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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 10-1: Onshore Noise and Vibration Technical Report

June, 2018, Revision A

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 10-1: Onshore Noise and Vibration Technical Report

June, 2018

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Revision	A

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Onshore Noise and Vibration Technical Report

May 2018

Amec Foster Wheeler
Environment
& Infrastructure UK Limited

Report for

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1. Introduction

1.1 Purpose of this report

1.1.1 Amec Foster Wheeler Environment and Infrastructure UK Limited ('Amec Foster Wheeler') has been appointed by GoBe Consultants, on behalf of Vattenfall Wind Power Ltd to undertake studies relating to the Environmental Impact Assessment (EIA) for the proposed Thanet Extension Offshore Wind Farm (Thanet Extension).

1.1.2 There is potential for onshore noise and vibration effects during construction, operation and decommissioning of the Thanet Extension. This baseline report sets out the measured baseline data undertaken in April 2017 at noise (and vibration) Sensitive Receptors (NSRs) identified by Amec Foster Wheeler to inform the assessment of likely significant onshore noise and vibration effects from these activities.

1.1.3 Derived baseline data, such as that associated with the road traffic assessment, is not presented within this report. The derived road traffic baselines and the associated modelling methodology will be fully presented within the Environmental Statement (ES) to support the application for Development Consent Order (DCO).

1.1.4 The scope of the onshore noise baseline report was developed through consultation with key statutory consultees. Consultation included responses to regular meetings, discussions held on the proposed survey and monitoring methodology and DCO 'Environmental Impact Assessment Report to Inform Scoping'. The key statutory consultees relating to onshore noise and vibration include Thanet District Council (TDC) and Dover District Council (DDC).

1.1.5 This scope of this report does not include underwater noise and vibration, this is covered within a separate technical report.

1.1.6 Terminology for this report is provided in **Appendix A.**

1.2 Site Overview

1.2.1 The proposed Thanet Extension wind farm area would be located approximately 8 km offshore (at the closest point to shore), in proximity to the operational Thanet Offshore Wind Farm (TOWF).

1.2.2 Onshore infrastructure is required to connect the proposed offshore wind farm to the National Grid network. Infrastructure sources of sound and/or vibration include the construction, operation and decommissioning of:

- The offshore infrastructure including cables, vessels and wind turbines;
- Underground export cables, and associated infrastructure including Transition Joint Bays (TJBs); and
- Onshore substation.

1.2.3 The Planning Inspectorate (PINS) Scoping Opinion requested that further assessment of the potential effects at dwellings along the coast during each phase of the development, but particularly cable laying/pulling and landfall activities close

to the shoreline). Offshore sound and vibration to onshore receptors will be assessed using the same criteria as for onshore sources of sound (see **Section 2**).

1.2.4 This report presents the baseline data associated with making landfall in Pegwell Bay with cabling extending to the substation carried in up to four trenches.

1.2.5 The area in the vicinity of the onshore Thanet Extension infrastructure currently comprises a mix of rural, industrial/commercial and recreational uses. The significant contributor to existing background sound levels is from road traffic on the A256 dual carriageway or from industrial/commercial premises. A number of noise sensitive receptors that may potentially be affected by noise from construction of the cable route have been identified in the surrounding area.

2. Technical guidance

2.1 Baseline survey

2.1.1 The planning policy, standards and technical guidance used to inform the onshore Noise and Vibration ES chapter is fully detailed in the Thanet Extension ES.

Technical Guidance

2.1.2 For the purpose of defining the scope of the baseline including the methodology for the onshore sound, noise and vibration surveys for Thanet Extension, the guidance and Standards listed in **Table 2.1** were of specific relevance.

Table 2.1 Summary of Standards and technical guidance

Technical guidance	Summary
Construction (noise) - British Standards Institution 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, 2014 (BS5228-1:2009:A1:2014, 2014)	Provides a recommended scope for construction and demolition noise assessment (the ABC Method) presented in Annex E, British Standard (BS) 5228-1:2009+A1:2014, and also gives example threshold values for potential significant effects at noise sensitive receptors based upon the results of ambient sound monitoring.
Operational road traffic (noise) - Highways Agency Design Manual for Roads and Bridges, 2011 (DMRB, 2011)	Presents a methodology for determining impacts upon noise sensitive receptors from changes in road traffic noise due to road projects.
Construction and Operational road traffic (noise) – The Department of Transport Calculation of Road Traffic Noise, 1988 (CRTN, 1988)	Provides a calculation methodology for road traffic noise.
Construction and Operational road traffic (noise) – Transport and Road Research Laboratory – Converting the UK traffic noise index $L_{A10, 18hr}$ to EU noise indices for noise mapping, 2002 (TRL PR/SE/451/02, 2002)	A method for converting the road traffic noise indexes described in CRTN to produce outputs in the form of European Union indices, in particular TRL Method 2 which outlines the conversion of the $L_{A10, 18hr}$ noise indices to the $L_{Aeq, 16hr}$ and $L_{Aeq, 8hr}$ indexes.
Operational (noise)- British Standards Institution 4142:2014 Methods for rating and assessing industrial and commercial sound, 2014 (BS 4142:2014, 2014)	BS 4142:2014 describes methods for rating and assessing sound of an industrial nature (using outdoor sound levels), such as from factories, industrial premises, or fixed installations affecting people who might be inside or outside a dwelling. BS 4142:2014 does not apply to noise associated with the passage of vehicles on public roads and railway systems.
Operational (noise) – British Standards Institution 8233:2014 Guidance on sound insulation and noise reduction for buildings, 2014 (BS 8233:2014, 2014)	BS 8233:2014 provides information on the design of buildings that have internal acoustics environments appropriate to their functions. BS 8233:2014 provides guidance on the control of noise outside buildings, the control of noise from plant within buildings, and room acoustics. The BS 8233:2014 design requirements are intended considerations for new residential dwellings. The internal ambient noise levels are set assuming external noise is anonymous i.e. does not have a specific distinguishable character such as a tone.
Operational (noise) - Acoustics – Attenuation of sound during propagation outdoors: Part 2 General Method of Calculation, 1996 (ISO 9613-2, 1996)	Defines a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at distances from a source.
Institute of Environmental Management and Assessment Guidelines for Environmental Noise Impact Assessment, 2014 (IEMA, 2014)	Presents guidelines on how the assessment of noise effects should be presented within the Environmental Impact Assessment (EIA) process. The IEMA guidelines cover aspects such as; scoping, baseline, prediction and example definitions of significance criteria.

3. Methodology

3.1 Noise and vibration sensitive receptors

3.1.1 The assessment has considered the effects upon onshore receptors with the potential for adverse noise and vibration effects from Thanet Extension, including:

- Residential receptors – existing and proposed residential receptors in isolation or as a community (i.e. a group of receptors located in close proximity to one another, or within a named hamlet, village or town);
- Non-residential receptors – including schools, places of worship, and medical facilities; and
- Quiet areas – areas referred to in the National Planning Policy Framework (NPPF, 2012) as being prized for their recreational and amenity value.

3.1.2 NSRs have been identified using aerial photography resources, in particular those in the vicinity of the activities associated with the onshore construction of the cable route, as well as the proposed substation. The study area was originally defined as a 500 m buffer around the location of the onshore infrastructure. The identified residential and non-residential NSRs are outlined in **Table 3.1** and shown on **Figure 3.1**.

Table 3.1 Noise Sensitive Receptors

NSR	Name	Description
1	Beech Grove	Residential area identified in south-western Cliffsend to be potentially affected by noise and vibration from the construction of the cable route.
2	Oakland Court	Residential area identified in south-western Cliffsend to be potentially affected by noise and vibration from the construction of the cable route.
3	125-131 Sandwich Road	Residential area in the vicinity of Pegwell Bay which may be potentially affected by noise and vibration from the construction of the cable route.
4	Ebbsfleet Lane	Residential area in the vicinity of Pegwell Bay which may be potentially affected by noise and vibration from the construction of the cable route as well as the construction and operation of the proposed substation.
5	Stonar Cottage	Identified as closest residential property to the proposed substation and therefore an assessment of this location will indirectly include an assessment of the less sensitive NSRs in the vicinity.
6	Pegwell Bay Country Park	Nature reserve in the vicinity of the area to be potentially affected by noise and vibration from the construction of the offshore cable route.
7	Great Oaks Small School	School in the vicinity of the area to be potentially affected by noise and vibration from the construction of the offshore cable route.
8	Baypoint Club	Sports club in the vicinity of the area to be potentially affected by noise and vibration from the construction of the offshore cable route.
9	Stoneless Golf Centre	Golf course in the vicinity of the area to be potentially affected by noise and vibration from the construction of the offshore cable route.

632000 633000 634000 635000 636000

164000 163000 162000 161000

N

LT1 LT2 LT3 LT4 LT5

ST1 ST2 ST3 ST4

Cliffs End
Pegwell Bay
Isle of Thanet
Minster Marshes
Ash Level
Sandwich Flats
Sandwich Bay & Pegwell Bay National Nature Reserve
Mud & Sand
River Stour
Solar Farm
Richborough Port
North Stonar
Clapper Hill
Cottington Hill
Weatherlees Hill
Shell Ness

Key

Onshore Red Line Boundary

Noise sensitive receptor

0 250 500 750 m

Scale at A3: 1:15,000

Thanet Offshore Windfarm Extension

amec foster wheeler

Figure 3.1
Noise Sensitive Receptor Locations

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3.1.3 It is considered that Pegwell Bay Country Park can be considered an “area of tranquillity” as referred to in the NPPF, therefore the exiting ambient sound levels should be protected.

3.1.4 NSRs to the offshore sound and vibration sources comprise those listed in paragraph 3.1.1 situated along the coastline overlooking the proposed offshore wind farm, vessel routes and cable route.

3.2 Field surveys

3.2.1 The scope of the onshore noise and vibration baseline, including defining survey methods, was developed through consultation with key statutory consultees, namely DDC. No response was received from TDC to the initial consultation.

3.2.2 The main consultation with respect to the onshore noise and vibration baseline concerned agreement over monitoring locations and methodology for the Thanet Extension project, which was provisionally set out within the Noise Survey Methodology (NSM, see **Appendix B**). Agreement was reached with DDC prior to undertaking each of the surveys, and included the requirement for additional monitoring locations (see **Table 3.1**).

3.2.3 The baseline surveys relevant to each of the assessments to be presented within the DCO ES are summarised in **Table 3.2**.

Table 3.2 Assessment scenarios – baseline surveys

Assessment scenario	Associated baseline survey
Construction (noise) – fixed and mobile plant	Ambient and background sound monitoring
Operational (noise) – fixed plant	Ambient and background sound monitoring

3.3 Ambient and background sound surveys

3.3.1 The ambient and background sound survey work is required in order to inform the assessment of potential effects on NSR caused by the onshore construction and operational activities associated with Thanet Extension. Sound measurements at locations representative of the closest NSR have been undertaken in order to determine the existing representative baseline ambient and background sound levels at these receptors.

3.3.2 The results of the ambient sound monitoring has been used to facilitate the assessment of potential construction noise emissions from the various elements of the onshore construction programme. The results of the background sound monitoring has also be used to facilitate the assessment of commercial and industrial noise emissions from the operation of the proposed onsite substation.

Data collection locations

3.3.3 Ambient and background sound monitoring was undertaken over a period from Tuesday 18 - 25 April 2017. The monitoring consisted of both long-term (LT) and

short-term (ST) measurements. LT measurements, approximately 7 days in duration, were undertaken at locations representative of residential NSR. ST measurements, approximately 1 hour in duration, were undertaken at locations representative of the sound environment at non-residential NSR. The monitoring locations are summarised in **Table 3.3** and are shown in **Figure 3.1**.

Table 3.3 Summary – ambient and background sound surveys

Location Reference	Location Description	Duration	Description	Latitude	Longitude
LT1	33 Beech Grove, Cliffsend	7 Days	Measurement of typical ambient noise levels for dwellings in the west of Ramsgate.	51.329156°	1.362636°
LT2	9 Oakland Court, Ramsgate	7 Days	Measurement of typical ambient noise levels for dwellings in the west of Ramsgate nearer to Sandwich Road.	51.327048°	1.364225°
LT3	125 Sandwich Road	7 Days	Measurement of typical ambient noise levels for dwellings adjacent to Sandwich Road.	51.325760°	1.364966°
LT4	Stonelees Cottage, Ebbsfleet Lane, Ramsgate	7 Days	Measurement of typical ambient noise levels for dwellings adjacent to Ebbsfleet Lane.	51.314683°	1.350708°
LT5	Stonar Cottage	7 Days	Measurement of typical ambient noise levels at Stonar Cottage.	51.301981°	1.346738°
ST1	Pegwell Bay Country Park	1 Hour	Measurement of typical ambient noise levels for users of the park.	51.322055°	1.361641°
ST2	Great Oaks Small School	1 Hour	Measurement of typical ambient noise levels at the school.	51.318579°	1.344987°
ST3	Baypoint Club*	1 Hour	Measurement of typical ambient noise levels for users of the club.	51.311004°	1.350866°
ST4	Land at Stoneless Golf Centre	1 Hour	Measurement of typical ambient noise levels for users of the golf course	51.318425°	1.348730°

*proxy location outside Baypoint Club was used.

3.3.4 The short-term measurements were undertaken during school term time and therefore represent typical road traffic sound levels. The measurement at Great Oaks Small School was undertaken after school hours for security and access reasons, however, provides a conservative (low) measurement of typical ambient sound levels as sound from use of the school will not be included in the ambient sound levels.

3.3.5 The short-term measurements were undertaken during daytime hours, but outside of times of peak road traffic flow to provide a conservative (low) measurement of typical sound levels for setting acceptable construction/decommissioning and operational noise levels during the periods of use of the NSRs.

Data collection methodology

3.3.6 All ambient and background sound measurements were undertaken by suitably qualified Amec Foster Wheeler personnel. ‘Suitably qualified’ means qualified to the Institute of Acoustics Certificate of Competence in Environmental Noise Monitoring, as a minimum.

3.3.7 Ambient and background sound monitoring equipment at the LT locations was left to measure sound continuously for approximately one week, between 18 - 25 April 2017. The sound monitoring equipment was left unmanned for a majority of the survey period and observations of the sound environment were made during its deployment and collection. The one week survey duration allowed for an adequate

understanding of potential changes in the baseline and background sound environments.

3.3.8 At the ST locations, ambient and background monitoring was undertaken for approximately 1 hour on either the 18 or 19 April 2017.

3.3.9 All ambient and background sound measurements were undertaken in accordance with BS 4142:2014 '*Methods for rating and assessing industrial and commercial sound*' (2014) and BS 7445 1:2003 '*Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures*' (2003), i.e. with microphones mounted to a minimum height of 1.2 – 1.5 m above ground level, and no less than 3.5 m from any reflecting surface other than ground. The measurement logging consisted of 15 minute and 100 ms resolution, in a full suite of energetic and statistical parameters including: $L_{Aeq,T}$, $L_{A90,T}$, $L_{A10,T}$ and L_{AFmax}. At locations LT1 and LT4, one-third octave band frequencies were recorded along with interval audio recording, recording 1 in every 10 minutes.

3.3.10 At each location sound levels were measured using integrating averaging sound level meters (SLM) conforming to Class 1 or better as defined by BS EN 61672:Part 1:2013 *'Electroacoustics, Sound Level Meters, Specifications'* (2013). The SLMs were field calibrated before and at the end of each survey period, by applying an acoustic calibrator or piston-phone, conforming to BS EN 60942:2003 *'Electroacoustics - Sound Calibrators'* (2003), to the microphone to check the sensitivity of the measuring equipment. Any drift in calibration levels was noted upon collection.

3.3.11 For all ambient and background sound surveys, the equipment used has undergone laboratory calibration within a period not exceeding two years prior to use (calibrators used are within a period not exceeding one year of calibration).

3.3.12 Meteorological measurement equipment was deployed at LT1 to monitor local wind speeds and direction, precipitation and air temperature during each of the ambient and background sound monitoring surveys. The results of the meteorological surveys have been used in the analysis of the ambient and background sound data to ensure that only data collected under appropriate weather conditions has been used in defining the baseline sound levels. Adverse weather conditions are considered to comprise periods with: wind speeds above 5 $m \cdot s^{-1}$; precipitation; frozen ground or snow coverage; temperature inversions; and/or fog/mist. This approach is advocated within British Standards BS4142:2014 and BS5228-1:2009+A1:2014 *'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'* (2014).

3.4 Baseline vibration

3.4.1 Baseline vibration surveys are not required as acceptable vibration levels are not dependant on pre-existing levels.

4. Results

Data analysis

4.1.1 Baseline levels were calculated from the sound monitoring results using Microsoft Office 365 ProPlus Excel 2013 for each of the monitoring locations described. For each monitoring location the statistical parameters, and the associated assessment requirements, are listed in Table 4.1.

Table 4.1 Summary – Ambient and background sound survey statistical parameters

Assessment	Assessment Period	Statistical Parameters (dB)
Construction assessment night-time	Monday – Sunday 23:00 – 07:00	$L_{Aeq,\,T}$
Construction assessment evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00 – 23:00 Sunday 07:00 – 23:00	$L_{Aeq,\,T}$
Construction assessment daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	$L_{Aeq,\,T}$
Operational assessment night-time	Monday – Sunday 23:00 – 07:00	$L_{Aeq,\,T}$ and $L_{A90,\,T}$ [mean / modal average]
Operational assessment daytime	Monday – Sunday 07:00 – 23:00	$L_{Aeq,\,T}$ and $L_{A90,\,T}$ [mean / modal average]

4.1.2 Meteorological data was used to identify periods when adverse weather conditions (see **Paragraph 3.3.12**) occurred during the ambient and background monitoring surveys. A 45-minute period from 19:15 on 24 April 2017 has been removed from the final ambient and background sound data set due to rainfall. There were no other periods of adverse weather during the sound monitoring.

Long-term ambient and background sound monitoring results

4.1.3 The results of the ambient and background sound monitoring for Thanet Extension and the statistical parameters are summarised in **Table 4.2**. **Appendix C** provides further details, including associated time-history graphs.

Table 4.2 Summary – LT ambient and background sound monitoring results

Location Reference	Monitoring Location	Weekday monitoring period	$L_{Aeq, T}$ (dB)	$L_{A90, T}$ [mean average] (dB)	$L_{A90, T}$ [modal average] (dB)*
LT1	33 Beech Grove, Cliffsend Content	Daytime (07:00 – 23:00)	57	41	46
		Night-time (23:00 – 07:00)	51	34	26
LT2	9 Oakland Court, Ramsgate	Daytime (07:00 – 23:00)	48	40	43
		Night-time (23:00 – 07:00)	46	32	26
LT3	125 Sandwich Road	Daytime (07:00 – 23:00)	54	43	44
		Night-time (23:00 – 07:00)	49	34	31
LT4	Stonelees Cottage, Ebbsfleet Lane	Daytime (07:00 – 23:00)	49	41	42
		Night-time (23:00 – 07:00)	50	34	31
LT5	Stonar Cottage	Daytime (07:00 – 23:00)	68	57	59
		Night-time (23:00 – 07:00)	61	38	32

*modal averages rounded to the nearest whole number

4.1.4 The sound environment noted during SLM deployment and collection of the LT locations had road traffic noise as a dominant contributor at the majority of the locations. Location specific sound environment observations are detailed within **Appendix C**.

Short-term ambient and background sound monitoring results

4.1.5 The results of the ambient and background sound monitoring for Thanet Extension in the ST locations are included in **Appendix C**, as summarised in **Table 4.3**.

Table 4.3 Summary – ST ambient and background sound monitoring results

Location Reference	Monitoring Location	Date / Time	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)
ST1	Pegwell Bay Country Park	18/04/2017 13:00 – 14:00	47	42
ST2	Great Oaks Small School	18/04/2017 15:30 – 16:30	49	46
ST3	Baypoint Club*	18/04/2017 14:15 – 15:15	58	55
ST4	Land at Stoneless Golf Centre	19/04/2017 11:00 – 12:00	52	43

*proxy location outside Baypoint Club was used, see Figure 3.1

4.1.6 The sound environment during observations was similar to that observed at the long-term locations (generally quiet) except for the Baypoint Club which is situated close to the main road. Road traffic noise was a dominant contributor at each of the long- and short-term locations. Location specific sound environment observations are detailed within **Appendix C**.

Appendix A
Noise and vibration terminology

Throughout this report the term ‘noise’ is used to describe an ‘unwanted sound’, and is generally applied when describing assessment methodologies or the predictions of emissions at receptors for the purpose of assessment. In keeping with relevant policy, Standards and guidance (see Table 2.1), calculated or measured emissions associated with the existing acoustic environment (such as ambient or background levels), and not associated with road traffic will be described as ‘sound’.

Whilst it is recognised that road traffic noise is not always considered ‘unwanted’, the term ‘noise’ will be applied when describing their measurement.

The term ‘noise’ refers to airborne noise, and ‘vibration’ to ground-borne vibration. For all other terminology, the full technical description is used, such as ‘ground-borne noise’. Additional technical terminology relevant to this report are presented in Table A.4.

Table A.4 Thanet Extension baseline report noise and vibration terminology

Term	Definition
Acoustic calibrator	The Acoustic Calibrator fits over the microphone and outputs a consistent sound level for the microphone to detect. The software in the sound level meter recognises the defined output from the calibrator and if any variation is detected the sound level meter offsets the difference to ensure all measurements are consistent and accurate against a consistent noise source.
Acoustic environment	Sound from all sources as modified by the environment.
Ambient sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.
Ambient sound level	The $L_{Aeq,\,T}$ of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
A-weighting	A frequency weighting derived to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies.
Background sound level	The underlying level of sound over a period, T, and is represented by $L_{A90,\,T}$
dB	A measure of sound pressure level in decibels, as specified BS EN 61672-2:2003 ‘Electroacoustics. Sound level meter’.
Façade level	A measurement that is undertaken within the acoustic influence of a reflective façade. BS 8233:2014 states that façade level measurement is typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the façade.
Fast time weighting	A time interval of 125 ms that the sound level meter records sound levels.
Free-field level	A measurement that is undertaken away from the acoustic influence of a reflective façades.
Hertz (Hz)	The number of waves per second. The unit of measurement for frequency of a sound wave.
Inverse square law	Any condition in which the magnitude of a physical quantity follows an inverse relationship to the square of the distance. In pure spherical divergence of sound from a point source in free space, the sound pressure level decreases 6 dB for each doubling of the distance.
$L_{A10,\,18h}$	The L_{A10} over the period 06:00 – 24:00 (local time), with a fast time weighting.

Term	Definition
$L_{A10, T}$	The A-weighted sound pressure level that is exceeded for 10% of a given time interval, *T*, measured using a fast time weighting. It is used to measure road traffic sound levels.
$L_{A90, T}$	The A-weighted sound pressure level that is exceeded for 90% of a given time interval, *T*, measuring using a fast time weighting.
$L_{Aeq, 16hr}$ / $L_{Aeq, 8hr}$	The L_{Aeq} over the periods 07:00 – 23:00 (local time), and 23:00 – 07:00 (local time), respectively, measured using a fast time weighting.
$L_{Aeq, T}$	The A-weighted equivalent continuous sound pressure level measured using a fast time weighting. It is a notional continuous level that, at a given position and over the defined time period, *T*, contains the same sound energy as the actual fluctuating sound that occurred at the given position over the same time period, *T*.
$L_{AFmax, T}$	The maximum recorded sound level within a given time period, *T*, measured using a fast time weighting.
$L_{ASmax,T}$	The maximum recorded sound level within a given time period, *T*, measured using a slow time weighting.
Longitudinal wave	A wave in which vibrations are in the direction of propagation of sound, for example, sound waves in air
Mean (average)	The arithmetic average of a set of numbers, e.g. add up the numbers and divide by the number of numbers.
Modal (average)	The mode is the number in a dataset that is repeated more often than any other number in the same set
Noise	A term used to describe “unwanted sound” or any sound that is undesired by the recipient.
Noise Level Indices (L_n parameters)	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
Octave Frequency Bands	A range of frequencies where the upper frequency limit is twice that of the lower frequency limit. For example, the 1000 Hertz octave band contains acoustic energy at all frequencies from 707 to 1414 Hz.
One Third Octave Frequency Bands	Octave bands that are sub-divided into three parts, equal to 23% of the centre frequency. Used when octave analysis is not discrete enough. Divides the audio spectrum into 33 or more equal parts where the cut-off frequencies have a ratio of 21/3, which is approximately 1.26. For example, a 1 kHz third-octave band filter has a centre frequency of 1000 Hz with lower and upper frequencies of 891 Hz and 1112 Hz, respectively.
Slow time weighting	A time interval of 1 s that the sound level meter records sound levels.
Sound	Any pressure variation that the human ear can detect. Depending on the medium, sound extends and affects a greater area (propagates) at different speeds. In air, sound propagates at a speed of approximately 343 $m \cdot s^{-1}$. In liquids and solids, the propagation velocity is greater - 1480 $m \cdot s^{-1}$ in water and 5120 $m \cdot s^{-1}$ in steel, for example.
Sound Exposure Level (SEL)	Is the $L_{Aeq, T}$ noise level normalised to 1 s and is commonly used to determine noise levels from trains, for example.
Sound level meter (SLM)	SLM is the instrument used for acoustic (sound that travels through air) measurements. It is commonly a hand-held instrument with a microphone. The diaphragm of the microphone responds to changes in air pressure caused by sound waves.
Sound Power Level (L_W)	The total sound energy radiated by a source per unit of time.
Sound pressure level (L_p)	Sound pressure level is the RMS value of the Instantaneous Sound Pressures measured over a specified period of time, measured in decibels (dB) to a given reference pressure level.
Specific sound level	An $L_{Aeq, T}$ measurement of a specific sound source at the assessment location of a given time period, *T*.
Threshold of hearing	The minimum sound pressure level of a pure tone that can be perceived by a person with good hearing. A sound pressure of 20x10-6 Pascal (0.0002 mBar) is defined as 0 dB L_p.

Table A.5 provides a summary of the abbreviations used within this report.

Table A.5 Summary of abbreviations

Abbreviation	Detail
DCO	Development Consent Order
DDC	Dover District Council
EIA	Environmental Impact Assessment
ES	Environmental Statement
LT	Long-term
NPPF	National Planning Policy Framework
NSM	Noise Survey Methodology
NSRs	Noise (and vibration) Sensitive Receptors
PINS	Planning Inspectorate
SLM	Sound level meters
ST	Short Term
TDC	Thanet District Council
TJBs	Transition joint bays
TOWF	Thanet Offshore Wind Farm
Thanet Extension	Thanet Extension Offshore Wind Farm

Appendix B
Noise Survey Methodology document

Technical note:
Noise Survey for Thanet Extension Offshore Wind Farm Onshore Cable and Substation Connection

1. Introduction

1.1 Introduction

The principal sound, noise and vibration consideration for the onshore cable route associated with the Thanet Extension Offshore Wind Farm (TEOWF) are from the construction of the route, including excavation of the route and construction vehicles on public roads. With regards to the grid connection, construction and operational noise will be considered.

This Technical Notes sets out Amec Foster Wheeler's proposed sound survey methodology, which is consistent with industry best practice and the technical experience and professional judgment of the noise consultant. This technical note has therefore been issued to inform the relevant Environmental Health Departments at Thanet District Council and Dover District Council of the proposed methodology.

1.2 On-shore Cable Route

The majority of the noise sensitive receptors (NSRs) that will be potentially affected by noise and vibration from construction of the cable route are located in the south-western area of Cliffsend. In addition to those located within Cliffsend, a number of other NSRs have been identified further south along the route, including:

- 125-131 Sandwich Road;
- Users of Pegwell Bay Country Park;
- Dwellings long Cottington Road at the northern edge of the 500 m buffer;
- A number of dwellings situated along Ebbsfleet Lane;
- Users of the Baypoint Club;
- Users of Stonelees Golf Centre; and
- Great Oaks Small School at the northern edge of the 500 m buffer.

There are also a number of commercial and industrial areas along the cable route, however, it is considered that these are likely to not be significantly affected by construction noise and vibration

1.3 Grid Connection

One of the options for the grid connection is to use the existing Richborough Energy Park and the proposed noise survey will collect baseline data for this option. Should an alternative grid connection be selected then further sound measurements will be undertaken. The nearest NSR to Richborough Energy Park is Stonar

Cottage. The remaining properties around Richborough Energy Park are commercial or industrial in nature and located in the vicinity of Stonar Cottage and therefore it is considered that assessment of the noise and vibration impacts to Stonar Cottage will indirectly include assessment of the less-sensitive NSRs.

2. Proposed Noise Survey Methodology

2.1 Noise Survey Locations

Based on a review of satellite imagery a combination of long-term monitoring for a period of at least seven days at five locations and short-term spot measurements at four locations over two 1-hour periods is recommended. It is considered that the survey duration will capture representative levels of sound in order to determine the existing baseline sound level. **Table 2.1** provides a summary of the proposed noise survey locations.

Table 2.1 Noise Survey Locations

Location Reference	Location Description	Rationalisation	Duration of Monitoring
LT1	33 Beech Grove, Cliffsend	Measurement of typical ambient noise levels for dwellings in the west of Ramsgate	At least seven days
LT2	9 Oakland Court, Ramsgate	Measurement of typical ambient noise levels for dwellings in the west of Ramsgate nearer to Sandwich Road	At least seven days
LT3	125-131 Sandwich Road[1]	Measurement of typical ambient noise levels for dwellings adjacent to Sandwich Road	At least seven days
LT4	Stonelees Cottage, Ebbsfleet Lane, Ramsgate	Measurement of typical ambient noise levels for dwellings adjacent to Ebbsfleet Lane	At least seven days
LT5	Stonar Cottage[1]	Measurement of typical ambient noise levels at Stonar Cottage	At least seven days
ST1	Pegwell Bay Country Park	Measurement of typical ambient noise levels for users of the park	Two 1-hour daytime measurements on different days
ST2	Great Oaks Small School (or land adjacent to the school if access to the school is not possible0	Measurement of typical ambient noise levels at the school	Two 1-hour daytime measurements on different days
ST3	Baypoint Club	Measurement of typical ambient noise levels for users of the club	Two 1-hour daytime measurements on different days
ST4	Land at Stonelees Golf Centre	Measurement of typical ambient noise levels for users of the golf course	Two 1-hour daytime measurements on different days

Note 1: Access for these locations has not yet been obtained. If access is not granted an alternative location and/or methodology will be proposed.

2.2 Proposed Survey Methodology

The noise survey will be undertaken in suitable weather conditions, i.e. no precipitation and when wind speeds are below 5 $m \cdot s^{-1}$. A MET station will be deployed at one of the survey locations.

The calibration of the sound level meters will be checked before and after each measurement and appropriate windshields will be fitted to the microphones to minimise the effects of any wind induced noise.

All measurements will be conducted, where possible, in accordance with BS 7445-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*.'

The pertinent details of BS 7445-1:2003 are as follows:

- Instrumentation to measure equivalent continuous A-weighted sound pressure level conforming to class 1 as given in BS EN 61672-1:2013;
- All equipment calibrated and the calibration shall follow manufacturer's instructions. All Amec Foster Wheeler sound monitoring equipment is calibrated at an accredited laboratory at a minimum interval of 24 months; and
- To minimise the influence of reflections by, whenever possible, undertaking measurements at least 3.5 m from any reflective surface other than the ground. The preferred measurement height is 1.2 m to 1.5 m above the ground.

All staff involved with sound measurements will be fully competent, either being Members of the Institute of Acoustics or holding the Institute of Acoustics (IOA) Certificate of Competence in Environmental Noise Measurement.

For the operational noise assessment, BS 4142:2014 requires consideration of the uncertainty associated with measured values. Measurement uncertainty will be minimised for the background sound measurements using the following steps:

- The measurement location will be representative of the external amenity areas of the proposed dwellings wherever possible;
- The measurement position will be located away from reflecting surfaces and leafy vegetation;
- The measurements will be undertaken using the minimum logging period suggested in BS 4142:2014;
- The measurements will be undertaken under suitable weather conditions as described in Section 6.4 of BS 4142:2014, as indicated by the results of weather monitoring; and
- The instrumentation will be suitable according to Section 5 of BS 4142:2014.

Long Term (LT) Location Noise Metrics

The noise monitoring equipment will measure the following metrics continuously for a minimum of seven days: $L_{Aeq,\ 15\ min}$, L_{AFmax}, $L_{A10,\ 15\ min}$, $L_{A90,\ 15\ min}$.

Short Term (ST) Location Noise Metrics

The noise monitoring equipment will measure the following metrics for one hour twice in each location: $L_{Aeq,\ 15\ min}$, L_{AFmax}, $L_{A10,\ 15\ min}$, $L_{A90,\ 15\ min}$.

Author	Reviewer
[redacted]	[redacted]
.....	pp .....
Angela Lamacraft	John Cookson

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Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Appendix C
Ambient and background sound monitoring results

Long-term monitoring

Location Reference
LT1: 33 Beech Grove

Location
Cliffsend

Period
18/04/2017 – 25/04/2017

Description of Monitoring Location

LT1 was located in the west of Cliffsend, an area identified to be potentially affected by noise and vibration from the construction of the onshore cable route associated with Thanet Extension. The Sound Level Meter (SLM) was positioned in a free-field location in the rear garden of the property, approximately 20 m from the northern façade of the house. The acoustic environment was considered to be representative of the background sound level within the area.

General Observations

Road traffic noise from the A299 (located 360 m north) and the A256 (located 500 m west) was the dominant contributor to the acoustic environment. Rail pass-bys were audible from the Ashford to Ramsgate railway (located 200 m north), which dominated the acoustic environment for the duration of the pass-by. Bird song was intermittent as well as aircraft noise.

Night-time observations were undertaken and it was noted that road traffic noise from the A299 and A256 remained the dominant contributor, however the overall traffic level had reduced and therefore the level of road traffic noise had subsided. Furthermore, because the road traffic noise had reduced, water flowing under a manhole cover on Beech Grove was audible.

Figure C.1 Monitoring Location LT1

Table C.1 Summary of Sound Monitoring at Location LT1

Assessment	Assessment Period	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)	$L_{A90,\,T}$ [modal average] (dB)*
Results for use in the construction assessment: night-time	Monday – Sunday 23:00 – 07:00	51	34	26
Results for use in the construction assessment: evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00 – 23:00 Sunday 07:00 – 23:00	50	37	38
Results for use in the construction assessment: daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	59	43	46
Results for use in the operational assessment: night-time	Monday – Sunday 23:00 – 0:700	51	34	26
Results for use in the operational assessment: daytime	Monday – Sunday 07:00 – 23:00	57	41	46

*modal averages rounded to the nearest whole number

Figure C.2 Sound Level Time History: LT1

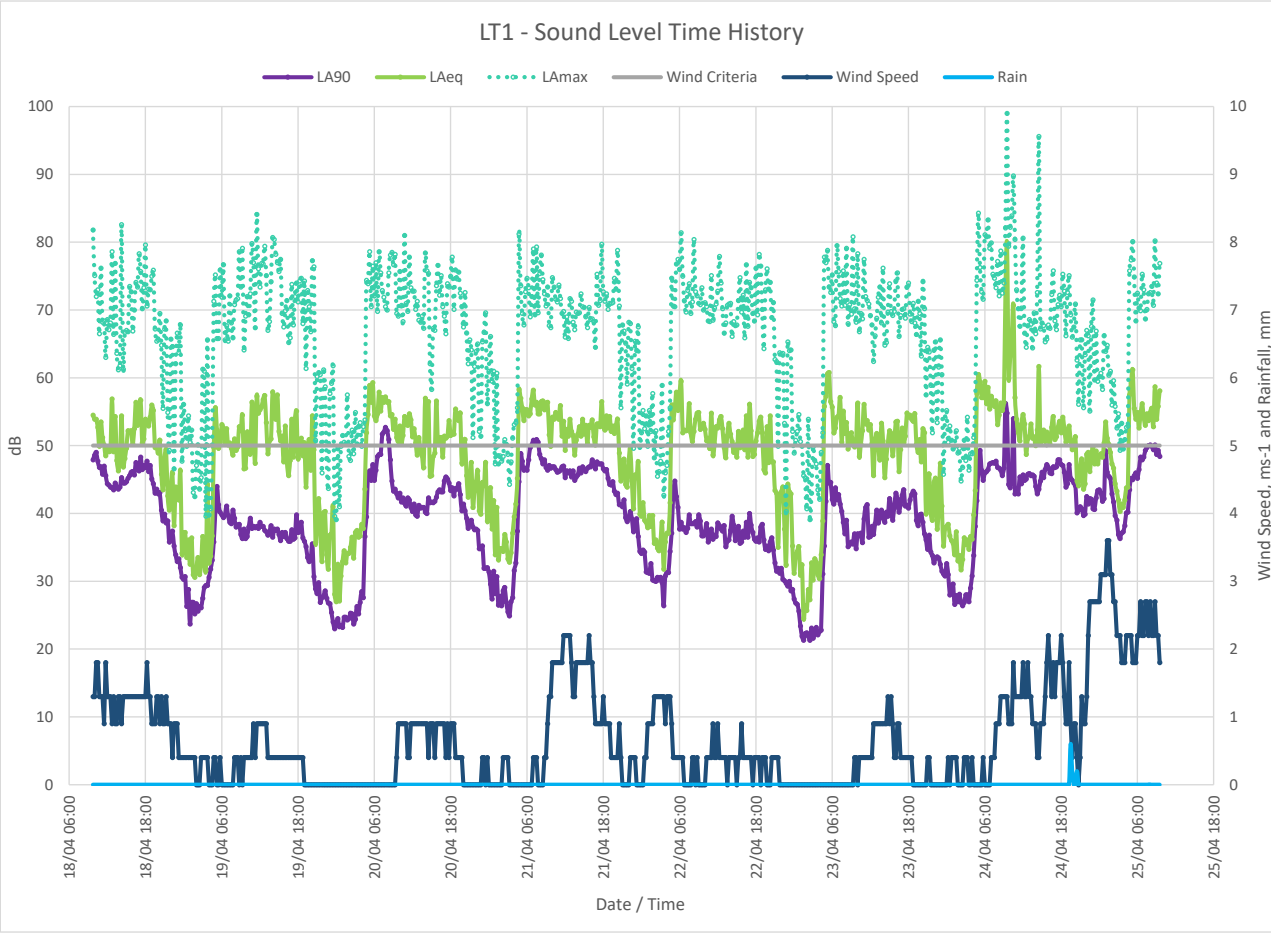


Figure C.3 Histogram of Background Sound Levels: LT1, Daytime

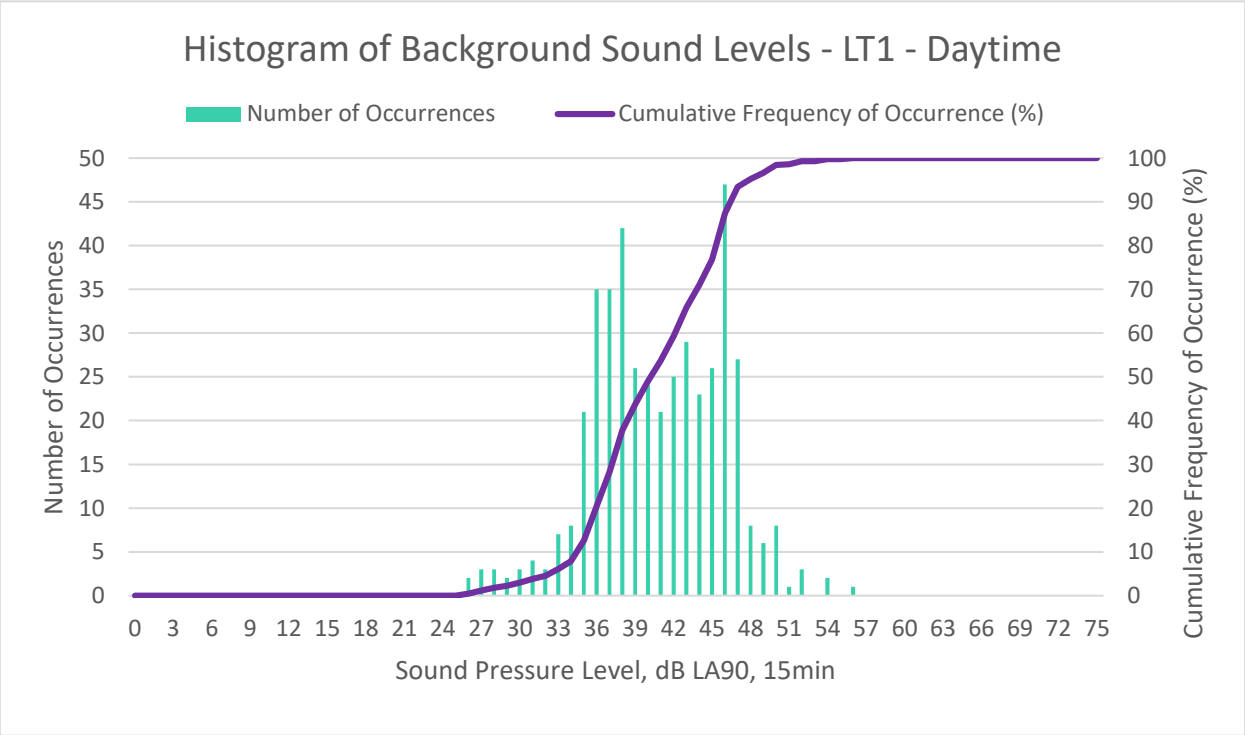
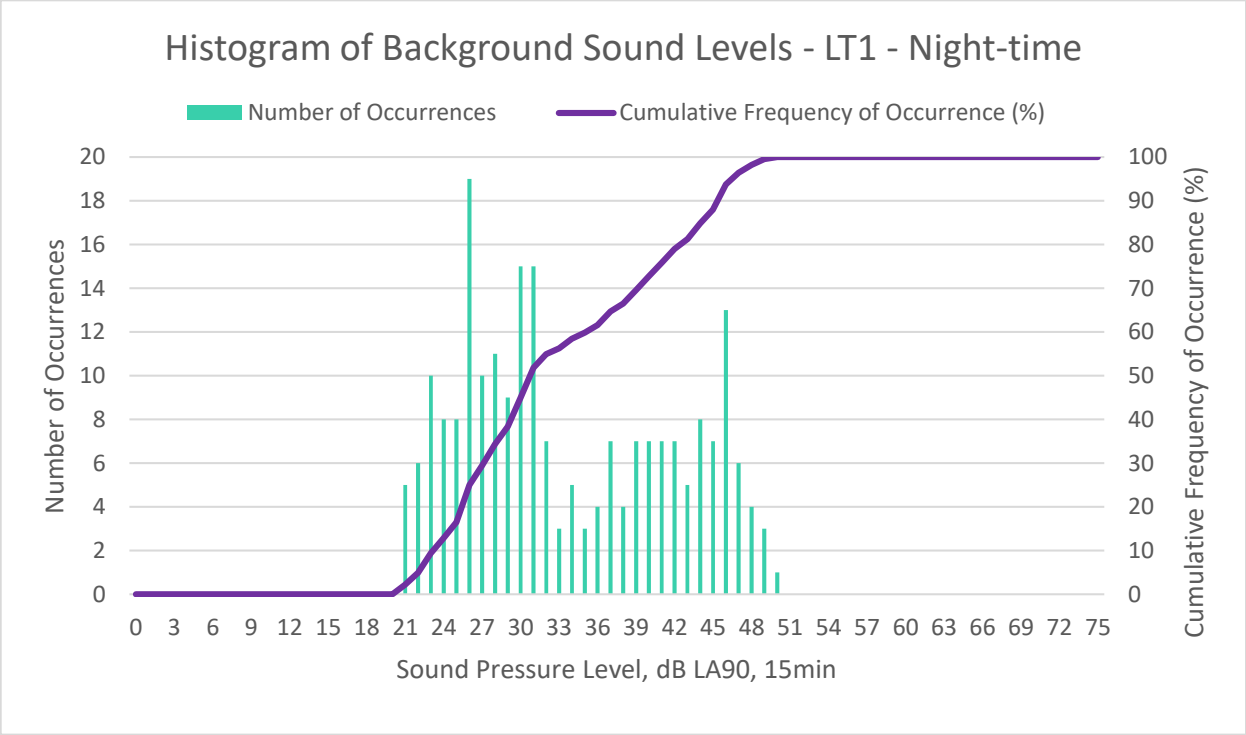


Figure C.4 Histogram of Background Sound Levels: LT1, Night-Time



Location Reference
LT2: 9 Oakland Court

Location
Cliffsend

Period
18/04/2017 – 25/04/2017

Description of Monitoring Location

LT2 was located in the south west of Cliffsend, an area identified to be potentially affected by noise and vibration from the construction of the onshore cable route associated with Thanet Extension. The SLM was positioned in a free-field location in the rear garden of the property, approximately 25 m from the southern façade of the house. The acoustic environment was considered to be representative of the background sound level within the area.

General Observations

Road traffic noise from the A299 (located 600 m north) was a dominant contributor to the acoustic environment observed upon deploying and collecting the SLM. Bird song was constant. Rail horns were audible from the Ashford to Ramsgate railway (located 510 m north), however, rail pass-bys were not audible. A helicopter flyover was also audible.

Night-time observations were undertaken and it was noted that road traffic noise from the A299 remained the dominant contributor, however the level of road traffic noise had subsided. The breeze moving the leaves in the trees was audible intermittently.

Figure C.5 Monitoring Location LT2

Table C.2 Summary of Sound Monitoring at Location LT2

Assessment	Assessment Period	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)	$L_{A90,\,T}$ [modal average] (dB)*
Construction assessment night-time	Monday – Sunday 23:00 – 07:00	46	32	26
Construction assessment evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00 – 23:00 Sunday 07:00 – 23:00	47	37	38
Construction assessment daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	49	42	43
Operational assessment night-time	Monday – Sunday 23:00 – 0:700	46	32	26
Operational assessment daytime	Monday – Sunday 07:00 – 23:00	48	40	43

*modal averages rounded to the nearest whole number

Figure C.6 Sound Level Time History: LT2

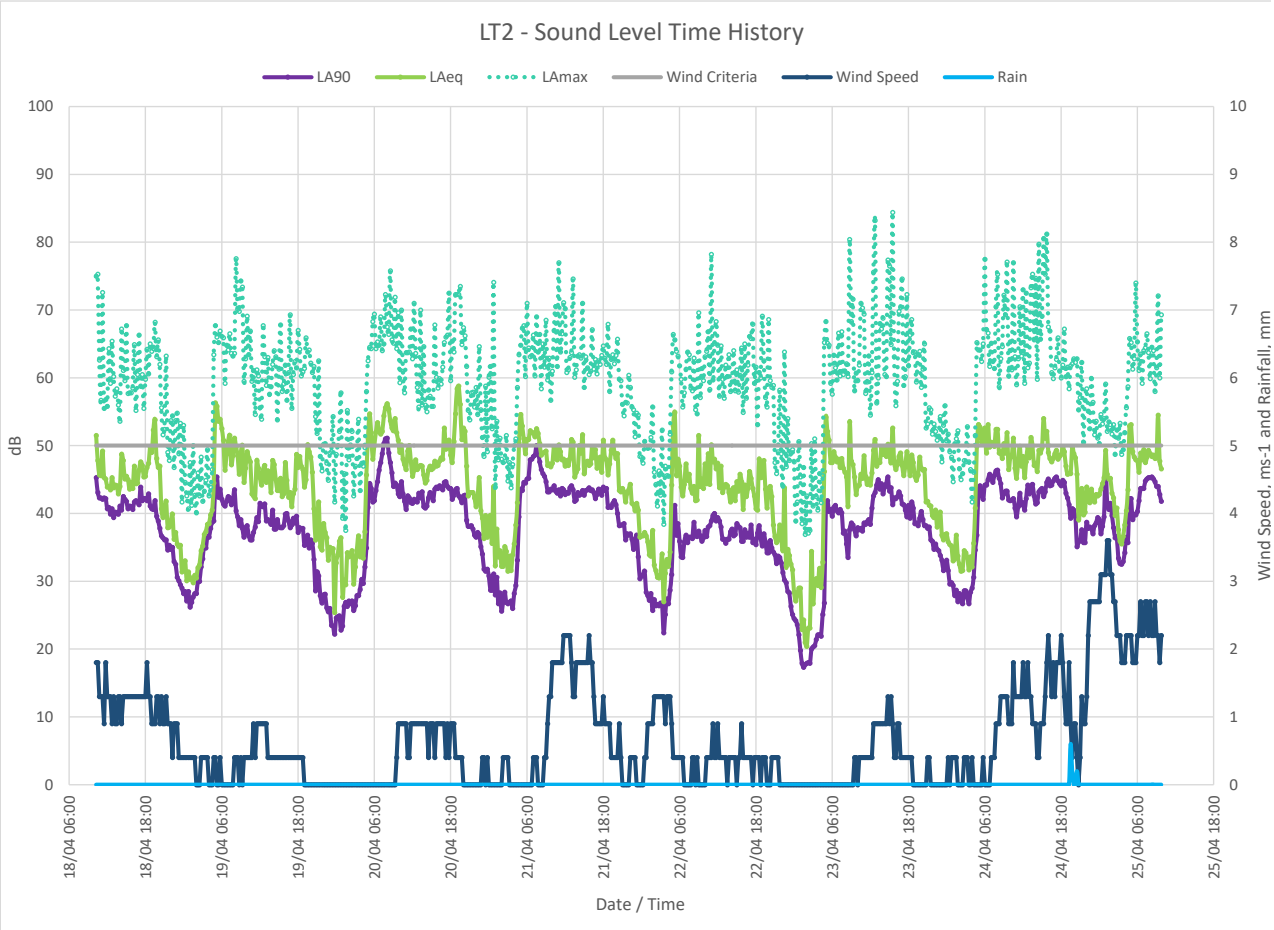


Figure C.7 Histogram of Background Sound Levels: LT2, Daytime

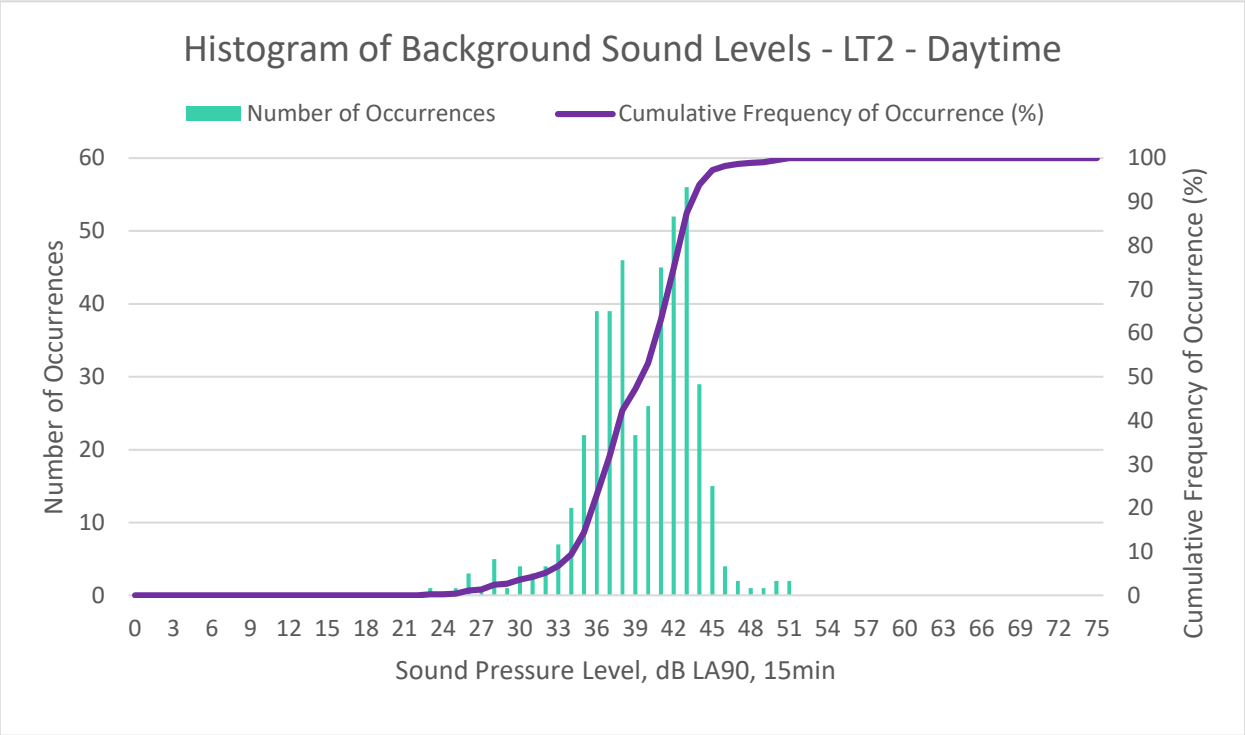
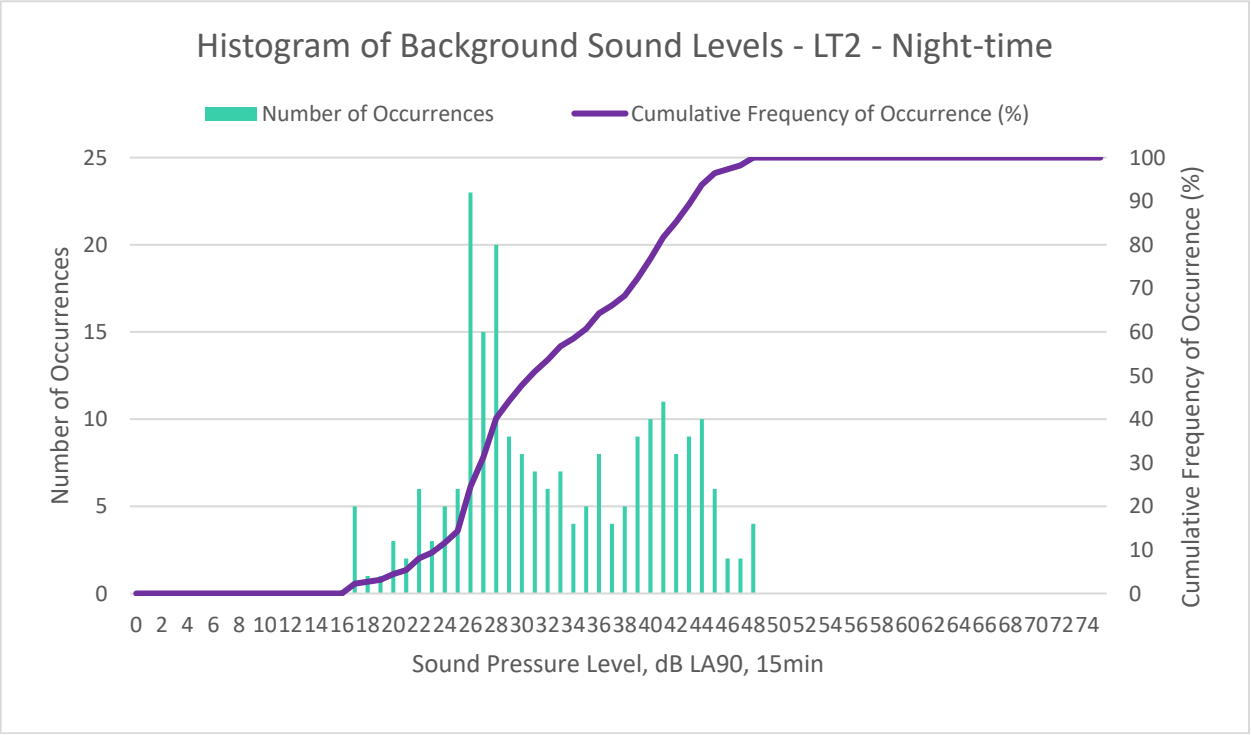


Figure C.8 Histogram of Background Sound Levels: LT2, Night-Time



Position
LT3: 125 Sandwich Road

Location
Cliffsend

Period
18/04/2017 – 25/04/2017

Description of Monitoring Location

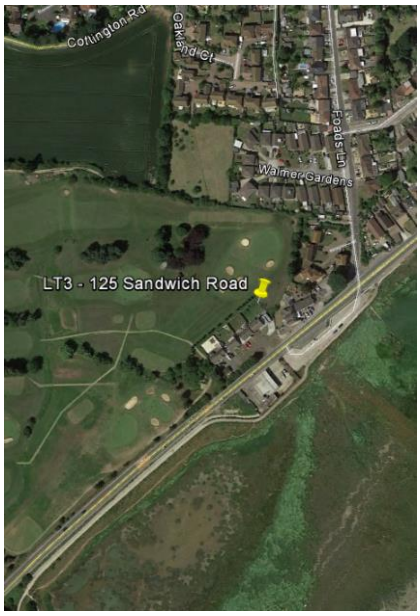
LT3 was located in the south of Cliffsend, an area identified to be potentially affected by noise and vibration from the construction of the onshore cable route associated with Thanet Extension. The SLM was positioned in a free-field location in the rear garden of the property, approximately 13 m from the north-western façade of the house. The acoustic environment was considered to be representative of the background sound level within the area.

General Observations

Road traffic noise was the dominant contributor to the acoustic climate, emanating from the north and intermittently from Sandwich Road (located 40 m south east). Road traffic noise emanating from Sandwich Road dominated the acoustic environment whilst traffic passed by. Bird song and dog barking was intermittent as well as sound from St. Augustine's Golf Club (which backs onto the rear garden of the property), which included golf caddies and lawn mowers.

Night-time observations were undertaken and it was noted that distant road traffic noise from the north remained dominant and traffic flow on Sandwich Road had reduced. The golf course was now not audible, whilst a low breeze moving through the trees became audible.

Figure C.9 Monitoring Location LT3



*modal averages rounded to the nearest whole number

Table C.3 Summary of Sound Monitoring at Location LT3

Assessment	Assessment Period	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)	$L_{A90,\,T}$ [modal average] (dB)*
Construction assessment night-time	Monday – Sunday 23:00 – 07:00	49	34	31
Construction assessment evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00 – 23:00 Sunday 07:00 – 23:00	48	40	42
Construction assessment daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	56	45	44
Operational assessment night-time	Monday – Sunday 23:00 – 0:700	49	34	31
Operational assessment daytime	Monday – Sunday 07:00 – 23:00	54	43	44

Figure C.10 Sound Level Time History: LT3

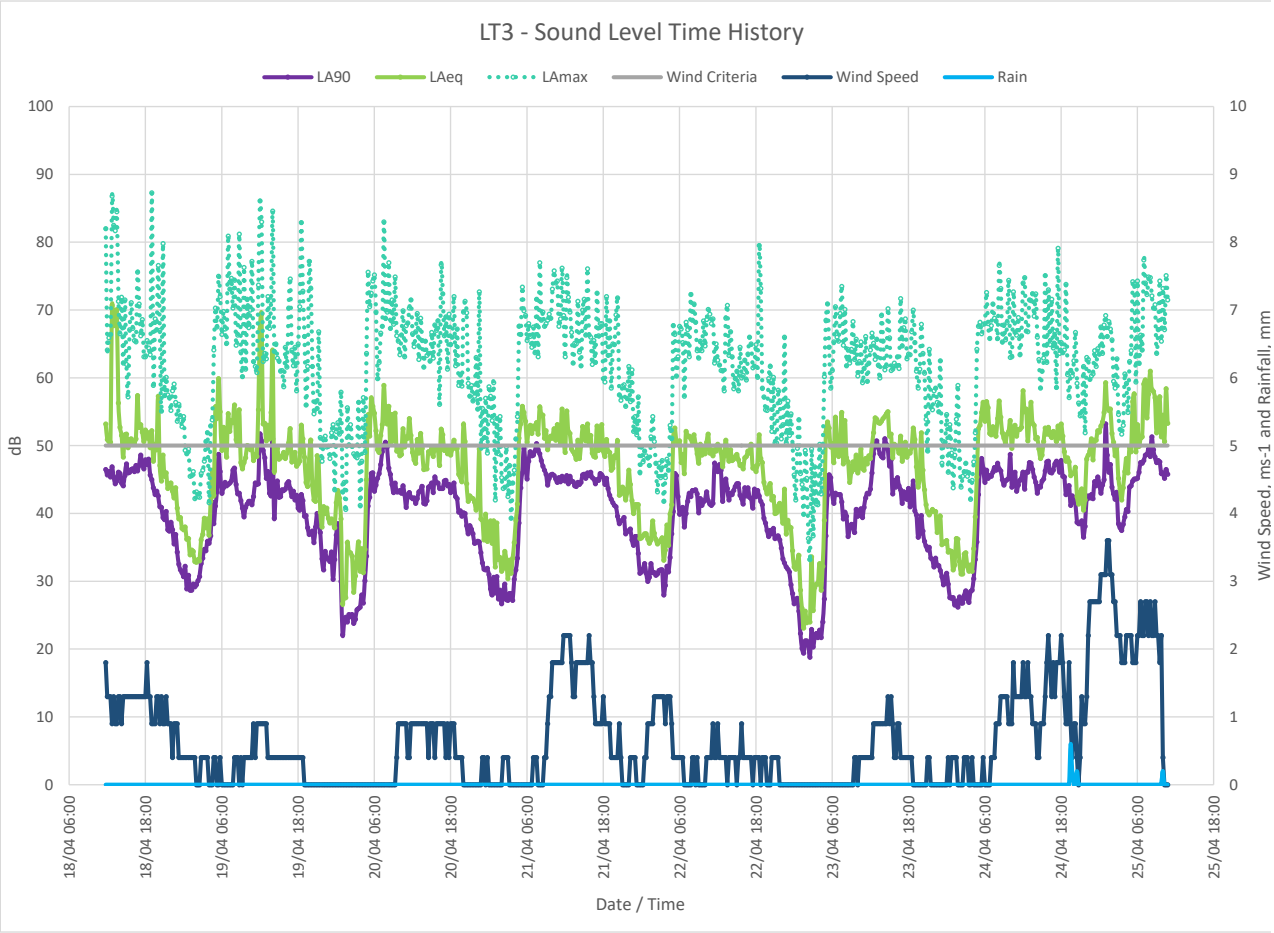


Figure C.11 Histogram of Background Sound Levels: LT3, Daytime

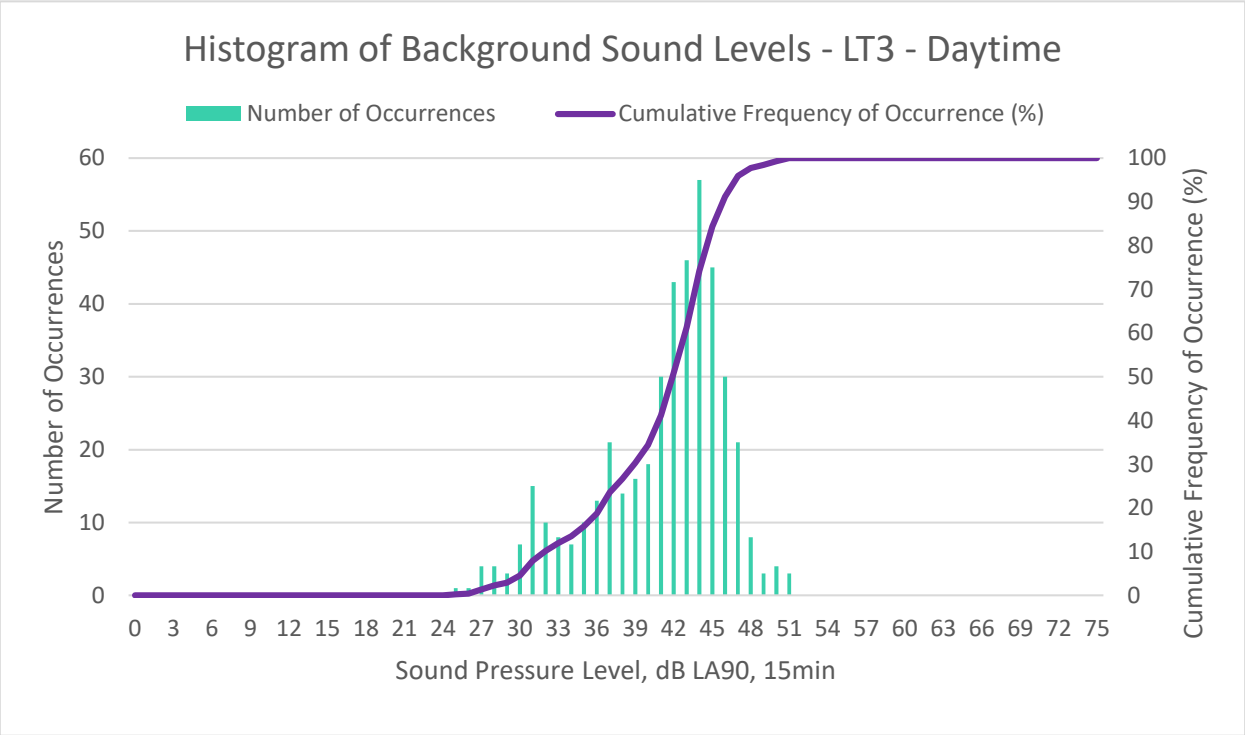
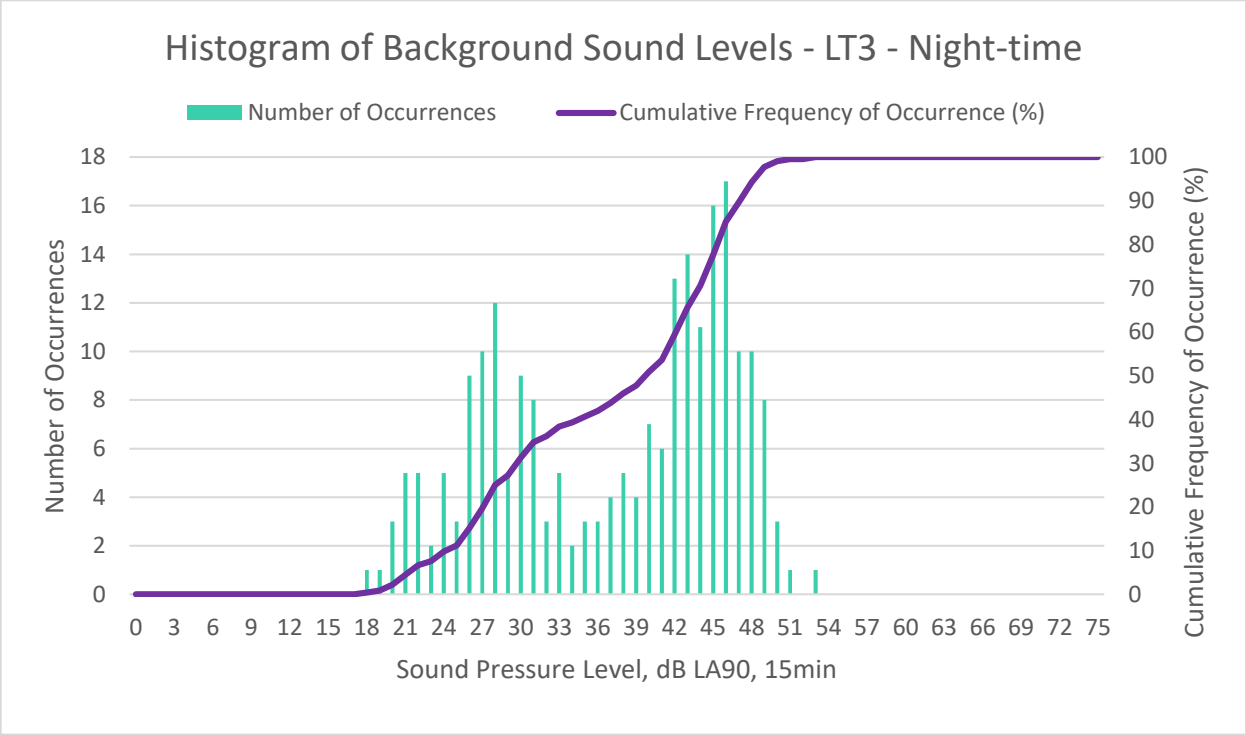


Figure C.12 Histogram of Background Sound Levels: LT3, Night-Time



Location Reference
LT4: Stoneless Cottage

Location
Ebbsfleet Lane

Period
18/04/2017 – 25/04/2017

Description of Monitoring Location

LT4 was located on Ebbsfleet Lane, which is both in an area to potentially be affected by noise and vibration from the construction of the onshore cable route associated with Thanet Extension as well as being in the vicinity of the Richborough Energy Park. The SLM was positioned in a free-field location in the rear garden of the property, approximately 10 m from the north-eastern façade of the house. The acoustic environment was considered to be representative of the background sound level within the area.

General Observations

The acoustic environment was dominated by distant road traffic noise from the A256 which is 120 m to the west of the property at its closest point. Road traffic noise on Sandwich Road (located 125 m east) was intermittent and did not dominate the acoustic environment whilst traffic on the road passed-by. Bird song was also intermittent.

Night-time observations were undertaken and it was noted that road traffic noise to the north was the dominant source of sound with intermittent road traffic noise emanating from Sandwich Road. Animal sounds were also audible from the south.

Figure C.13 Monitoring Location LT4

*modal averages rounded to the nearest whole number

Table C.4 Summary of Sound Monitoring at Location LT4

Assessment	Assessment Period	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)	$L_{A90,\,T}$ [modal average] (dB)*
Construction assessment night-time	Monday – Sunday 23:00 – 07:00	50	34	31
Construction assessment evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00 – 23:00 Sunday 07:00 – 23:00	47	38	37
Construction assessment daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	50	43	43
Operational assessment night-time	Monday – Sunday 23:00 – 0:700	50	34	31
Operational assessment daytime	Monday – Sunday 07:00 – 23:00	49	41	42

Figure C.14 Sound Level Time History: LT4

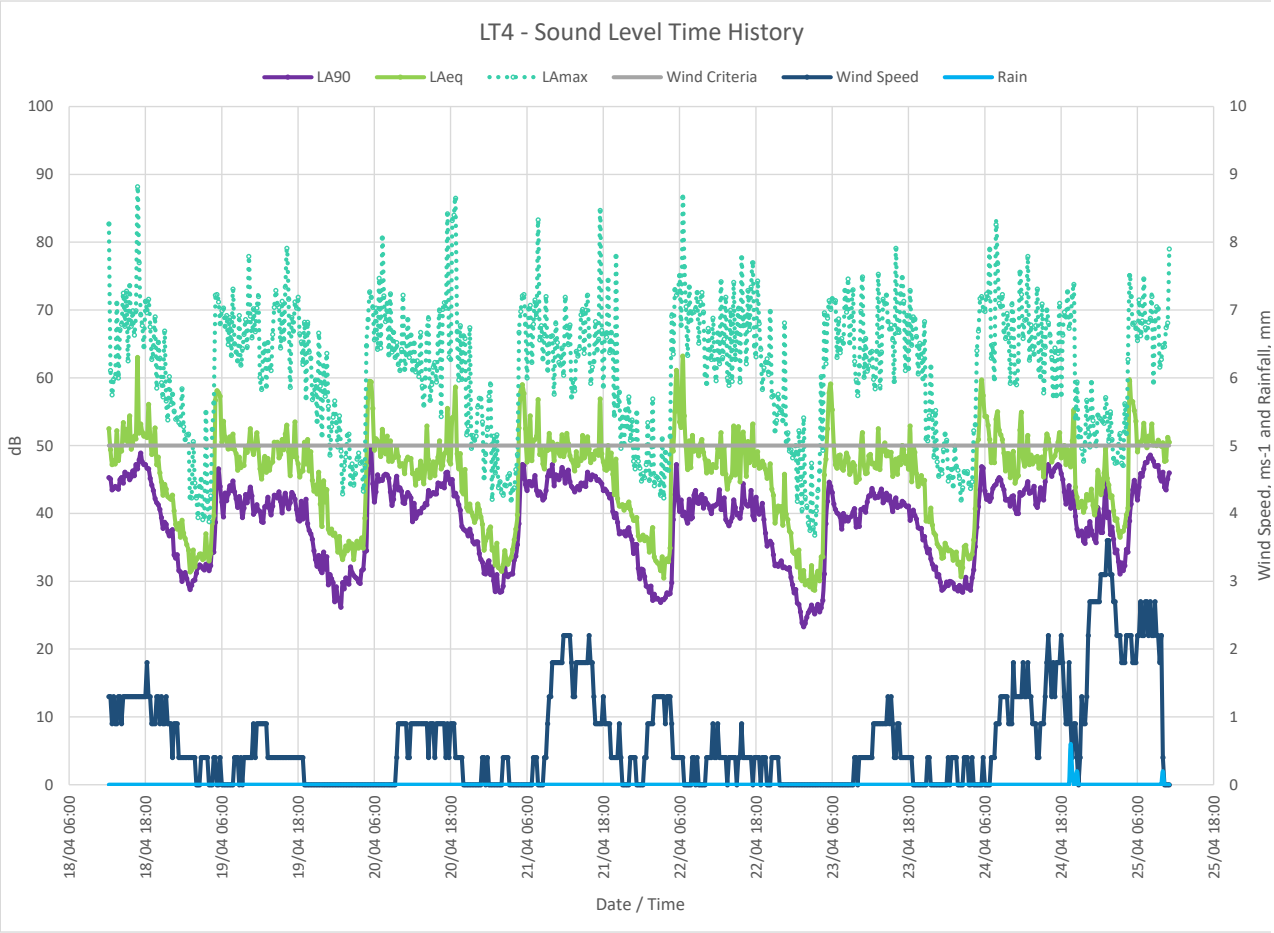


Figure C.15 Histogram of Background Sound Levels: LT4, Daytime

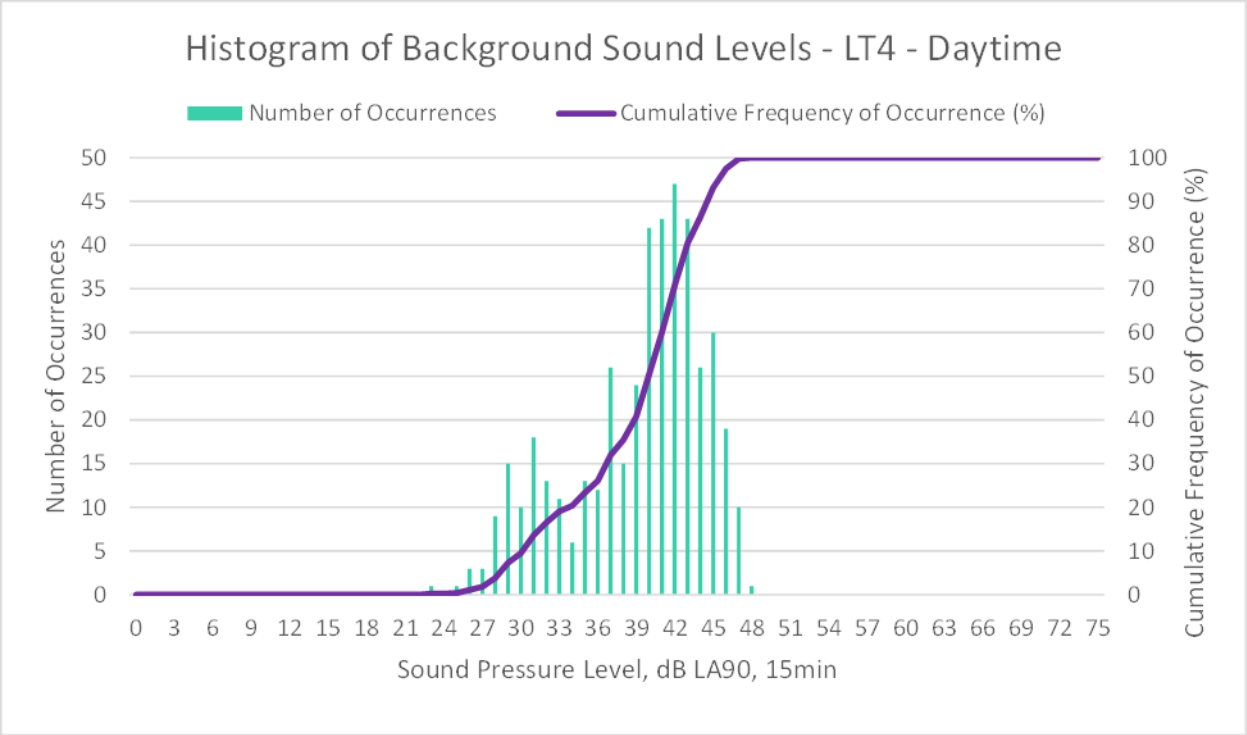
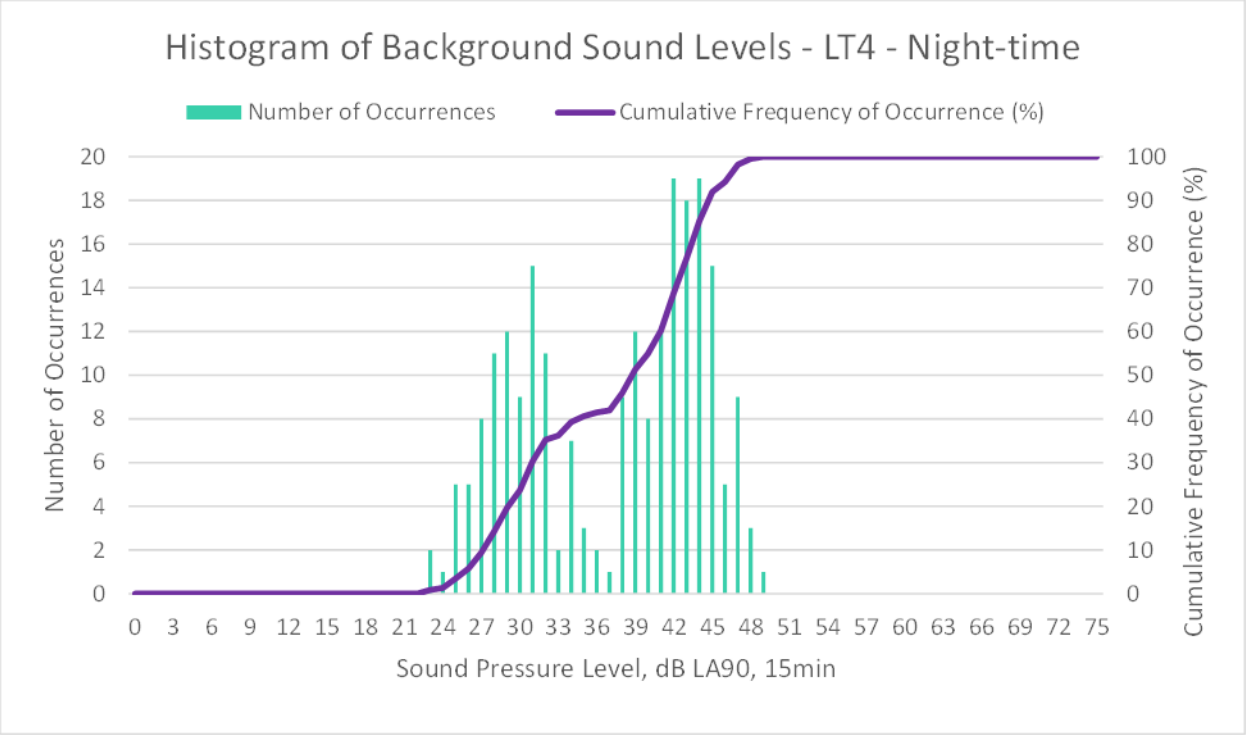


Figure C.16 Histogram of Background Sound Levels: LT4, Night-Time



Location Reference
LT5: Stonar Cottage

Location
Ramsgate Road

Period
18/04/2017 – 25/04/2017

Description of Monitoring Location

LT5 was located on the A256 next to the Stonar Cut in the River Stour and was identified as being the nearest sensitive receptor to the Richborough Energy Park. The SLM was positioned free-field location in the front garden of the property, approximately 5 m from the eastern façade of the house.

General Observations

The acoustic environment was dominated by road traffic noise from the A256 (located 15 m east) and was constant. No sound from construction of the Richborough Energy Park was observed. There was intermittent industrial noise, consisting mostly of banging of a digger, from the skip company located inside Richborough Business Park.

Night-time observations were undertaken and it was noted that road traffic noise was still dominant, however had reduced. Wind in trees was also audible.

Figure C.17 Monitoring Location LT5

*modal averages rounded to the nearest whole number

Table C.5 Summary of Sound Monitoring at Location LT5

Assessment	Assessment Period	$L_{Aeq,\,T}$ (dB)	$L_{A90,\,T}$ [mean average] (dB)	$L_{A90,\,T}$ [modal average] (dB)*
Construction assessment night-time	Monday – Sunday 23:00 – 07:00	61	38	32
Construction assessment evening and weekends	Monday – Friday 19:00 – 23:00 Saturday 13:00- – 23:00 Sunday 07:00 – 23:00	66	51	59
Construction assessment daytime	Monday – Friday 07:00 – 19:00 Saturday 07:00 – 13:00	69	60	59
Operational assessment night-time	Monday – Sunday 23:00 – 0:700	61	38	32
Operational assessment daytime	Monday – Sunday 07:00 – 23:00	68	57	59

Figure C.18 Sound Level Time History: LT5

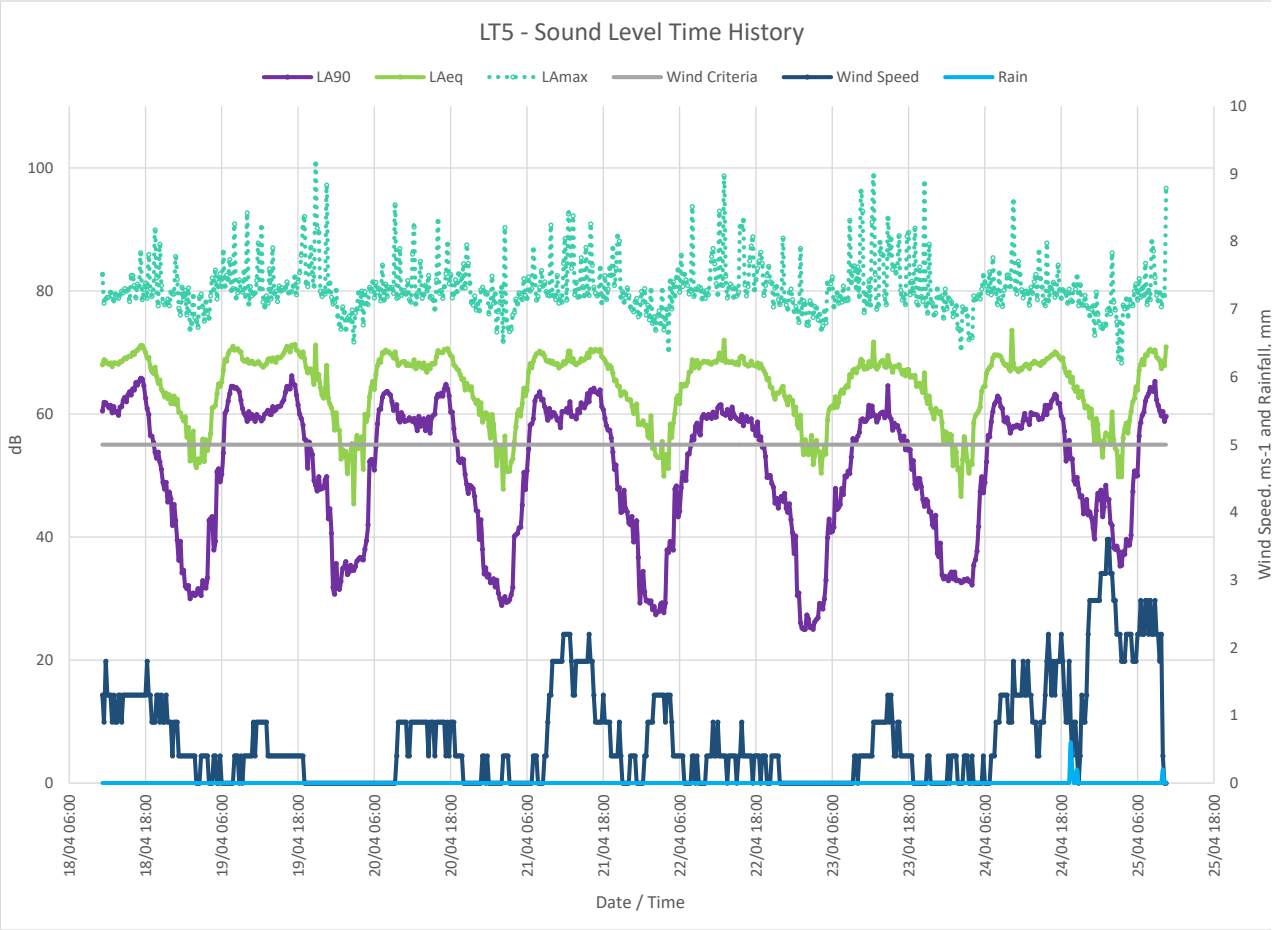


Figure C.19 Histogram of Background Sound Levels: LT5, Daytime

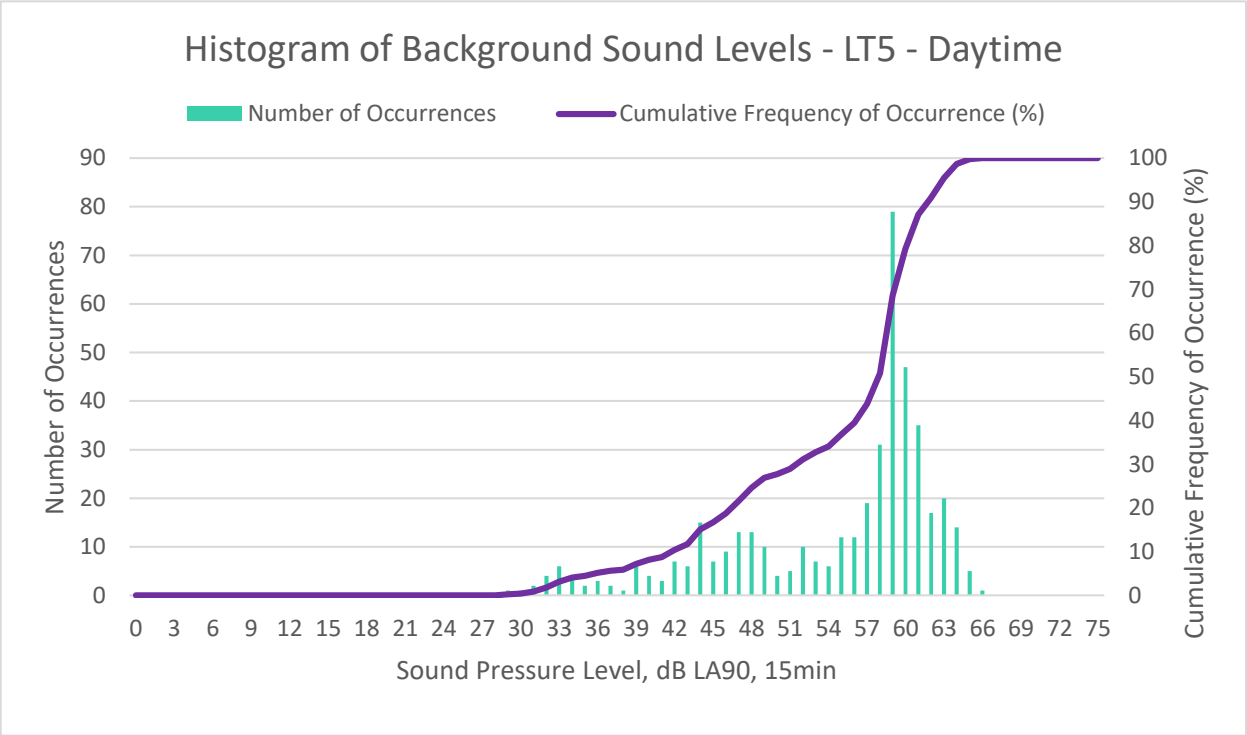
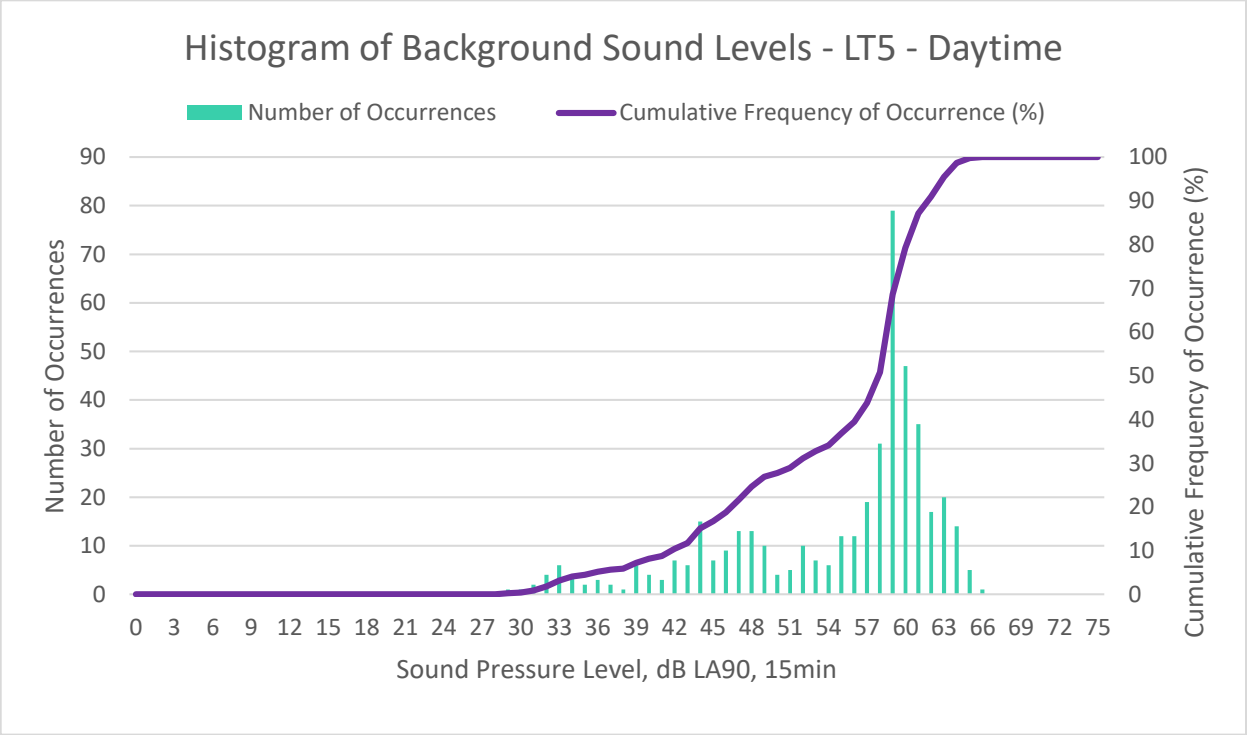


Figure C.20 Histogram of Background Sound Levels: LT5, Night-Time



Short-term monitoring

Location Reference
ST1: Pegwell Bay Country Park

Location
Pegwell Bay

Period
18/04/2017
13:00-14:00

General Observations

Road traffic noise from the A256 and the A299, approximately 1.1 km north of the monitoring location was the dominant contributor to the acoustic environment. Intermittent road traffic noise from Sandwich Road, approximately 100 m west of the monitoring location, was audible. Bird song and wind in trees was also audible intermittently.

Figure C.21 Monitoring Location ST1

Location Reference
ST2: Great Oaks Small School

Location

Period
18/04/2017
15:30-16:30

General Observations

Road traffic noise from the A256, approximately 100 m east of the monitoring location was a dominant contributor to the acoustic environment. Bird song, along with the breeze moving leaves in the trees, was intermittent. A train horn was audible from the north west during the measurement.

Figure C.22 Monitoring Location ST2

Location Reference
ST3: Baypoint Club

Location

Period
18/04/2017
14:15-15:15

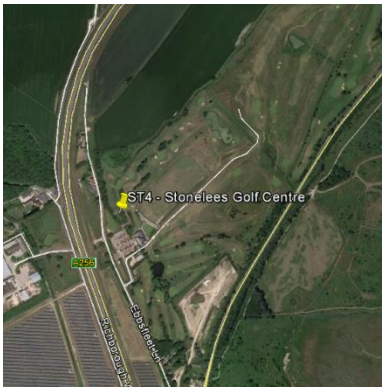
General Observations

Road traffic noise from the A256, approximately 50 m west of the monitoring location was a dominant contributor to the acoustic environment. Road traffic noise was audible intermittently whilst cars entered and departed from the Baypoint Club, also when pulling in and leaving the Subway carpark (10 m south of the Baypoint Club). Bird song was intermittent.

Figure C.23 Monitoring Location ST3

Location Reference	General Observations
ST4: Stoneless Gold Centre **Location** **Period** 19/04/2017 11:00-12:00	Road traffic noise from the A256, approximately 130 m west of the monitoring location was the dominant contributor to the acoustic environment. Bird song was constant during the measurement. Lawn mowers on the golf course were audible intermittently, as well as aircraft noise.

Figure C.24 Monitoring Location ST4



Appendix D
Ambient and background sound monitoring – photographs

Table D.1 Ambient and background sound monitoring – photographs

Location Reference	Photograph
LT1	
LT2	
LT3	

Location Reference	Photograph
LT4	
LT5	
ST1	

Location Reference	Photograph
ST2	
ST3	

Location Reference	Photograph
ST4