location, BNAL ID	Immission Level, dB $L_{Aeq(t)}$
BNAL07	27
BNAL08	26
BNAL09	24
BNAL10	27
BNAL11	23
BNAL12	23
BNAL13	25
BNAL14	24
BNAL15	29
BNAL16	26
BNAL17	19
BNAL18	24

6 Noise Impact Assessment

6.1 Noise Limit Criteria

A fixed noise level limit assessment has been adopted rather than undertaking an assessment against background sound levels. This is because at the NMLs, particularly during the night-time, background sound levels are very low (20 dB $LA_{90(10mins)}$ in some cases) and as such it may not be appropriate to rely on BS 4142 as the appropriate assessment method. In this regard the ANC BS 4142 Technical Note states[1];

"The standard states that the absolute level of sound can be of significance, where the residual values are low and where they are high and should be taken into account when determining the overall impact of a particular specific sound source. The second paragraph notes that absolute levels may be as, or more, important than relative outcomes where background and rating levels are low. It is important to note that both background and rating levels would need to be low for this particular caveat to apply.

BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example, a situation might be considered acceptable where a rating level of 30 dB is 10 dB above a background sound level of 20 dB, i.e., an initial estimate of a significant adverse impact is modified by the low rating and background sound levels.

There may be situations where the opposite is true, and it is for the assessor to justify any modifications to the initial estimate of impact. BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$. The WG [Working Group] suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate."

In this case, as defined in BS4142:1997 and acknowledged in the ANC Technical Note:

- The measured background sound levels are 'very low' i.e. below 30 dB L_{A90}; and,
- The Rating Level is low i.e. below 35 dB $L_{Ar,Tr}$

Accordingly, it is felt that the use of fixed noise level limits, as opposed to context based limits is the most appropriate form of assessment and this assessment approach has previously been used by TNEI and agreed with some Local Authorities in the UK for similar projects where measured background sound levels in rural areas were similarly low.

6.2 Quantitative Assessment

An assessment is detailed below against the most stringent of the guideline levels presented in BS 8233:2014. To determine a set of external limits, 13 dB has been added to the BS 8233 internal levels to allow for the attenuation provided by a partially open window, as detailed in Table 6-1.

[1] Underlining added by TNEI for emphasis.

Table 6-1: Derived BS 8233 Fixed Level Limits

Assessment Parameter	BS 8233 Guideline Level (dB LAeq,t)	Allowance for Open Window Attenuation (dB LAeq,t)	Equivalent External Level (dB LAeq,t)
Daytime 07:00-23:00	35	13	48
Night-time 23:00-07:00	30	13	43

Table 6-2 below compares the predicted immission levels at the BNALs with the derived noise limits.

Table 6-2: Quantitative Assessment

Noise Assessment Location, BNAL ID	Daytime		Night-time	
	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB
BNAL01	26	-22	26	-17
BNAL02	25	-23	25	-18
BNAL03	29	-19	29	-14
BNAL04	29	-19	29	-14
BNAL05	28	-20	28	-15
BNAL06	28	-20	28	-15
BNAL07	27	-21	27	-16
BNAL08	26	-22	26	-17
BNAL09	24	-24	24	-19
BNAL10	27	-21	27	-16
BNAL11	23	-25	23	-20
BNAL12	23	-25	23	-20
BNAL13	25	-23	25	-18
BNAL14	24	-25	24	-20
BNAL15	29	-19	29	-14
BNAL16	26	-22	26	-17

Noise Assessment Location, BNAL ID	Daytime		Night-time	
	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB
BNAL17	19	-29	19	-24
BNAL18	24	-24	24	-19

As can be seen, the predictions are at least 13dB below the threshold levels of BS 8233 and no significant noise impact is predicted. No noise mitigation measures are required for the proposed BESS compound.

7 Summary

In order to assess the impact of noise emissions from the proposed BESS compound within the Proposed Project, TNEI has produced a noise propagation model in accordance with ISO 9613 that predicts the noise immission levels at the nearest identified residential receptors, based on a layout and candidate plant that is typical for this type of BESS development. A small number of residential properties was identified and assessed, the nearest of which is approximately 950 m to the proposed BESS compound.

A baseline survey was undertaken as part of the Proposed Wind Farm operational noise assessment to determine background sound levels in the vicinity. The resulting low levels of measured background sound, alongside with low predicted Rating Levels, indicates that the methodology of BS 4142 is not appropriate. As such, fixed guideline levels detailed in BS 8233 were used for both daytime and night-time assessment periods.

The assessment results shows that noise predictions are at least 13dB below the threshold levels of BS 8233 and no significant noise impact is predicted. No noise mitigation measures are required for the proposed BESS.

8 References

1. **British Standards Institute.** *Guidance on Sound Insulation and Noise Reduction for Buildings.* UK : BSI, 2014. BS8233:2014.

2. **(ISO), International Organization for Standardization.** *Acoustics – Attenuation of Sound During Propagation Outdoors: Part 2 – General Method of Calculation.* Geneva : (ISO), International Organization for Standardization, 1996. ISO 9613-2:1996.

3. **Commission Electrotechnique Internationale (IEC).** *Electroacoustics - Sound level meters - Part 1: Specifications.* Geneva : IEC, 2013. IEC 61672-1:2013.

4. **British Standards Institute.** *Methods for Rating and Assessing Industrial and Commercial Sound.* UK : BSI, 2014. BS4142:2014 + A1:2019.

5. **Association of Noise Consultants.** *ANC Good Practice Working Group, BS 4142:2014+A1:2019 Technical Note. s.1.* 2020.

Annex 1 – Glossary of Terms

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.

Background Sound Level: the sound level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night-time periods. The LA90 indices (see below) are typically used to represent the background sound level.

Broadband Noise: noise with components over a wide range of frequencies.

Decibel (dB): the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in sound level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.

dB(A): the ear has the ability to recognise a particular sound depending on its pitch or frequency. Microphones cannot differentiate sound in the same way as the ear, and to counter this weakness the sound measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) weighting is internationally accepted and has been found to correspond well with people's subjective reaction to sound levels and noise. Some typical subjective changes in sound levels are:

- a change of 3 dB(A) is just perceptible;
- a change of 5 dB(A) is clearly perceptible; and
- a change of 10 dB(A) is twice (or half) as loud.

Directivity: the property of a sound source that causes more sound to be radiated in one direction than another.

Emission: the sound energy emitted by a sound source (e.g. a wind turbine).

Frequency: the pitch of a sound in Hz or kHz. See Hertz.

Ground Effects: the modification of sound at a receiver location due to the interaction of the sound waves with the ground along its propagation path from source to receiver. Described using the term 'G', and ranges between 0 (hard ground), 0.5 (mixed ground) and 1 (soft ground).

Hertz (Hz): sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)).

Immission: the sound pressure level detected at a given location (e.g. the nearest dwelling).

Isopleth: a line on a map connecting points of equal value, for example air pressure, noise level etc.

Noise: unwanted sound.

L_w: is the sound power level. It is a measure of the total sound energy radiated by a sound source and is used to calculate sound levels at a distant location. The L_{WA} is the A - weighted sound power level.

L_{eq}: is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The $L_{Aeq,\,T}$ is the A - weighted equivalent continuous sound level over a given time period (T).

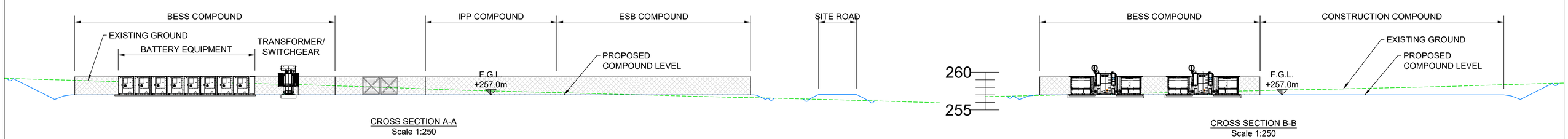
L_{90}: index represents the sound level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background sound level. The $L_{A90,10min}$ is the A - weighted background sound level over a ten-minute measurement sample.

Sound Level Meter: an instrument for measuring sound pressure level.

Sound Pressure Level: a measure of the sound pressure at a point, in decibels.

Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of ≤20 Hz). This noise is subjectively more annoying than broadband noise.

Annex 2– Development Information



CROSS SECTION A-A
Scale 1:250

CROSS SECTION B-B
Scale 1:250

NOTES

REV	DATE	DRAWN BY	CHECKED BY	DETAILS
A	19/12/2023	M.B.	L.P.	FIRST ISSUE

ENGINEER

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CLIENT

EDF renewables

PROJECT

SESKIN WIND FARM

TITLE

SUBSTATION AND BESS COMPOUND
LAYOUT AND CROSS SECTIONS

REVISION

A

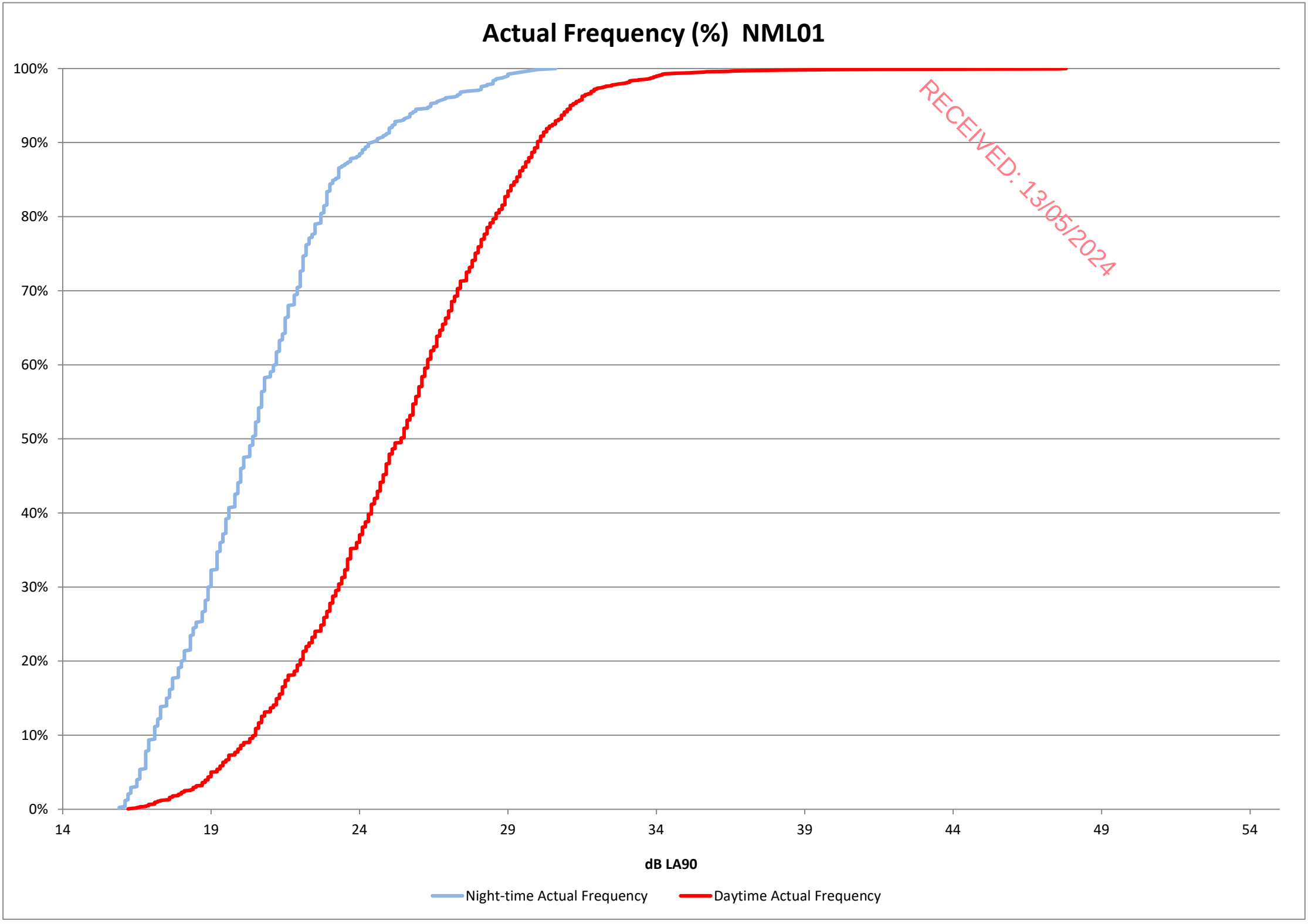
DRAWN BY	DATE	PAPER SIZE	SCALE
M. BROWNE	19/12/2023	A1	1:250
CHECKED AND APPROVED	DATE	STATUS	
L. POWER	19/12/2023	PRELIMINARY	

DRAWING NUMBER

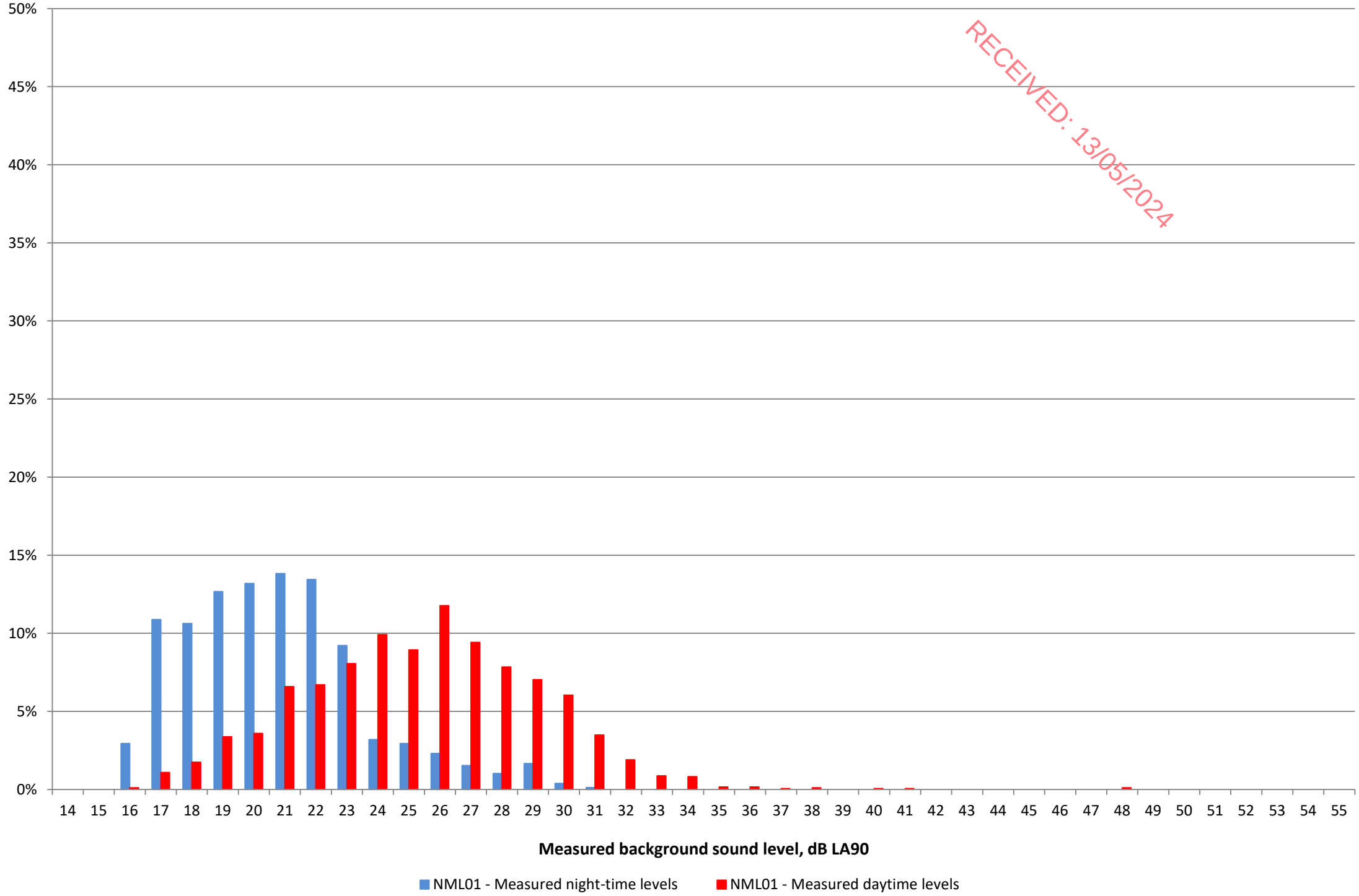
LKRH d006.1.1

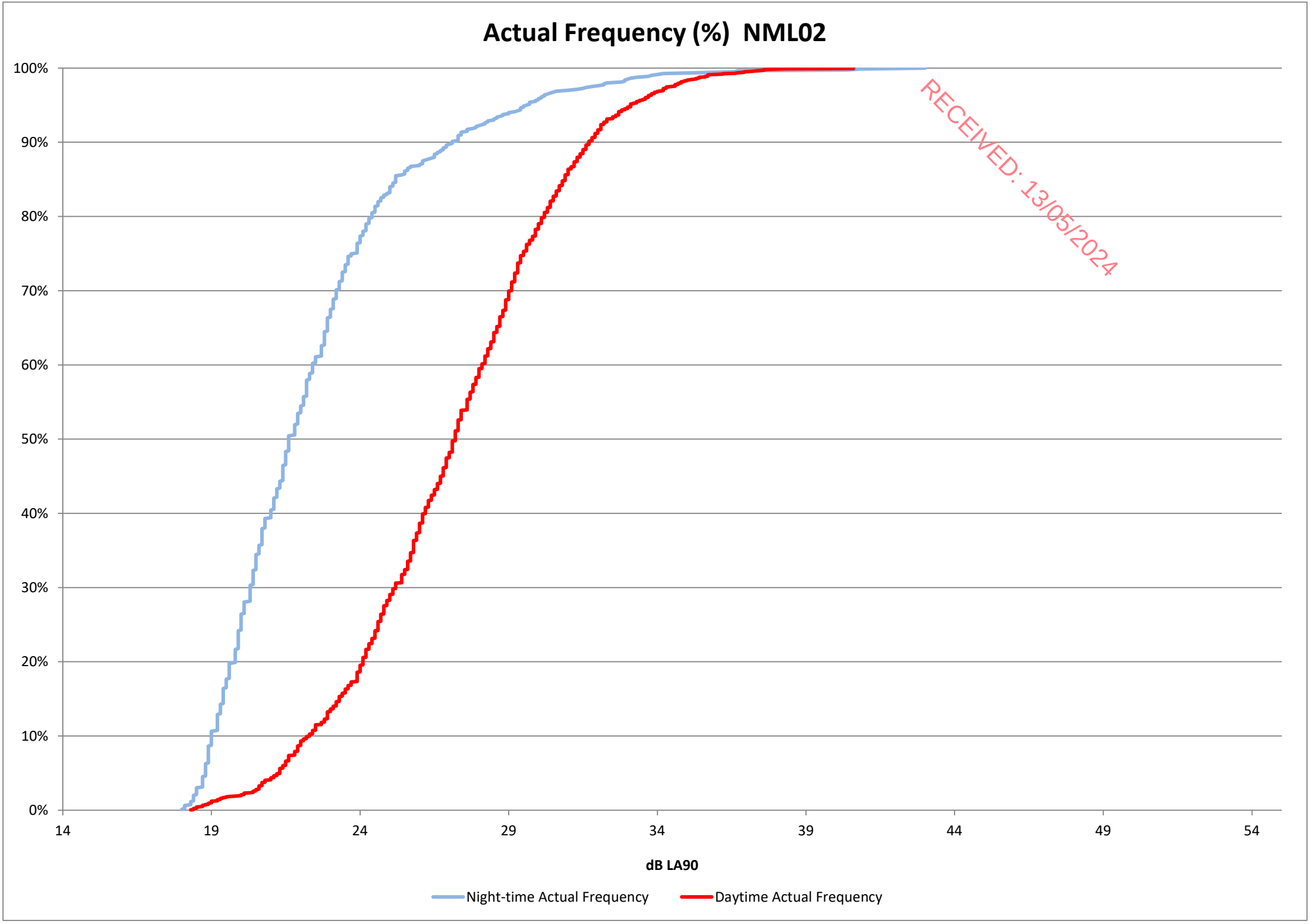
Plotted - 09/01/2024 15:29:55
Z:\Projects\Ireland\Seskin SESK\Drawings\d006 Substation Compound\SESK D006.1 Substation Compound Design Plan And Section

Annex 3 - Baseline Survey Data

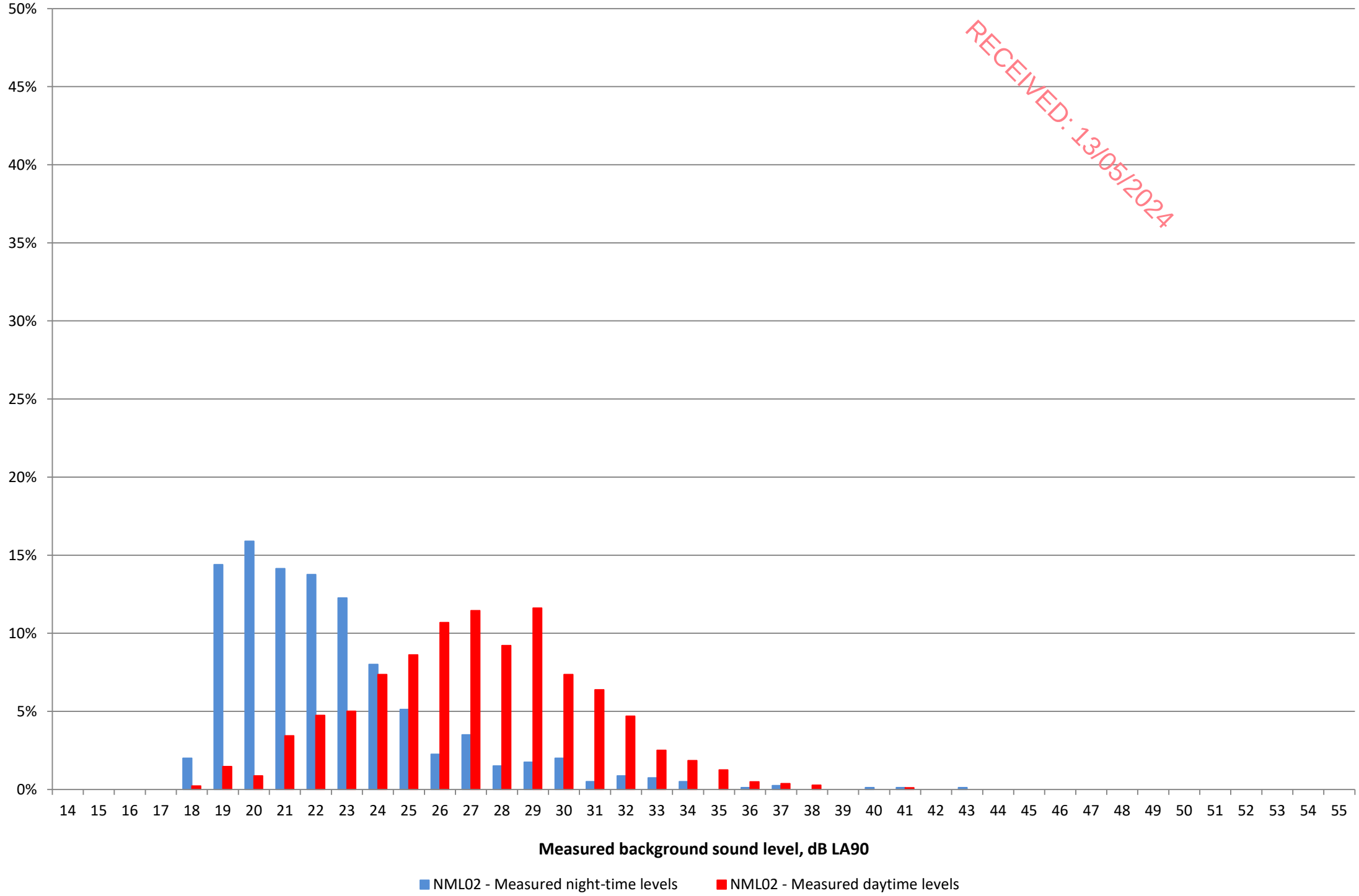

Actual Frequency (%) NML01
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

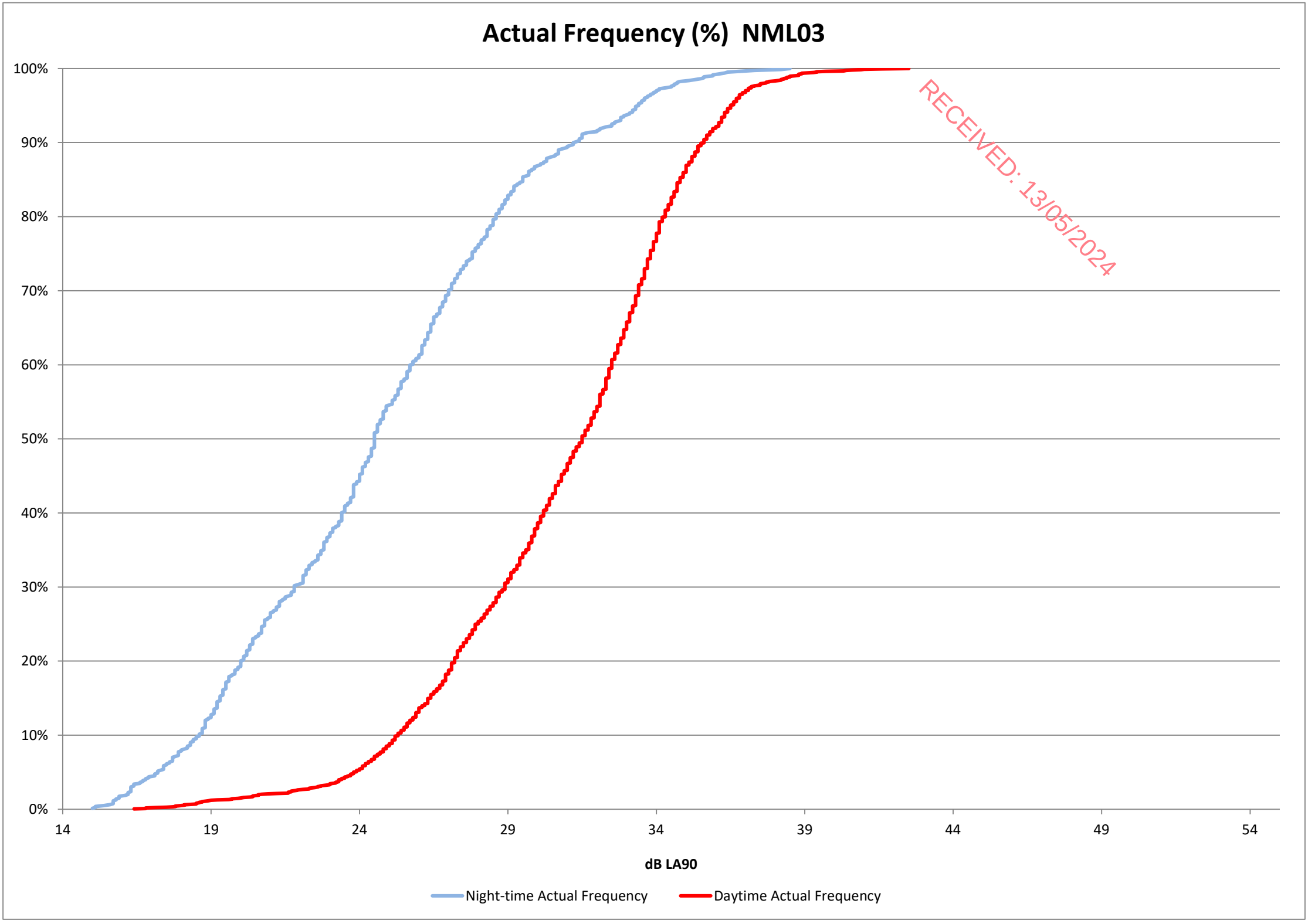
Statistical Analysis to Determine the Background Sound Level NML01




Actual Frequency (%) NML02
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML02




Actual Frequency (%) NML03
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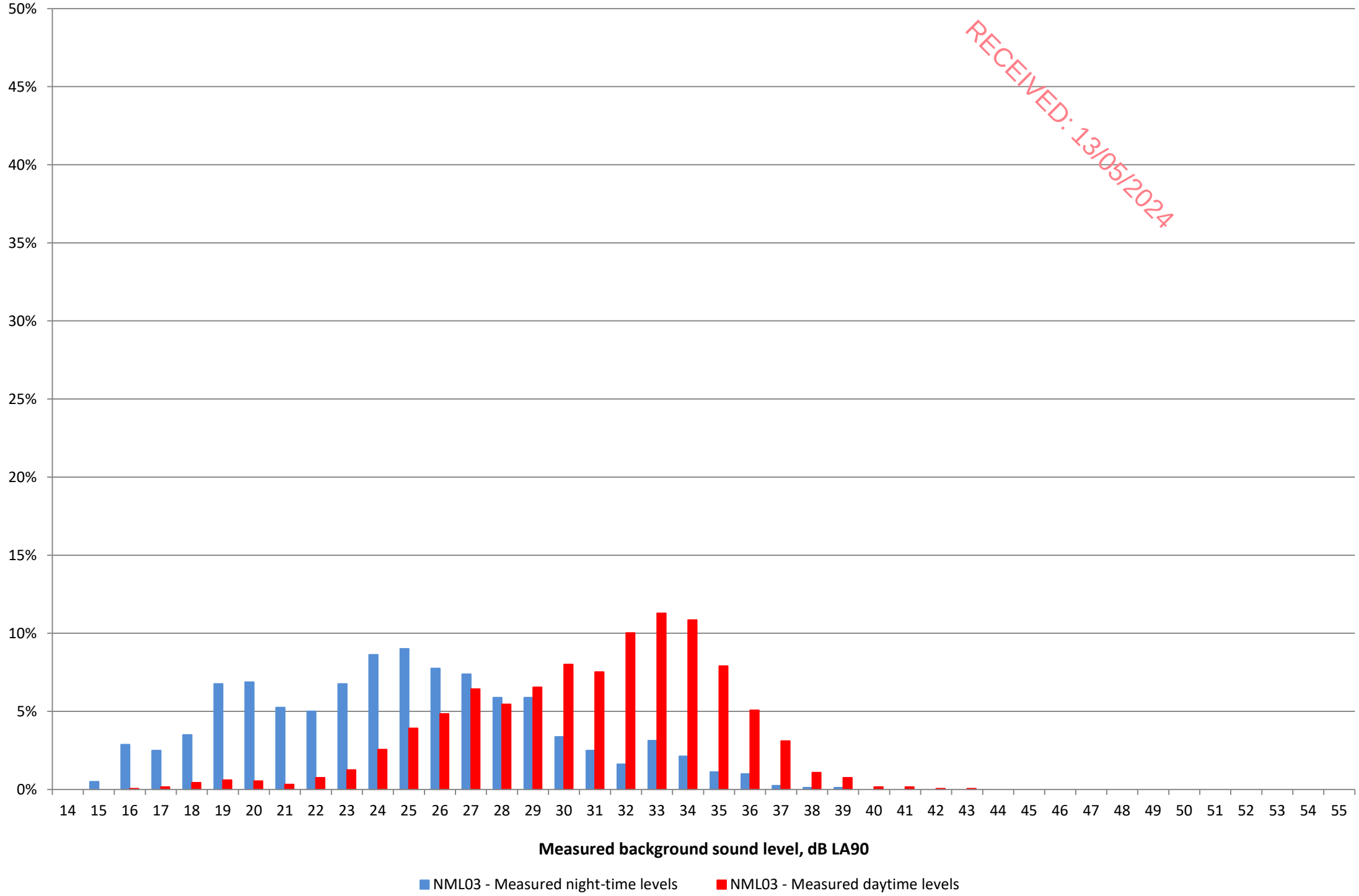
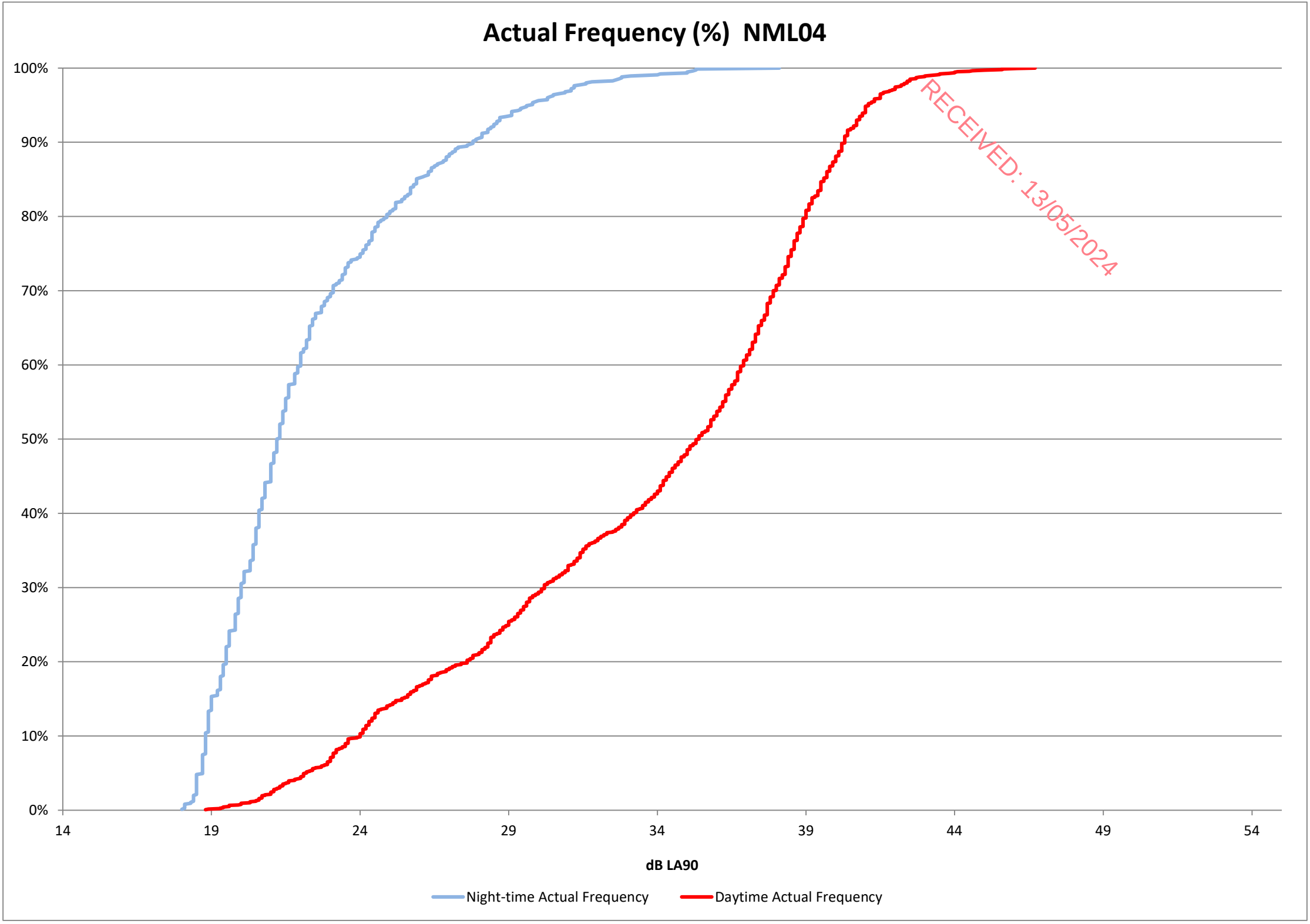
80%
70%
60%
50%
40%
30%
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML03

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90%
80%
70%
60%
50%
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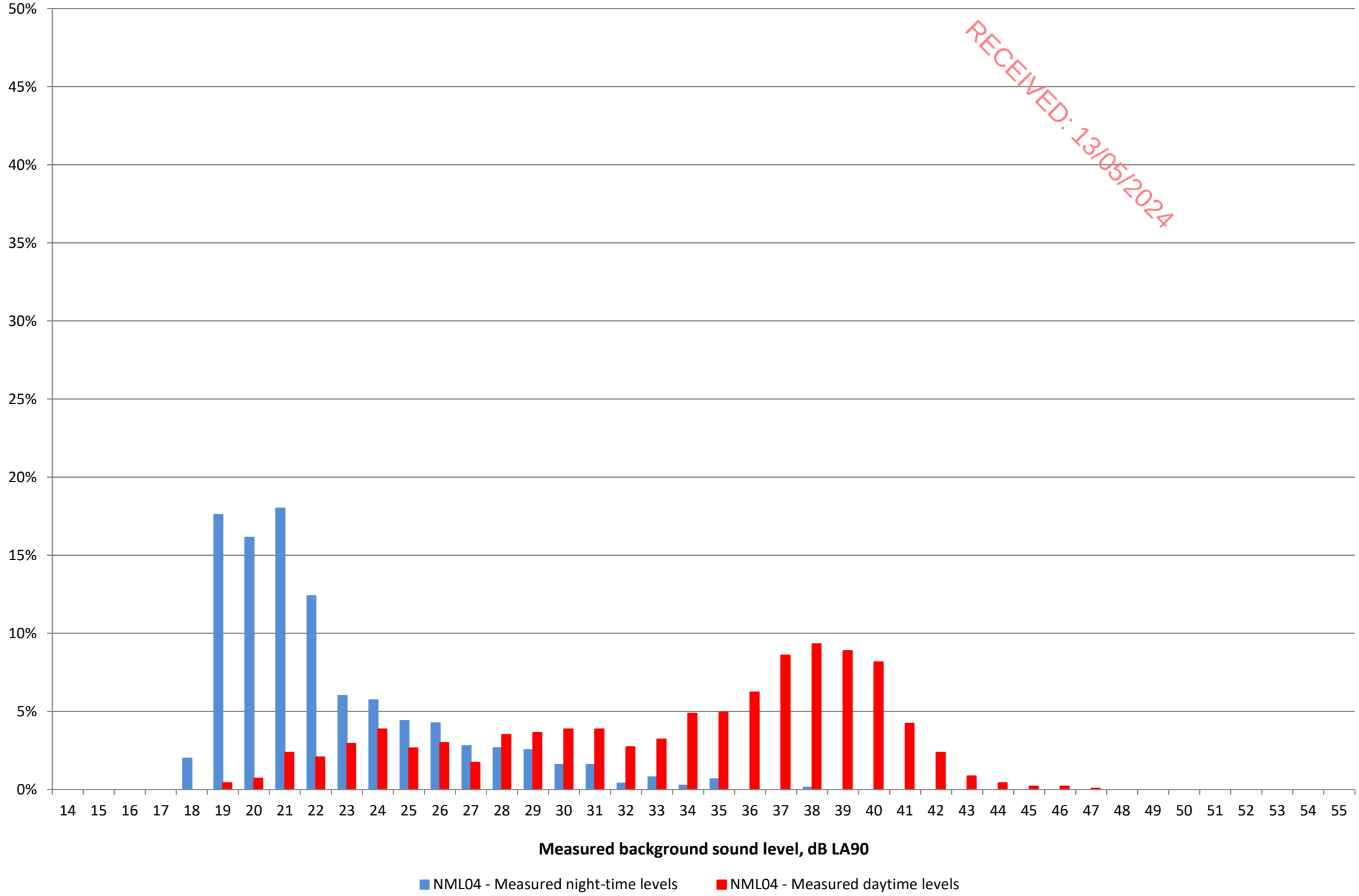
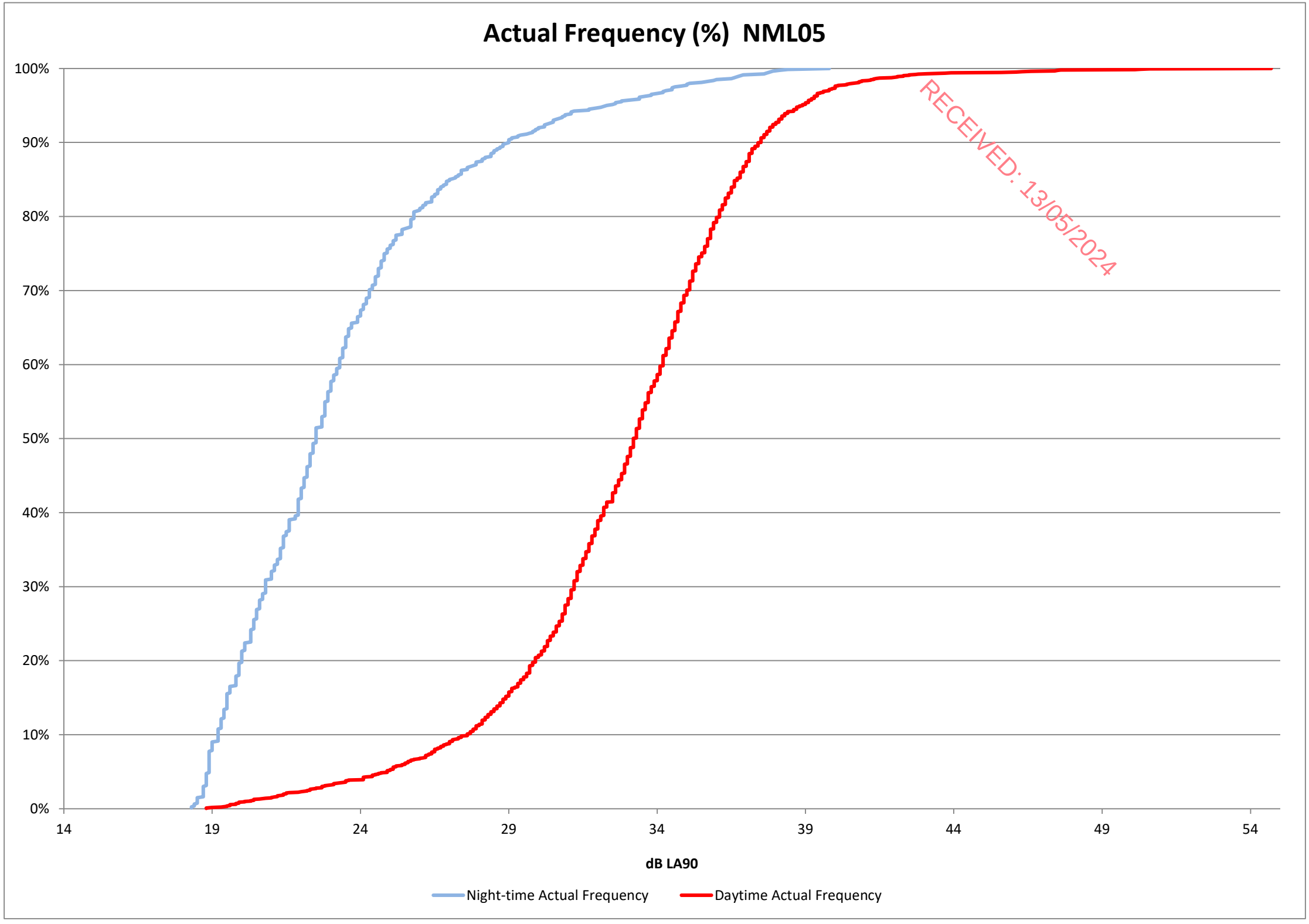
30%
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML04




Actual Frequency (%) NML05
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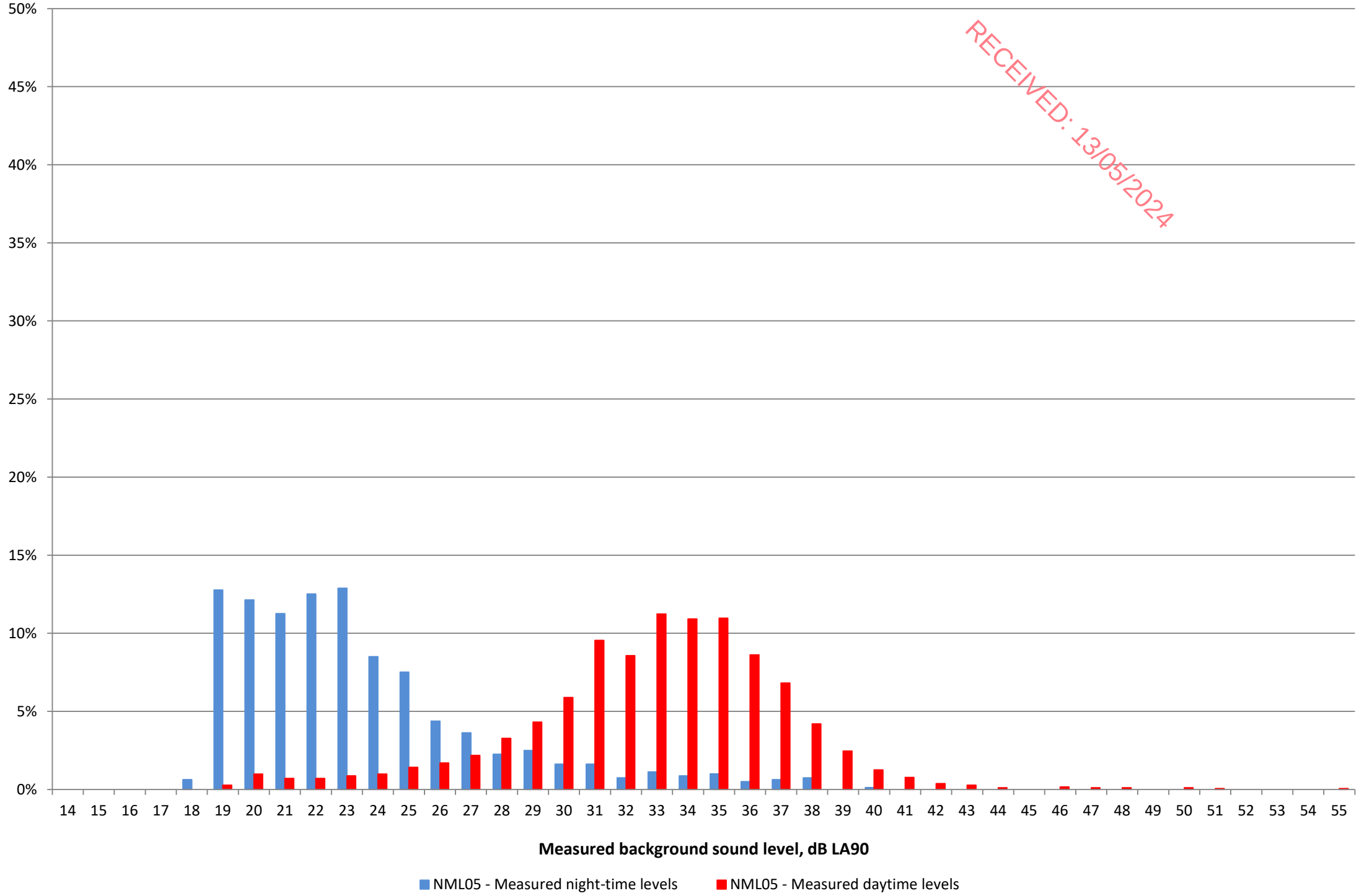
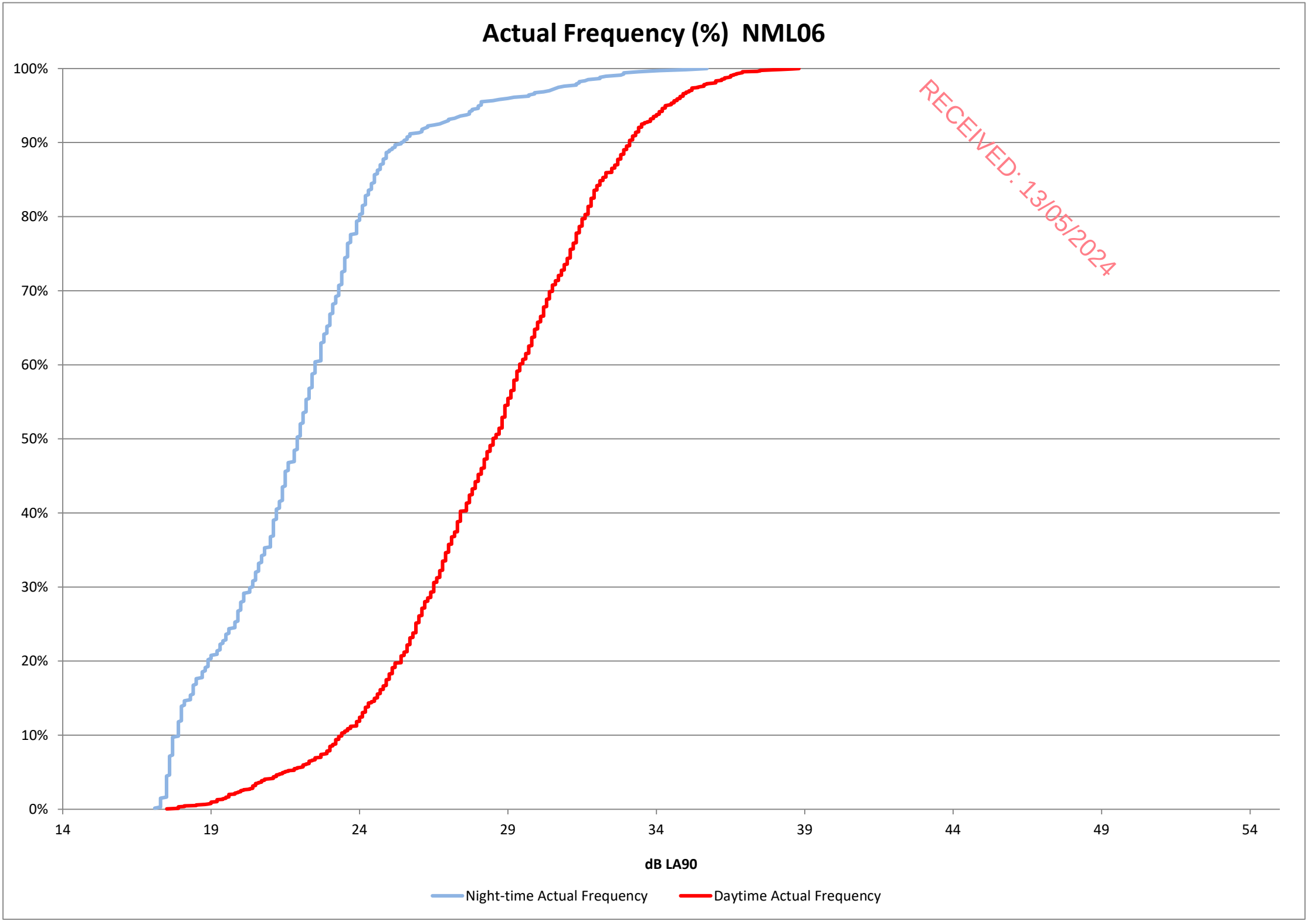
80%
70%
60%
50%
40%
30%
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML05




Actual Frequency (%) NML06
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70%
60%
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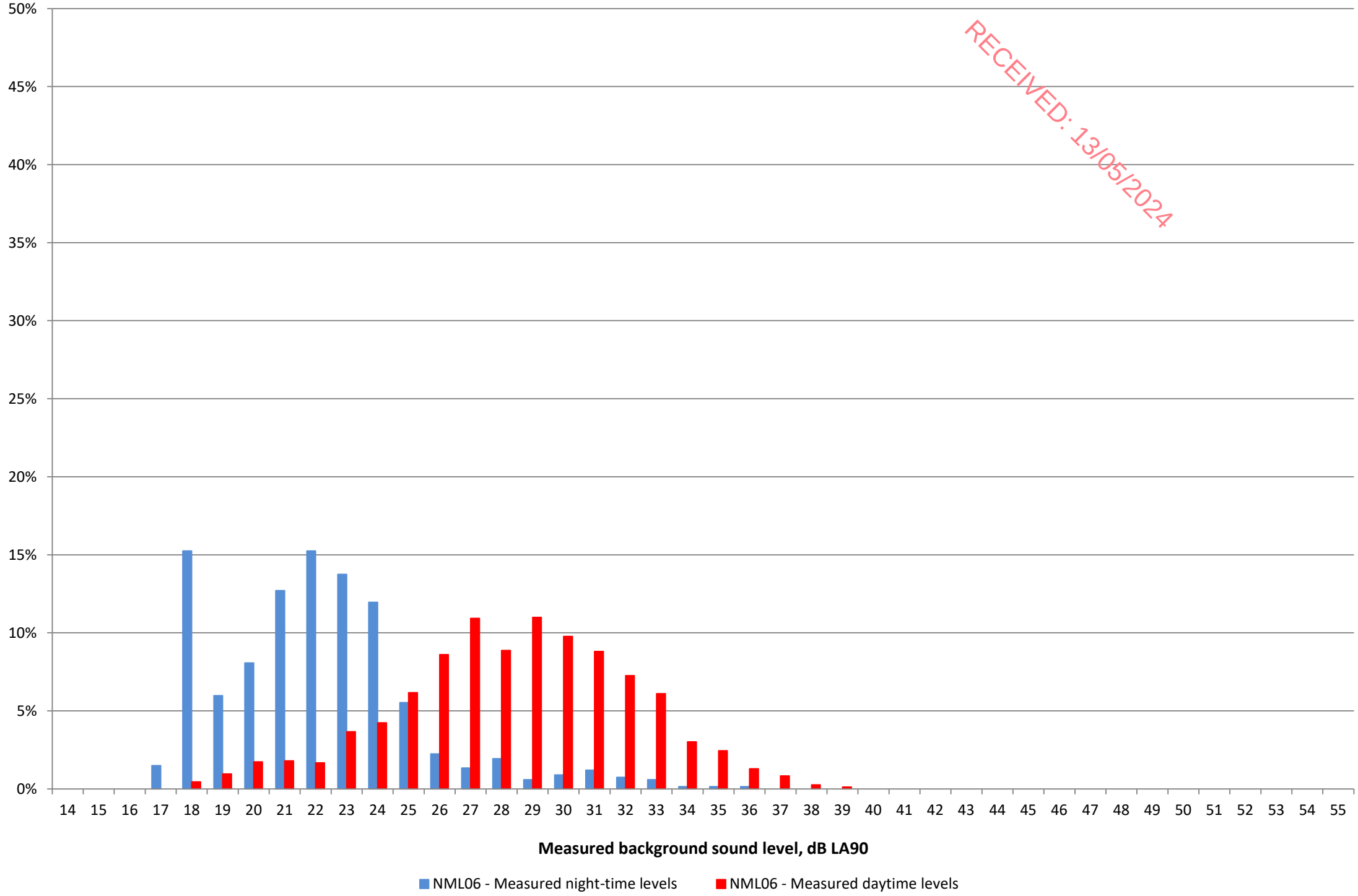
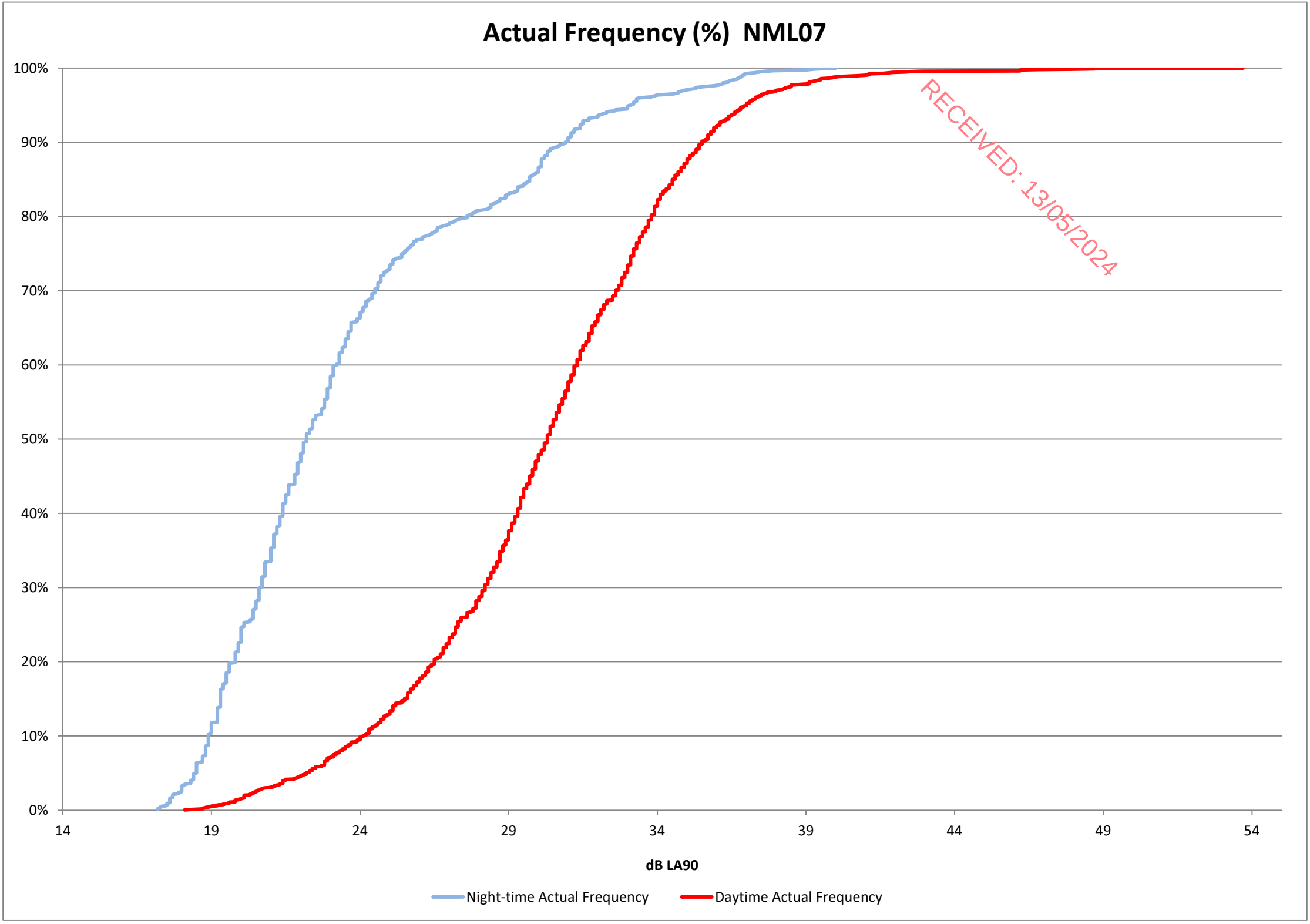
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML06




Actual Frequency (%) NML07
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70%
60%
50%
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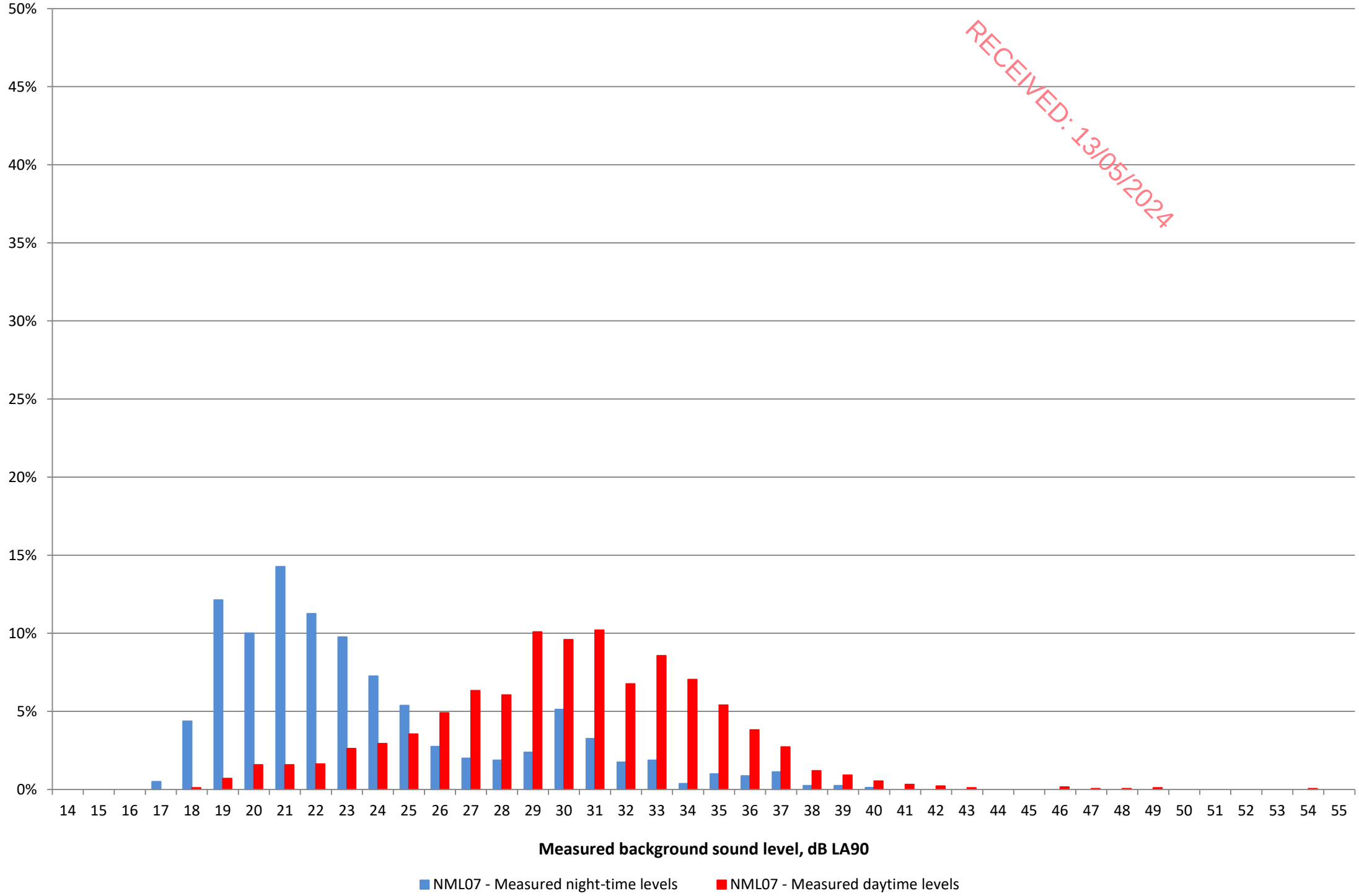
20%
10%
0%
14
19
24
29
34
39
44
49
54
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency
RECEIVED: 13/05/2024

Statistical Analysis to Determine the Background Sound Level NML07



Annex 4 – Noise Modelling Data

20.	Guaranteed noise level acc. to IEC 60076-10					
	Sound pressure level at 100%Un, 100%In at	ONAN	65	dB(A)	at	0.3 m
		ONAF	68	dB(A)	at	2.0 m
21.	Dimensions and masses (approx.)					
	Length		9,000	mm		
	Width		5,600	mm		
	Height		6,400	mm		
	Oil mass		34,100	kg		
	Total mass		167,800	kg		
	Transport dimensions and mass of heaviest part (approx.)					
	Length		7,500	mm		
	Width		2,300	mm		
	Height		4,200	mm		
	Transport mass		112,300	kg	dry air filled	
	Estimated packing details per unit : see attached Masses and dimension sheet					

TEST REPORT

Sound Level

Serial No. : 1ZPL001334582

Combination of sound level measurements

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			
100	33	100	262.43		8	

Frequency	Measurement I Sound Power Level	Measurement d Sound Power Level		Combined Sound Power Level
[Hz]	[dB(A)]	[dB(A)]		[dB(A)]
Total Sound Level	76.9	87.8		**88.2**
Octave Band 63	39.6	64.4		**64.4**
125	59.5	79.6		**79.6**
250	76.1	81.2		**82.3**
500	67.3	82.6		**82.7**
1000	56.3	81.7		**81.7**
2000	51.6	75.4		**75.4**
4000	54.1	71.3		**71.4**
8000	57.4	64.2		**65.0**
⅓ Octave Band 50	36.1	63.8		**63.8**
63	37.0	47.4		**47.8**
80	0.0	55.1		**55.1**
100	58.4	71.9		**72.1**
125	47.5	68.5		**68.6**
160	51.3	78.4		**78.4**
200	63.1	73.7		**74.1**
250	60.9	76.4		**76.5**
315	75.8	78.0		**80.1**
400	61.2	77.0		**77.1**
500	63.7	76.9		**77.1**
630	62.5	79.2		**79.3**
800	53.7	78.6		**78.6**
1000	51.4	76.7		**76.7**
1250	47.1	74.5		**74.5**
1600	47.0	72.4		**72.4**
2000	46.7	70.2		**70.2**
2500	46.9	68.5		**68.5**
3150	48.4	67.5		**67.6**
4000	49.6	66.9		**67.0**
5000	49.9	64.8		**64.9**
6300	51.2	61.5		**61.9**
8000	52.9	58.8		**59.8**
10000	53.6	56.4		**58.2**

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			

Frequency				Combined Sound Power Level
[Hz]				[dB(A)]
Total Sound Level				
Octave Band 63				
125				
250				
500				
1000				
2000				
4000				
8000				
⅓ Octave Band 50				
63				
80				
100				
125				
160				
200				
250				
315				
400				
500				
630				
800				
1000				
1250				
1600				
2000				
2500				
3150				
4000				
5000				
6300				
8000				
10000				

Annex 5 – Figures

NML07
BNAL04
BNAL03
NML01
BNAL05
BNAL06
BNAL02
BNAL01
BNAL07
NML02
BNAL08
BNAL09
NML06
BNAL16
BNAL15
BNAL10
BNAL17
NML05
BNAL14
BNAL11
BNAL12
BNAL13
BNAL18
NML04
N
0
0.5
1
Kilometre

RECEIVED 13/05/2024

LEGEND

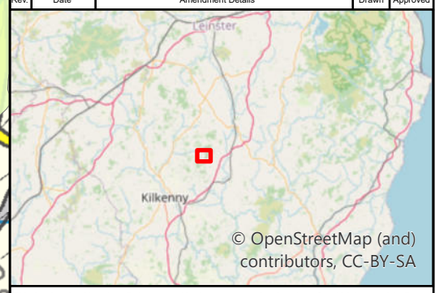
- Proposed EIAR Site Boundary
- Battery Noise Assessments (BNALs)
- Noise Monitoring Locations (NMLs)
- BESS Modelled Noise Sources
- Noise Sensitive Receptors (NSRs)

Predicted Noise Levels (dBA)

20 - 25	55 - 60
25 - 30	60 - 65
30 - 35	65 - 70
35 - 40	70 - 75
40 - 45	75 - 80
45 - 50	80 - 85
50 - 55	

Noise contours modelled in accordance with ISO 9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.
All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
0	01/05/2024	CLIENT COMMENTS	JCM	MC
0	11/03/2024	FIRST ISSUE	MR	MC



Client: EDF renewables

Drawing Status: FOR INFORMATION

Project Title: SESKIN WIND FARM, CO. CARLOW

Drawing Title: FIGURE A5.1 - BESS NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:12,500	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00102-012

Annex 6 – Quantitative assessments at all NSRs

BESS Quantitative Assessment at all NSRs

H / BNAL	Immission Level, dB $L_{Aeq(t)}$	Daytime		Night-time	
		Equivalent External Level (dB LAeq,t)	Margin above/below Noise Level Limit, dB	Equivalent External Level (dB LAeq,t)	Margin above/below Noise Level Limit, dB
H6(BNAL08)	26	48	-22	43	-17
H7(BNAL09)	24	48	42	43	-19
H8(BNAL12)	23	48	42	43	-20
H9(BNAL10)	27	48	43	43	-16
H10(BNAL05)	28	48	45	43	-15
H11(BNAL04)	29	48	44	43	-14
H12(BNAL03)	27	48	42	43	-16
H13(BNAL15)	28	48	47	43	-15
H14(BNAL11)	23	48	42	43	-20
H15(BNAL13)	25	48	45	43	-18
H16(BNAL07)	26	48	42	43	-17
H17(BNAL06)	27	48	44	43	-16
H18	26	48	43	43	-17
H19	27	48	41	43	-16
H20	21	48	40	43	-22
H21	24	48	44	43	-19
H22	23	48	41	43	-20
H23	21	48	39	43	-22
H24	24	48	44	43	-19
H25(BNAL01)	26	48	43	43	-17
H26	24	48	44	43	-19
H27	24	48	45	43	-19
H29	23	48	41	43	-20
H30	26	48	46	43	-17
H31	22	48	41	43	-21
H32	22	48	40	43	-21
H33	24	48	45	43	-19
H34	24	48	45	43	-19
H35	21	48	40	43	-22
H36	21	48	40	43	-22
H37	25	48	40	43	-18
H38	24	48	44	43	-19
H39	22	48	39	43	-21
H40	25	48	40	43	-18
H41(BNAL02)	25	48	42	43	-18
H42	24	48	48	43	-19
H43	23	48	50	43	-20
H44(BNAL14)	23	48	49	43	-20
H45	22	48	39	43	-21
H46	23	48	40	43	-20
H47	24	48	46	43	-19
H48	23	48	42	43	-20
H49	25	48	39	43	-18
H50	24	48	47	43	-19
H51	24	48	46	43	-19
H52	23	48	44	43	-20
H53(BNAL16)	26	48	43	43	-17
H54	25	48	39	43	-18
H55	22	48	39	43	-21
H56	25	48	41	43	-18
H57	25	48	41	43	-18
H58	18	48	36	43	-25
H59	18	48	36	43	-25
H60	22	48	38	43	-21
H61	19	48	38	43	-24
H62	24	48	38	43	-19
H63	18	48	37	43	-25
H64	24	48	46	43	-19
H65	24	48	45	43	-19
H66	24	48	39	43	-19
H67	23	48	38	43	-20
H68	24	48	39	43	-19
H69	24	48	39	43	-19
H70	18	48	37	43	-25
H71	23	48	40	43	-20
H72	24	48	45	43	-19
H73	24	48	45	43	-19
H74	22	48	39	43	-21
H75	19	48	37	43	-24
H76	21	48	38	43	-22
H77	25	48	42	43	-18
H78	25	48	42	43	-18

H79	23	48	38	43	-20
H80	24	48	43	43	-19
H81	23	48	38	43	-20
H82	21	48	37	43	-22
H83	22	48	37	43	-21
H84	20	48	37	43	-23
H85	20	48	37	43	-23
H86	23	48	37	43	-20
H87	18	48	37	43	-25
H88	23	48	37	43	-20
H89	18	48	36	43	-25
H90(BNAL18)	23	48	38	43	-20
H91	23	48	39	43	-20
H92	18	48	36	43	-25
H93	24	48	40	43	-19
H94	24	48	39	43	-19
H95	11	48	27	43	-32
H96	23	48	39	43	-20
H97	23	48	38	43	-20
H98	23	48	38	43	-20
H99	17	48	35	43	-26
H100	23	48	38	43	-20
H101	23	48	38	43	-20
H102	9	48	26	43	-34
H103	19	48	37	43	-24
H104	20	48	36	43	-23
H105	22	48	39	43	-21
H106	22	48	38	43	-21
H107	22	48	39	43	-21
H108	16	48	34	43	-27
H109	18	48	35	43	-25
H110	14	48	34	43	-29
H111	22	48	37	43	-21
H112	20	48	35	43	-23
H113	21	48	36	43	-22
H114	20	48	35	43	-23
H115	20	48	35	43	-23
H116	20	48	35	43	-23
H117	22	48	38	43	-21
H118	12	48	29	43	-31
H119	16	48	33	43	-27
H120	14	48	33	43	-29
H121	16	48	33	43	-27
H122	20	48	34	43	-23
H123	12	48	29	43	-31
H124	22	48	37	43	-21
H125	20	48	35	43	-23
H126(BNAL17)	19	48	35	43	-24
H127	19	48	35	43	-24
H128	19	48	34	43	-24
H129	15	48	34	43	-28
H130	14	48	32	43	-29
H131	15	48	33	43	-28
H132	19	48	35	43	-24
H133	14	48	32	43	-29
H134	19	48	34	43	-24
H135	15	48	32	43	-28
H136	14	48	32	43	-29
H137	18	48	35	43	-25
H138	15	48	32	43	-28
H139	13	48	30	43	-30
H140	15	48	32	43	-28
H141	19	48	34	43	-24
H142	15	48	33	43	-28
H143	15	48	32	43	-28
H144	17	48	34	43	-26
H145	18	48	35	43	-25
H146	13	48	30	43	-30
H147	21	48	39	43	-22
H148	12	48	31	43	-31
H149	14	48	32	43	-29
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H151	14	48	32	43	-29
H152	19	48	33	43	-24
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H154	18	48	33	43	-25
H156	12	48	31	43	-31
H157	19	48	33	43	-24
H158	18	48	32	43	-25