Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Environmental Statement Volume 3

Chapter 10: Noise and Vibration

June 2018, Revision A

Document Reference: 6.2.10

Pursuant to: APFP Reg. 5(2)(a)

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Volume 3

Chapter 10: Noise and Vibration

June 2018

Drafted By:	Amec Foster Wheeler
Approved By:	Helen Jameson
Date of Approval	June 2018
Revision	A

Vattenfall Wind Power Ltd

First Floor

1 Tudor Street

London

EC4Y 0AH

T +44 207 451 1150

www.vattenfall.co.uk

Table of Contents

10 NOISE AND VIBRATION

10.1 Introduction

10.1.1 This chapter of the Environmental Statement (ES) presents the results of the Environmental Impact Assessment (EIA) of the onshore elements of Thanet Extension Offshore Wind Farm (Thanet Extension) relevant to noise and vibration during its construction, Operations and Maintenance (O&M) and decommissioning. The chapter should be read in conjunction with the project description in Volume 3, Chapter 1: Onshore Project Description (Document Ref: 6.3.1). This chapter has also drawn upon information presented in Volume 3, Chapter 8: Traffic and Access (Document Ref: 6.3.8).

10.1.2 Following a summary of the relevant policy and legislation, the chapter describes the assessment methodology, the existing onshore environment with regard to noise and vibration (baseline conditions) in the study area, the embedded mitigation that has been incorporated into the design of the proposed development and the likely significant environmental effects.

10.1.3 Noise can have an effect on the environment and on the quality of life, health and well-being of individuals and communities. It can also pervade and affect the quality of natural resources.

10.1.4 The applicable national, regional and local planning policies relating to noise matters are discussed, together with the relevant legislative and policy context. Baseline noise levels in the areas around the proposed development are considered and there then follows a discussion of the spatial, temporal and technical scope of the assessment, including the identification of noise sensitive receptors.

10.1.5 This assessment evaluates effects from the following principle sources of sound at key sensitive receptors:

- Temporary construction noise from works associated with landfall operations including the construction of Transition Joint Bays and the installation and removal, where necessary, of cofferdams;
- Temporary construction noise from excavation of the trenches required for the onshore cable route;
- Temporary construction noise and vibration from the construction of the onshore substation at Richborough Port;
- Temporary noise from construction traffic associated with the onshore construction works;
- Permanent operational sound from the onshore substation at Richborough Port; and
- Temporary construction noise from the decommissioning of the onshore substation at Richborough Port;

10.1.6 The assessment also considers the potential cumulative noise effects from other developments in the vicinity of Thanet Extension.

10.1.7 Baseline sound levels were measured at, or in the vicinity of, noise and vibration sensitive receptors near Thanet Extension. The proposed assessment locations were agreed through consultation with Dover District Council (DDC). No response was received from Thanet District Council (TDC) to the consultation request. The results were summarised in a Noise and Vibration Technical Report, which is provided as Volume 5, Annex 10-2 Noise and Vibration Supporting Information (Document Ref: 6.5.10.1) to this ES.

10.2 Statutory and policy context

10.2.1 This section identifies legislation and national and local policy of particular relevance to onshore noise and vibration. Planning Act 2008, Infrastructure Planning EIA Regulations 2017 and Environment Act (1995) are considered along with the legislation relevant to noise and vibration.

10.2.2 Policy advice on EIA of relevance to the proposed development is provided by the National Policy Statements (NPSs). These provide the primary basis for the recommendations made by the Examining Authority (the Planning Inspectorate) to the Secretary of State for Business Energy and Industrial Strategy on applications for development consent for nationally significant renewable energy projects. Overarching guidance on nationally significant energy projects is provided in National Policy Statement for Energy (NPS EN-1) (DECC 2011a).

10.2.3 Guidance in relation to renewable energy projects is provided within EN-3 (DECC 2011b). For offshore wind farms, this policy document focuses primarily on the offshore elements of the project. In terms of general principles for the assessment of onshore grid connections, EN-3 (DECC 2011b) notes at paragraph 2.6.43 that, where precise details of proposed developments are not known, the maximum potential adverse effects of the project should be considered. In accordance with this guidance, where options exist, the maximum parameters (e.g. development footprint) have been considered within this assessment. This approach is set out in the 'Key Parameters Assessed' section of this chapter. References to noise within the offshore wind farm section of EN-3 (DECC 2011b) relate to effects from the operation of Wind Turbine Generators (WTG), which has been scoped out of this ES.

10.2.4 Guidance specifically relating to onshore grid connections is provided in EN-5 (DECC 2011c). This policy focuses on guidance primarily in relation to overhead lines which is not applicable to Thanet Extension as all export transmission cables from the landfall location at Pegwell Bay Country Park to the substation at Richborough Port would be buried. EN-5 states at 2.9.7 that noise effects can also arise from substation equipment. Such effects have been assessed within this chapter.

10.2.5 Relevant legislation and policy is outlined in Table 10.1.

Table 10.1: Legislation and policy context

Policy/ legislation	Key provisions	Section where provision addressed
NPS EN-1 Para 5.11.1 (DECC 2011a)	Excessive noise can have wide-ranging impacts on the quality of human life, health (for example owing to annoyance or sleep disturbance) and use and enjoyment of areas of value such as quiet places and areas with high landscape quality. The Government's policy on noise is set out in the Noise Policy Statement for England (NPSE). It promotes good health and good quality of life through effective noise management. Similar considerations apply to vibration, which can also cause damage to buildings.	Section 10.5 describes how a set of assessment criteria have been developed which has enabled the proposed development to be assessed against the principal aims of the NPSE which is referenced here.
NPS EN-1 Para 5.11.6 (DECC 2011a)	Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.	The standards and guidance used to assess the proposed development are set out in this table. Section 10.5 describes how these standards have been used to assess the impact of noise and vibration.
NPS EN-1 Para 5.11.7 (DECC 2011a)	The applicant should consult Environment Agency (EA) and Natural England (NE), or the Countryside Council for Wales (CCW), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account.	The assessment of noise impacts on ecological receptors is provided in Volume 3, Chapter 5: Terrestrial Ecology (Document Ref: 6.3.5).
NPS EN-1 Para 5.11.8 (DECC 2011a)	The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission.	Embedded mitigation for reducing noise and vibration is described in section 10.1. No additional mitigation is required as described in section 10.15.
NPS EN-1 Para 5.11.9 (DECC 2011a)	The Secretary of State (SoS) should not grant development consent unless it is satisfied that the proposals will meet the following aims: • avoid significant adverse impacts on health and quality of life from noise; • mitigate and minimise other adverse impacts on health and quality of life from noise; and • where possible, contribute to improvements to health and quality of life through the effective management and control of noise.	Section 10.5 describes how a set of assessment criteria have been developed which has enabled the proposed development to be assessed against the principal aims of the NPSE which are in accordance with the three aims set out in Para 5.11.9 of NPS EN-1.
NPS EN-1 Para 5.11.10 (DECC 2011a)	When preparing the development consent order, the SoS should consider including measurable requirements or specifying the mitigation measures to be put in place to ensure that noise levels do not exceed any limits specified in the development consent.	Embedded mitigation for reducing noise and vibration is described in Section 10.1. No additional mitigation is required as described in section 10.15. The mitigation measures set out could be specified to ensure that the noise levels do not exceed any limits specified in the development consent order.

Policy/ legislation	Key provisions	Section where provision addressed
HM Government (1974), Control of Pollution Act 1974 (HMG 1994)	The legislation gives the Local Authority powers to serve a notice to the developer requiring the control of site noise under Section 60 of the Act. This may include specific controls to restrict certain activities identified as causing particular problems. Conditions regarding hours of operation would generally be specified and noise and vibration limits at certain locations may be applied in some cases. All requirements must adhere to established guidance and be consistent with best practicable means (BPM) to control noise only as far as is necessary to prevent undue disturbance.	Section 10.1 describes specific controls for construction noise and vibration and how contractors working on the proposed development will employ BPM to reduce noise throughout the works.
Department for the Environment, Food and Rural Affairs (DEFRA) (2010), NPSE. (DEFRA 2010)	NPSE sets out the vision and aims for dealing with noise (except for workplace/ occupational noise), which are consistent with the aims for noise as presented in NPS EN-1. NPSE requires that noise and vibration assessments identify impacts that would result in significant adverse impacts on health and quality of life from a proposed development. The aims of NPSE include: avoiding significant adverse impact on health and quality of life; mitigating adverse impacts on health and quality of life; and to contribute to the improvement of health and quality of life.	Section 10.5 describes how a set of assessment criteria have been developed which has enabled the proposed development to be assessed against the principal aims of the NPSE. The residual effects of the proposed development, taking account of mitigation measures, are summarised in section 10.16. This section also describes if the design of proposed development will deliver the aims of the NPSE.
Department for Communities and Local Government (2012), National Planning Policy Framework (NPPF), The Stationary Office Limited. Paragraph 109 (DCLG 2012)	The NPPF states that new development should contribute to and enhance the environment by preventing new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.	Section 10.5 describes how the assessment follows the principles of the NPPF. Assessments of the noise and vibration impact of the proposed development are presented in sections 10.10 and 10.11 . Embedded measures to reduce the impact of noise and vibration are presented in section 10.1. No additional mitigation is required as described in section 10.15. The residual effects of the proposed development, taking account of mitigation measures, are summarised in section 10.16.
Department for Communities and Local Government (2014), Noise Planning Practice Guidance (NPPG). Paragraph 005 (DCLG 2014)	The NPPG relates in terms of a noise hierarchy the levels of perception to noise exposure with expected outcomes and required actions.	Section 10.5 describes how the assessment follows the principles of the NPPG.
Draft Thanet Local Plan to 2031 (TLP 2018)	Policy SE06 (Noise) states that: "In areas where noise levels are relatively high, permission will be granted for noise-sensitive development only where adequate mitigation is provided, and the impact of the noise can be reduced to acceptable levels. Development proposals that generate significant levels of noise must be accompanied by a scheme to mitigate such effects, bearing in mind the nature of surrounding uses. Proposals that would have an unacceptable impact on noise-sensitive areas or uses will not be permitted."	Section 10.5 describes how a set of assessment criteria have been developed which has enabled the proposed development to be assessed against the principal aims of the NPSE. Assessments of the noise and vibration impact of the proposed development are presented in sections 10.10 and 10.11 . Embedded measures to reduce the impact of noise and vibration are presented in section 10.1. No additional

Policy/ legislation	Key provisions	Section where provision addressed
		mitigation is presented in section 10.15.
British Standards Institution (2009), BS 5228-1-2009 (+A1: 2014), Code of practice for noise and vibration control on construction and open sites - Part 1 Noise. (BSI 2009a)	Provides a recommended scope for construction and demolition noise assessment. Annex E gives example threshold values for potential significant effects at noise sensitive receptors based upon the results of ambient sound monitoring.	Section 10.5 describes how this standard has been incorporated in the assessment. Section 10.10 presents an assessment of the construction noise impacts of the proposed development which has been undertaken in accordance with this standard.
British Standards Institution (2009), BS 5228-2 (2009) +A1: 2014, Code of practice for noise and vibration control on construction and open sites – Part 2 Vibration. (BSI 2009b)	Provides guidance on the assessment of ground-borne vibration associated with activities such as demolition and construction.	Section 10.5 describes how this standard has been incorporated in the assessment. Section 10.10 presents an assessment of the construction noise impacts of the proposed development which has been undertaken in accordance with this standard.
British Standards Institution (2008), BS 6472-1, Guide to Evaluation of Human Exposure to Vibration in Buildings - Part 1: Vibration Sources other than Blasting. (BSI 2008)	Presents an assessment approach to determining adverse impacts from vibration within residential buildings, offices and workshops.	Section 10.5 describes how this standard has been incorporated in the assessment to assess the potential impact of vibration.
Highways Agency (2011), Design Manual for Road and Bridges (DMRB) HD 213/11	Presents a methodology for determining impacts upon noise sensitive receptors from changes in road traffic noise due to road projects.	Section 10.5 describes how potential impact of traffic noise during construction and O&M has been assessed
A5/25, The Stationary Office Ltd. (HA 2011)		according to the guidance given in the DMRB. Section 10.10 presents an assessment of the construction traffic noise impacts of the proposed development which has been undertaken in accordance with the DMRB.
Department of Transport (1988), Calculation of Road Traffic Noise, Her Majesty's Stationary Office (HMSO). (DoT 1988)	Provides a calculation methodology for road traffic noise.	Section 10.10 presents an assessment of the construction traffic noise impacts of the proposed development which has been undertaken in accordance with this calculation methodology.
British Standards Institute (2014), BS 4142, Method for rating industrial noise affecting mixed residential and industrial areas. (BSI 2014a)	BS 4142:2014 describes methods for rating and assessing sound of an industrial nature, 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.	Section 10.5 describes how this standard has been used to inform assessment criteria for the potential impacts of noise from fixed plant and machinery associated with the proposed development. Section 10.11 presents an assessment of noise from fixed plant and machinery using the impact criteria set out in this standard.
British Standards Institution (2014), BS 8233, Guidance on sound insulation and noise reduction for Buildings. (BSI 2014b)	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.	Section 10.4.26 *et seq* describes how this standard has been used to develop assessment criteria for sensitive non-residential receptors.

Policy/ legislation	Key provisions	Section where provision addressed
	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.	
International Standards Organisation (1996), Acoustics – Attenuation of sound during propagation outdoors – Part 2: general Method of Calculation, International Standard ISO 9613-2: 1996 (E). (ISO 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.	Section 10.11 includes predictions of noise from fixed plant and machinery that has been undertaken according to this standard.
Guidelines for Environmental Noise Impact Assessment (2014). Institute of Environmental Management and Assessment (IEMA). (IEAM 2014)	Presents guidelines on how the assessment of noise effects should be presented within the EIA process. The IEMA guidelines cover aspects such as; scoping, baseline, prediction and example definitions of significance criteria.	This chapter has been undertaken accordance with the guidelines.

10.3 Consultation and scoping

10.3.1 Potential noise and vibration issues were outlined in the Scoping Report sent to the Planning Inspectorate (PINS). Scoping responses were received from the SoS as detailed in Volume 6, Scoping Opinion (Document Ref: 6.8.1).

10.3.2 Additional consultation to discuss the survey methodology was undertaken with TDC and DDC.

10.3.3 Table 10.2 provides a summary of all consultation relating to noise and vibration undertaken to date.

Table 10.2: Summary of consultation relating to noise and vibration

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
02/2017 Scoping Opinion (SoS response)	The SoS considers that further assessment will be required as to the potential effects at residential populations along the coast during each of the phases of the development (but particularly that associated with cable laying/ pulling and landfall activities close to the shoreline). In this respect, Paragraph 932 of the Scoping Report states that "vessel or cable laying noise would be indistinguishable from background". The SoS considers that there is insufficient information provided to justify this conclusion.	Cable laying activities are closest to the shoreline at landfall. The noisiest activities associated with cable laying at landfall are the excavation works required to construct the cable route which are likely to be noisier than cable laying itself. The assessment of significant construction noise effects in section 10.10 considers these types of noise sources at landfall and will therefore identify the worst-case construction noise effects from activities close to the shoreline.
02/2017 Scoping Opinion (SoS response)	The Scoping Report states that the spatial scope of the construction noise assessment would be "400 m from the cable corridor routes where significant activities could affect noise sensitive receptors". The Environmental Statement (ES) should clearly set out what 'significant activities' would comprise, and should include potential recreational users of Public Rights of Way (PRoW). The SoS expects further explanation and justification be provided in the ES to support the 400 m distance used for the assessment.	Significant construction activities in the context of noise are described in section 10.10. A discussion supporting the scoping out of noise effects on users of PRoW from the assessment is provided in section 10.4. A justification for the 400 m scoping distance for construction noise is provided in Volume 5, Annex 10-2: Noise and Vibration Supporting

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
		Information (Document Ref: 6.5.10.2).
02/2017 Scoping Opinion (SoS response)	The Scoping Report states that traffic routes subject to "significant changes in traffic flows" would be included in the ES for assessment. The ES should explain how a 'significant change' has been determined in accordance with relevant guidance, with cross reference to the Traffic and Transport Chapter where appropriate.	Section 10.5 describes how the assessment has used the impact criteria described in the DMRB to assess the significance of changes in traffic flows. DMRB states "*In terms of permanent impacts, a change of 1dB(A) in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible.*" The assessment presented in this ES is consistent with DMRB.
02/2017 Scoping Opinion (DDC response)	DDC in their consultation response express that Table 3.20 should include more properties, it is therefore recommended that this be discussed with DDC and a list of receptors agreed prior to commencing the assessment.	DDC has subsequently been consulted regarding the baseline survey and sensitive receptors covered in this ES. The outcomes of this consultation are described later in this table.
02/2017 Scoping Opinion (DDC response)	The Scoping Report does not set out information regarding the types of vehicles and plant to be used during the construction phase. This information should be included in the ES. Furthermore, the assessment should consider a 'worst-case' for receptors, i.e. that it reflects the impact of vehicles and plant at the closest possible point between works and the receptors (including for any limits of deviation which may be sought).	Significant construction activities in the context of noise are described in section 10.10. Here the types of vehicles, plant and equipment to be used are described. Furthermore, detailed information is also provided in Volume 5, Annex 10.2 – Noise and Vibration
		Supporting Information (Document Ref: 6.5.10.2).
02/2017 Scoping Opinion (SoS response)	SoS recommends that the ES clearly defines what constitutes a 'significant' effect to enable the methodology for the assessment to be understood. Furthermore, there is no inclusion of other construction techniques which may lead to impacts from vibration such as Heavy Goods Vehicles (HGVs). The SoS is of the view that the ES should consider all potential sources of vibration, particularly those in proximity to residential and other sensitive receptors.	Section 10.4 sets out how significant effects have been assessed. All potential sources of vibration are also discussed in section 10.4.
02/2017 Scoping Opinion (SoS response)	The SoS is content that noise from WTGs during operation be scoped out of the onshore noise and vibration assessment.	Noted.
02/2017 Scoping Opinion (SoS response)	SoS also notes that the Applicant wishes to scope out vibration from all aspects of the proposed development's operation onshore (although without further justification beyond Paragraph 937 of the Scoping Report). In the absence of information provided to substantiate this, the SoS does not agree this can be scoped out at this stage.	Further evidence and discussion around the reasons for scoping out operational vibration from the assessment are provided in section 10.4.
02/2017 Scoping Opinion (SoS response)	The potential for cumulative vibration effects of the proposed development and other infrastructure at the Richborough Energy Park should also be considered.	A cumulative impact assessment is provided in section 10.13 which includes other projects currently under construction and those consented but not yet implemented.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
02/2017 Scoping Opinion (SoS response)	SoS recognises the proposed level of activity at the Richborough Energy Park and therefore does not agree that cumulative operational noise can be scoped out on the basis of the justification provided.	A cumulative impact assessment is provided in section 10.13 which includes other projects currently under construction and those consented but not yet implemented.
30/03/2017 Scoping (DDC response)	Contact made with DDC to introduce noise and vibration survey and assessment methodology. Comments provided on 05/04/2017, AFW response 12/04/2017, further DDC response 26/04/2017.	The noise survey locations set out in section 10.7 were agreed with DDC in this consultation. DDC also requested that vibration which could cause damage to nearby structures was assessed. The vibration assessment is presented in section 10.10.
30/03/2017 Scoping (TDC comment)	Contact made with TDC to introduce noise and vibration survey and assessment methodology.	No response received.
12/01/2018 Section 42 response (DDC response)	Earlier concerns regarding impact of construction activities on some properties within DDC were addressed in a series of progress meetings. Conclusions stated in section 10.15.1 of the [ES] are agreed and there are no further comments regarding noise impact for properties in the DDC area. DDC are in agreement with the approach to the assessment and data gathering and accept the factors and methodology identified.	Noted.
12/01/2018 Section 42 response	It is not clear what the proposed hours of working will be, this appears to vary throughout the submission. 24 hour working and working at weekends appears to be being proposed for all stages. This has the potential to significantly increase noise and disturbance. There needs to be some control to protect residential receptors.	The typical construction hours are presented in the Onshore Project Description chapter (Document Ref: 6.3.1) section 10.8, Table 10.17 and section 10.10, paragraph 10.10.2. Limited weekend, evening and night time working may be required in the intertidal zone however this is expected to be for periods of less than one month hence it is unlikely to give rise to significant effects. 24-hour working may be required for offshore piling. This ES demonstrates that this work is unlikely to result in significant effects as detailed in Section 10.10.
12/01/2018 Section 42 response (DDC response)	Does the noise assessment include queuing traffic at Sandwich Road and the delivery of equipment and manoeuvring of HVGs on and off site?	The assessment takes account of all vehicles accessing the site and manoeuvring on site. A Construction Traffic Management Plan will seek to minimise queuing traffic at Sandwich Road. Typically noise from queueing traffic would be expected to be less than noise from freely moving traffic.
16/01/2018 Section 42 response (TDC response)	The assessment methodology takes into account current and relevant noise standards and guidance.	Noted.
16/01/2018 Section 42 response	It is accepted that noise and vibration impacts of the operational and maintenance phase are negligible given that the cabling is underground at depth.	Noted.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
(TDC response)		
16/01/2018 Section 42 response (TDC response)	However, there are 8 residential properties (LT4 - Ebbsfleet Lane) that although 530m away to the proposed substation have the potential for noise impacts. The BS4142 substation assessment should be considered along with existing and proposed noise sources in the vicinity.	A BS4142 assessment is provided in section 10.11.
16/01/2018 Section 42 response (TDC response	The report must address the issue of noise (including low frequency noise) and vibration from the station to ensure that there is no loss of amenity.	An assessment of noise from the substation has been undertaken in accordance with BS 4142:2014. This is provided in section 10.11 and is considered the appropriate method of assessment to determine the potential impact of noise within this EIA.
16/01/2018 Section 42 response (TDC response)	Mitigation shall ensure that the low frequency noise emitted from the substation is controlled so that it does not exceed the Low Frequency Criterion Curve for the 10 to 160Hz third octave bands inside residential accommodation as described in The DEFRA Procedure for the Assessment of Low Frequency Noise Complaints 2011 (NANR45). I would also recommend the applicant using the baseline background modal measurements to assess significance – for a worst-case approach.	NANR45 (DEFRA 2011) states the following in relation to its use in planning situations: "*The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable.*" An assessment based on this document has therefore not been undertaken. Modal measurements have been used to ascertain background within BS 4142 assessment provided in section 10.11.
16/01/2018 Section 42 response (TDC response)	Construction works have also been identified as having potentially significant noise impacts to residential properties in Ebbsfleet and mitigation is proposed to be implemented and embedded within the Noise and Vibration Management Plan (NVMP) to ensure ABC threshold 65dB $L_{Aeq16hr}$ is not exceeded. However, I would suggest that trench excavation alongside Ebbsfleet properties (e.g. within an appropriate radius) is restricted further than that proposed in section 10.10.2 to typical COPA hours i.e. 8am to 6pm Monday to Friday and 8am to 1pm on Saturdays – works outside this time should not be permitted.	The proposed working hours of 0700 to 1900 typically would include a 1 hour set up period at 0700 and 1 hour set down period at 1800 where noise will be limited. Noisy works will therefore only take place between 0800 and 1800.

10.4 Scope and methodology

10.4.1 This section outlines the scope of assessments to support the identification of likely significant effects from the proposed development. It sets out:

- The potential significant effects of the proposed development by considering the type and nature of the noise and vibration producing activities described in the Volume 3, Chapter 1: Onshore Project Description (Document Ref: 6.3.1);
- The study areas for the assessment based on relevant standards and guidance and experience of similar developments;
- The survey work undertaken to establish the baseline (the results of the baseline surveys are set out in section 10.7); and

- The assessment and significance criteria which have been derived from relevant standards and guidance for each type of potentially significant effect and considering the distinct types of sensitive receptor within the study area.

Potentially significant effects

10.4.2 Without mitigation, noise generated by the proposed development has the potential to cause disturbance to neighbouring noise sensitive receptors:

- During construction, airborne noise would be generated by:
    - Excavation plant and equipment required to construct the onshore cable route;
    - Plant and equipment required to construct the substation at Richborough Port;
    - Construction vehicles on haul routes and local roads resulting in changes to road traffic noise;
    - Cable laying activities within the intertidal zone close to the shoreline; and
    - Offshore piling to construct the WTGs.
- During O&M, airborne noise would be generated by stationary sources of noise such as substation equipment.
- During decommissioning, airborne noise would be generated by:
    - Plant and equipment required to decommission the substation at Richborough Port and return the land to its original condition.

10.4.3 Without mitigation, vibration created by construction activities such as piling can propagate through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings. The following types of potential significant effect that could occur include:

- Very high levels of vibration generated by construction activities could give rise to a risk of cosmetic damage to buildings; and
- Perceptible vibration within residential buildings.

10.4.4 The assessment covers the potential impacts described above at all noise and vibration sensitive receptors, subject to the screening distances provided below. Where a receptor has multiple uses the assessment has been made based on the most sensitive use.

Impacts that have been scoped out of the assessment

10.4.5 The following potential impacts are not considered likely to generate significant effects as a result of the proposed development and have been scoped out of the assessment:

Construction vibration from activities other than piling

10.4.6 BS 5228-2:2009:A1:2014 (BSI 2009b) provides advice on the control of vibration from construction sites. The empirical formulae for predicting vibration from most types of vibratory construction activities are set out in Annex E of the standard. Construction activities cited include vibratory compaction, percussive and vibratory piling, vibration of stone columns and tunnel boring operations. At EIA scoping stage it is common to use this list of activities as the basis of identifying construction activities which may potentially give rise to significant construction vibration effects.

10.4.7 For the construction of the cable routes and transition joint bays none of the vibratory activities listed in BS 5228-2:2009:A1:2014 (BSI 2009b) are expected to be used. The types of plant expected to be used include dozers, excavators, dump trucks, pumps and generators. These types of activities will generate lower levels of vibration than the vibratory activities listed in BS 5228-2:2009:A1:2014 (BSI 2009b). Typically, vibration from these types of plant are not assessed in detail in an ES because they do not usually result in significant effects. This approach is consistent with major infrastructure schemes such as High Speed 2, the A14 Huntington to Cambridge improvement scheme and Thames Tideway.

10.4.8 For the construction of the substation the method of piling foundations will be confirmed in the final design process. At this stage, it is not known whether the foundations would either be ground-bearing or piled based on the prevailing ground conditions. As impact or vibratory piling cannot be ruled out, these have been assessed within this ES.

10.4.9 With regard to HGVs which will use existing roads to access the construction sites, as set out in DMRB HD213/11 (HA 2011), appreciable vibration is not generated by a road with a well maintained road surface. Hence operational or construction traffic is unlikely to result in significant effects resulting from vibration and are not, therefore, assessed within this ES.

Vibration from the O&M of the proposed development

10.4.10 The operational components of the onshore development comprise cable trenches connecting from the landfall at Pegwell Bay Country Park to a new substation at Richborough Port and then on to the National Grid substation. Once operational, the static cables will not generate appreciable environmental vibration. Substation equipment can generate environmental vibration that would be perceptible adjacent to the transformer. However, the closest sensitive receptor to the new substation is Baypoint Sports Club which is approximately 350 m away. It is unlikely that the substation will generate appreciable environmental vibration at this distance. Hence it is considered unlikely that vibration from the O&M of the cable route and the substation will result in significant adverse effects, and consequently they have not been assessed any further in this ES.

Noise and vibration affecting recreational users of public open spaces and PRoW

10.4.11 PRoW and public open spaces, such as Pegwell Country Park, and sports recreational facilities, such as Baypoint Club and Stonelees Golf Centre, are by their nature transitory in their use, with users not staying in any one location for any length of time. Recreational users of public open spaces are unlikely to be significantly affected by noise or vibration at the levels associated with construction or O&M of the proposed cable routes or onshore substation. The assessment of construction impacts on PRoW and public open spaces is provided in Volume 3, Chapter 4: Tourism and Recreation (Document Ref: 6.3.4).

10.4.12 Levels of noise and vibration from the construction of Thanet Extension will vary depending a person's location in relation to the works. Noise and vibration effects from the construction of the cable routes and onshore substation will be minimised using the embedded mitigation measures described in this report. During O&M, as described above, the completed cable routes will not generate appreciable levels of noise or vibration. Noise from the onshore substation will be controlled so that effects at noise sensitive receptors are minimised, which will serve to reduce operational noise levels at open spaces. Significant noise or vibration effects are therefore considered unlikely at PRoW, public open spaces and sports recreational facilities during either construction or O&M.

Offshore Wind Farm effects on onshore receptors

10.4.13 Due to the large distance between WTGs and onshore noise sensitive receptors the reduction of noise from distance divergence and atmospheric attenuation would be such that an operational noise effect would be negligible.

Study areas

10.4.14 The study areas for the potential noise and vibration impact assessment have been defined by the extent of the *potentially significant effects* (in terms of the EIA Directive (EC 2014), and the *potential adverse effects* (in terms of Government Policy) arising from the construction and O&M of Thanet Extension to onshore receptors.

10.4.15 Study areas have been defined which will ensure that all likely significant effects have been identified and that the study area extends out to the distance beyond which adverse effects of the proposed development are unlikely to occur. For each type of noise or vibration source, adverse effects are unlikely when noise levels are below the relevant Lowest Observed Adverse Effect Level (LOAEL) for the type of noise source (see section 10.4.26 *et seq*).

10.4.16 The study area has been broken down into three sections, and these sections have been assessed individually in terms of their potential noise and vibration impacts. The sections considered within this chapter comprise the following:

- Construction noise for the daytime works associated with the proposed landfall, onshore cable routes, and substation has been assessed at noise sensitive receptors within 400 m of the proposed construction sites (see Volume 5, Annex 10-2: Noise and Vibration Supporting Information (Document Ref: 6.5.10.2));
- Construction noise for the potential night time works associated with cable laying, piling and excavation activities in the vicinity of inter-tidal zone at landfall has been assessed at noise sensitive receptors within 1400 m of landfall (see Volume 5, Annex 10-2: Noise and Vibration Supporting Information (Document Ref: 6.5.10.2));
- Construction vibration associated with piling of the proposed substation has been assessed out to the distance where potentially significant effects may occur. The extent depends on the size of the piling rig and the hammer energy used;
- Noise from construction and operational traffic using existing roads has been assessed at all noise sensitive receptors in the vicinity of existing roads where the forecast operational or construction traffic is likely to change road traffic noise by more than 1 dB (This is consistent with the guidance in the DMRB);
- Construction noise from the offshore piling works has been assessed at noise sensitive receptors at the shore, closest to the proposed WTGs. Where levels of noise are suitably controlled for receptors at the shore, noise on receptors beyond the shoreline will also be suitably controlled, due to the further reduction of noise due to distance attenuation.
- Operational noise from the new substation has been assessed out to the distance where potentially significant effects may occur. The extent depends on the magnitude of noise generated by the plant and the ambient noise level at each individual noise sensitive receptor; and
- Decommissioning noise associated with the deconstruction of the substation has been assessed at noise sensitive receptors within 400 m of the proposed substation.

10.4.17 The study/assessment areas are shown in Figure 10.1 and Figure 10.2 later in this chapter.

10.4.18 Aerial imagery using aerial photography resources (Google Earth Pro version 7.0.1.8244, 2016) as well as OS mapping, OS datasets and land owner information were used as a basis for design of the baseline survey work, undertaken to inform the noise and vibration assessments, and for the identification of residential, non-residential receptors, and quiet areas within the study areas.

Baseline surveys

10.4.19 Survey work undertaken to date has concentrated on locations within the study areas defined above. The current baseline has been informed by a combination of sound monitoring and characterisation of the sound environment.

10.4.20 Prior to undertaking the baseline sound surveys, TDC and DDC were consulted to agree the format and methodology of the sound survey and to agree key receptors. Agreement was reached with DDC prior to undertaking the measurements, and included the requirement for additional monitoring locations. No response was received from TDC, however baseline data gathered within the TDC area covers all sensitive receptors within the study areas defined above.

10.4.21 Ambient background sound survey work has informed the assessment of potential effects on noise sensitive receptors caused by the onshore construction and O&M activities associated with Thanet Extension. Sound measurements at locations representative of the closest noise sensitive receptors have been undertaken to determine the existing representative baseline ambient and background sound levels at these receptors.

10.4.22 The results of the ambient sound monitoring have been used to obtain baseline ambient sound levels during the daytime to inform the assessment of construction noise emissions at the nearest noise sensitive receptors and to inform indicative construction noise thresholds advocated in BS 5228-1:2009+A1:2014.

10.4.23 The results have been used to understand the background sound environment at noise sensitive receptors where operational sound from the proposed substation could have a potential impact.

10.4.24 The baseline surveys are described in detail in Noise and Vibration Baseline Report Volume 5, Annex 10-1: Noise and Vibration Baseline report (Document Ref: 6.5.10.1)). A summary of the findings relevant to the proposed Thanet Extension development is presented in section 10.7.

10.4.25 Baseline vibration surveys were not undertaken as no sources of appreciable environmental vibration were identified within the vicinity of the development. Vibration from construction of Thanet Extension has been assessed using absolute measures of vibration rather than a change in vibration.

Prediction methods

10.4.26 Sound and vibration from the proposed development have been assessed using the following methodologies:

- Construction noise: calculations have been made using the methodology described in BS 5228-1:2009+A1:2014 (BSI 2009a);
- Construction vibration: calculations have been made based on the methods set out in BS 5228-2:2009+A1:2014 (BSI 2014b); and
- Operational noise: calculations have been made using the Attenuation of sound during propagation outdoors: Part 2 General Method of Calculation, 1996 (ISO 9613-2) (ISO 1996).

10.5 Assessment criteria and assignment of significance

10.5.1 This section sets out the significance criteria applied to each of the assessments in this chapter.

10.5.2 The acoustic, noise and vibration assessment methodology reflects current best practice and follows the requirements of the EIA Directive and addresses the aims of the Government's Noise Policy which are summarised in the NPSE (DEFRA (2010)) as follows:

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

1. avoid significant adverse impacts on health and quality of life;
2. mitigate and minimise adverse impacts on health and quality of life; and
3. where possible, contribute to the improvement of health and quality of life".

10.5.3 Exposure to noise can cause annoyance and sleep disturbance both of which impact on health and quality of life. The effects on health and quality of life have been assessed in the ES for the proposed development using:

- Thresholds for the onset of effects on quality of life; and
- Thresholds above which impacts on health and quality of life could be significant.

10.5.4 The effects on health and quality of life have also been assessed for noise by consideration of changes in the noise environment that could impact on quality of life e.g. a change in annoyance or sleep disturbance. This approach is described in more detail below.

10.5.5 Government Noise Policy, namely that set out within the NPSE (2010) (DEFRA 2010), is based on the premise that once sound becomes perceptible, the effect on people in dwellings and other receptors used by people increases as the total level of sound increases. Government Noise Policy defines three levels of effect in increasing severity:

- No effect;
- Adverse or beneficial effect; and
- Significant adverse or beneficial effect.

10.5.6 Government Noise Policy also introduces the concept that noise and vibration level triggers can be set to define the onset of adverse effects at the Lowest Observed Adverse Effect Levels (LOAELs) and significant adverse effects at the Significant Observed Adverse Effect Levels (SOAELs). Government Noise Policy also describes the Unacceptable Adverse Effect Level (UAEL), above which the adverse effects are unacceptable.

10.5.7 In line with best practice, the assessment identifies likely significant effects by consideration of the existing levels of the noise or vibration exposure, the change in noise and vibration exposure with and without Thanet Extension, the number and type of buildings impacted and other relevant factors. The impact of any noise change is considered within the context in which that change will occur.

10.5.8 The PPG-N (DCLG 2014) links the increasing effect levels to an effect, perception by receptor and associated action, as summarised in Table 10.3.

Table 10.3: Summary of noise exposure hierarchy

Increasing effect level	Effect	Perception	Action
Less than No Observed Effect Level (NOEL)	No effect	Not noticeable	No specific measures
Greater than NOEL	Effect	Noticeable and not intrusive	No specific measures
Greater than LOAEL	Adverse effect	Noticeable and intrusive	Mitigate and reduce to a minimum
Greater than SOAEL	Significant adverse effect	Noticeable and disruptive	Avoid
Greater than UAEL	Unacceptable adverse effect	Noticeable and very disruptive	Prevent

10.5.9 The NPSE states that it is not possible to have a 'single objective' noise (or vibration) based measure applicable to all sources and receptors that define the on-set of the LOAEL or the SOAEL. It is however possible to define threshold levels for the onset of each of the effect levels for the different types of receptor based upon available Standards and technical guidance.

10.5.10 The evaluation of significance differs depending on type and sensitivity of the assessed receptor(s). National Noise Policy and Standards documents generally focus on the effects of noise on residential receptors in isolation, whilst there is a requirement within the NPSE and PPG-N to evaluate the effects on a community basis, such as within a neighbourhood. The evaluation of significance within a community is therefore a combination of advice derived from Standards and policy, in addition to considerations of context and receptor sensitivity.

10.5.11 Non-residential receptors, such as offices, hospitals and schools, are often cited as containing buildings and/ or activities that are potentially noise sensitive. The World Health Organisation (WHO) Guidelines for Community Noise (WHO 1999) introduce the concept of differentiating between these uses in terms of the degree of sensitivity to noise effects. The evaluation of significance for non-residential receptors may therefore differ from that adopted for residential receptors and communities.

10.5.12 As highlighted within the NPPF (DCLG 2012), noise and vibration assessments shall also consider effects upon quiet areas "*which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*", although no quiet areas have been identified within the study area for the proposed development.

10.5.13 In summary, the assessment considers the appropriate noise and vibration effects upon the following receptors:

- Residential receptors: existing residential receptors; and
- Non-residential receptors: these include commercial premises, schools, places of worship, and medical facilities.

Residential Receptors

10.5.14 For assessment purposes, where the calculated sound or vibration exposure at any individual residential receptor is greater than the SOAEL and is therefore a *significant observed adverse impact* on health and quality of life in Government noise policy terms, this has also been treated as a likely *significant adverse effect* in the context of the EIA Directive.

10.5.15 Sound levels from the proposed development between LOAEL and SOAEL are not significant in terms of Government noise policy. However, in terms of this assessment and in line with best practice, a likely significant effect (in EIA terms) identified on a *community* area is dependent on the magnitude of the impact due to the change in noise levels, the number of dwellings experiencing the impact (the higher the impact magnitude the smaller the number of dwellings receiving the impact required to identify a likely significant effect in the ES) and the grouping of the dwellings subject to an impact (weighted towards clusters of dwellings in close proximity that form a community or part of a community).

10.5.16 The decision-making process as to whether an *adverse effect* at a residential receptor or a group of receptors occurs when the sound or vibration exposure is between the LOAEL and SOAEL can require additional quantitative and qualitative considerations. These require elements of professional judgement and consideration of the context within which the effect occurs. In summary, these considerations include:

- The magnitude of the effect;
- The change in magnitude of the effect;
- The number of receptors impacted and whether the receptors form part of a community;
- The type of effect, including its intermittency;
- The existing acoustic environment;
- The effectiveness of mitigation, including BPM; and
- The duration of the effect.

10.5.17 Noise and vibration impacts at receptors have been considered within the cumulative assessment which has considered committed developments and Thanet Extension projects within the study area, as detailed in section 10.13.

Non-residential receptors

10.5.18 For non-residential receptors, the evaluation of significance takes into account the considerations outlined for residential receptors and the sensitivity of the non-residential receptors accounting for its existing use.

Assessment criteria

Residential receptors

10.5.19 This section sets out how the criteria for *likely significant effects* upon residential and community receptors in terms of the EIA Regulations for each of the scoped assessments have been derived, taking into account *significant adverse impacts* as outlined in government policy, and other relevant guidance.

Residential receptors: construction noise: earthworks and fixed and mobile plant

10.5.20 Potential adverse effect thresholds have been established using methodologies advocated within BS 5228-1:2009+A1:2014 (BSI 2014a), namely the 'ABC Method', which defines thresholds of potentially significant effect on the basis of existing noise levels. These thresholds have been used to establish assessment criteria in terms of Government noise policy and EIA Regulations as set out in Table 10.4. An adverse impact is identified if the SOAEL for construction noise is exceeded or the ABC Category is exceeded by more than 3 dB. An impact is deemed to be a significant effect if the construction noise level is forecast to exceed the impact criteria for more than one month. This is consistent with the significance criteria described in BS 5228-1:2009+A1:2014 (BSI 2014a).

Table 10.4: Summary of construction noise (earthworks, fixed and mobile plant) threshold levels

Noise Sources	Receptor	Period	Category A (LOAEL)	Category B	Category C (SOAEL)
Construction noise (earthworks, fixed and mobile plant)	Residential	Daytime	65 dB $L_{Aeq, 12h}$	70 dB $L_{Aeq, 12h}$	75 dB $L_{Aeq, 12h}$
	Residential	Evening	55 dB $L_{Aeq, 4h}$	60 dB $L_{Aeq, 4h}$	65 dB $L_{Aeq, 4h}$
	Residential	Night-time	45 dB $L_{Aeq, 8h}$	50 dB $L_{Aeq, 8h}$	55 dB $L_{Aeq, 8h}$
Definitions and notes: Daytime: Weekdays (07:00-19:00) and Saturdays (07:00-13:00). Evening: Weekdays (19:00-23:00), Saturdays (13:00-23:00), Sundays and Bank Holidays (07:00-23:00). Night-time: Weekdays, Weekends and Bank Holidays (23:00-07:00). Category A: threshold level is LOAEL when ambient sound levels (rounded to the nearest 5 dB) are less than these values. Category B: threshold level is LOAEL when ambient sound levels (rounded to the nearest 5 dB) are the same as Category A values. Category C: threshold level is SOAEL for ambient sound levels (rounded to the nearest 5 dB) which are 3 dB or more below these values. Where ambient noise levels are less than 3 dB below these values, SOAEL is indicated if the total $L_{Aeq, T}$ noise level for the period increases by more than 3 dB due to site noise.					

10.5.21 Exceedances of the Category C threshold values are considered to directly correlate with SOAEL in government policy, and to have a *significant adverse effect*, in terms of the EIA Regulations. This approach is consistent with other infrastructure projects, namely: Thames Tideway Tunnel; Crossrail; and HS2 Phase 1 and 2a.

10.5.22 The daytime Category C (SOAEL) threshold of 75 dB $L_{Aeq, T}$ is taken from the Committee on the Problem of Noise: Noise report (Wilson, 1963) and was set to avoid interference with normal speech indoors. This is considered a conservative approach given the improvement in construction methods and glazing specifications since 1963. The night-time Category C (SOAEL) of 55 dB $L_{Aeq, 8h}$ is consistent with advice presented within the WHO Night Noise Guidelines for Europe. The evening Category C (SOAEL) is set at 10 dB lower than the daytime criteria, based upon advice presented in the Department of the Environment Advisory Leaflet 72 – Noise Control on Building Sites.

10.5.23 The Category A threshold values set out within Table 10.4 are considered representative of LOAEL given they are the 'ABC Method' lower thresholds for the adverse effects.

10.5.24 Where the calculated construction noise impacts at residential receptors lie between the LOAEL and the SOAEL, consideration has been given to the items set out in paragraph 10.5.16 to evaluate the magnitude of significance in terms of EIA Regulations.

Residential receptors: construction vibration: earthworks and fixed and mobile plant

10.5.25 Sources of potential adverse effects due to vibration at residential receptors which are relevant to Thanet Extension include the piling works which may be required to construct the foundations of the onshore substation.

10.5.26 BS 6472:2008 Part 1 '*Guide to Evaluation of Human Exposure to Vibration in Buildings*' (BSI 2008) covers vibration sources other than those associated with blasting. This standard provides guidance on predicting human response to vibration over the frequency range 0.5 - 80 Hz. The standard uses typical human responses to whole-body vibration in order to determine a Vibration Dose Value (VDV) which may be used to determine the potential for unfavourable reaction and adverse comment to vibration from residential occupants.

10.5.27 While it is common to assess vibration from most types of vibration sources using the VDV, Annex B of BS5228 recommends that significance criteria for assessing the human response to vibration from construction are presented in terms of Peak Particle Velocity ($mm \cdot s^{-1}$) PPV rather than VDV. This is because this parameter is more routinely measured based upon the more usual concern over potential building damage and many of the empirical vibration prediction methods yield a result in terms of PPV. Annex B of BS5228 also provides guidance on the consequence vibration in PPV and in terms of human perception and disturbance. The guidance has been used to develop a set of construction vibration significance thresholds which are presented in Table 10.5. As for construction noise an impact is not considered significant unless it is forecast to exceed the impact threshold for more than one month.

10.5.28 Where the calculated vibration levels at residential receptors lie between the LOAEL and the SOAEL, consideration has been given to the items set out in paragraph 10.5.16 receptors to evaluate the magnitude of significance in terms of EIA Regulations.

Table 10.5: Thresholds of potential effects for operational and construction vibration permanent residential buildings

Threshold	Impact Threshold	Vibration level[A), B), C)] (PPV)	Effect
LOAEL	Negligible	> 0.14 mm·s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
	Low	> 0.3 mm·s^{-1}	Vibration might be just perceptible in residential environments.
SOAEL	Medium	> 1.0 mm·s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
	High	> 10 mm·s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case.

The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/ or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

Cosmetic damage

10.5.29 The assessment criteria for the likelihood of cosmetic damage to buildings are based upon guidance presented within BS 7385-2, 1993 '*Evaluation and measurement for vibration in buildings: Part 2 Guide to damage levels from ground-borne vibration*' (BSI 1993). An exceedance of the values, specified in terms of PPV, in Table 10.6 would indicate a *significant adverse effect* in terms of EIA Regulations.

Table 10.6: Vibration impact criteria for buildings (conservative criteria below which there is no risk of cosmetic damage)

Category of building	Peak Particle Velocity[1)] - PPV - at building foundation	
	Transient[2)] vibration	Continuous vibration[3)]
Potentially vulnerable building	6 mm·s^{-1}	3 mm·s^{-1}
Structurally sound building	12 mm·s^{-1}	6 mm·s^{-1}

1) At the building foundation
2) Transient relative to building response e.g. from percussive piling
3) Continuous relative to building response e.g. from vibratory piling, vibrating rollers

Residential receptors: Construction and operational noise: change in road traffic

10.5.30 The determination of impact thresholds for road traffic noise has been based upon the guidance values set out within the Noise Insulation (Amendment) Regulations (NIR 1988) and the WHO '*Guidelines for Community Noise*' for daytime noise criteria (WHO 1999). The WHO '*Night Noise Guidelines for Europe*' (WHO 2009) have been used to derive night-time noise criteria.

10.5.31 Noise exposures exceeding 63 dB $L_{Aeq,\ 16h}$ free-field (equivalent to 68 dB $L_{A10,\ 18h}$ façade level) at assessed residential receptors during the daytime will result in a *significant adverse effect*. The 68 dB $L_{A10,\ 18h}$ façade level is one of the requirements set out within the NIR (NIR 1988), under which buildings may qualify for statutory noise insulation. In the event that the assessment identifies any requirements for mitigation under the NIR, these would be clarified. The 63 dB $L_{Aeq,\ 16h}$ free-field threshold level was considered a suitable value for the SOAEL for the purpose of the assessment of likely significant effects.

10.5.32 55 dB $L_{Aeq,\ 8h}$ was considered to be representative of SOAEL and is consistent with advice presented within WHO '*Night Noise Guidelines for Europe*' (WHO 2009) during the night-time.

10.5.33 The day-time and night-time LOAEL were set at 50 dB $L_{Aeq,\ 16h}$ (free-field) and 40 dB $L_{Aeq,\ 8h}$ (free-field) respectively, based upon advice set out within WHO '*Guidelines for Community Noise*' (WHO 1999) and WHO '*Night Noise Guidelines for Europe*' (WHO 2009).

10.5.34 The road traffic noise threshold levels due to the construction and O&M of Thanet Extension are summarised in Table 10.7. A *significant adverse effect* has been deemed to occur when the calculated noise levels are greater than the SOAEL threshold level. The threshold levels are presented for the daytime and night-time periods and are free-field (i.e. away from acoustically reflective surfaces).

Table 10.7: Summary of road traffic noise threshold levels

Noise Sources	Receptor	Period	LOAEL	SOAEL
Construction and operational road traffic noise	Residential	Daytime (07:00 – 23:00)	50 dB $L_{Aeq,16h}$	63 dB $L_{Aeq,16h}$
		Night-time (23:00-07:00)	40 dB $L_{Aeq,8h}$	55 dB $L_{Aeq,8h}$

10.5.35 Where the road traffic noise levels at residential receptors lie between the LOAEL and the SOAEL, consideration has been given to the change in traffic noise levels resulting from Thanet Extension using the impact thresholds set out in the Highways Agency (now Highways England) DMRB (HA 2011) which presents impact thresholds for changes in road traffic noise levels ($L_{A10,18h}$). DMRB sets out different criteria associated with change in noise level for short-term (i.e. immediately after the development opening) and long-term (15 years from the development opening) impacts, as outlined in Table 10.8 and Table 10.9 respectively.

10.5.36 At residential receptors where the baseline road traffic noise is already greater than the SOAEL threshold level, a significant adverse effect is considered to be likely to occur when the overall magnitude of change is greater than 1 dB. This approach is in keeping with the DMRB short-term criteria (HA 2011)), summarised in Table 10.8.

10.5.37 At residential receptors where both the existing and proposed levels of road traffic noise exposure are calculated to be less than the SOAEL threshold level but above the LOAEL thresholds, there is a potential for *a significant adverse effect* where the magnitude of change is 3 dB. This approach is in keeping with the DMRB long-term criteria (HA 2011), summarised in Table 10.9.

Table 10.8: DMRB classification of magnitude of noise impacts: short-term

Change in road traffic noise level	Magnitude of Impact
0 dB $L_{A10,18h}$	No change
0.1 – 0.9 dB $L_{A10,18h}$	Negligible
1 – 2.9 dB $L_{A10,18h}$	Minor (Low)
3 – 4.9 dB $L_{A10,18h}$	Moderate (medium)
5 dB $L_{A10,18h}$ and over	Major (High)

Table 10.9: DMRB classification of magnitude of noise impacts: long-term

Change in road traffic noise level	Magnitude of Impact
0 $L_{A10,18h}$	No change
0.1 – 2.9 dB $L_{A10,18h}$	Negligible
3 – 4.9 dB $L_{A10,18h}$	Minor (Low)
5 – 9.9 dB $L_{A10,18h}$	Moderate (medium)
10 dB $L_{A10,18h}$ and over	Major (High)

Residential receptors: Operational noise: fixed plant

10.5.38 The proposed development includes an onshore substation which incorporates high voltage transformers. It is common to assess the sound produced by fixed plant against the existing background noise level using the assessment methodology set out in BS 4142: 2014 Methods for Rating and Assessing Industrial and Commercial Sound (BSI 2014a).

10.5.39 The background level $L_{A90,T}$ is defined in BS 4142:2014 (BSI 2014a) as the A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels. The specific level - $L_{Aeq,Tr}$ is the equivalent continuous 'A' weighted sound pressure level of the source in question over a given time interval. The rating level - $L_{Ar,Tr}$ is the specific level plus any adjustment made for the characteristic features of the sound.

10.5.40 The background level used in the assessment at each residential receptor potentially affected by noise from fixed plant should be representative of those occurring during the day and night depending on the sources and their hours of operation.

10.5.41 Table 10.10 presents noise impact criteria for stationary noise sources in terms of the difference between background sound level and the rating level. The semantic scale used to describe the impacts of different levels is also shown. The impact criteria are consistent with BS 4142: 2014 (BSI 2014a) which states:

"A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context";

"A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context"; and

"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

Table 10.10: BS 4142 assessment guidance

Magnitude of Impact	Rating level minus background level
No impact	< -10 dB
Negligable	≥ -10 dB and < 0 dB
Minor (Low)	≥ 0 dB and < 5 dB
Moderate (medium)	≥ 5 dB and < 10 dB
Major (High)	≥ 10 dB

10.5.42 A *significant adverse effect,* in terms of the EIA Regulations, is determined to occur when the rating level (free-field) exceeds the background sound level by 10 dB or more; subject to taking into account factors relating to context. This applies to both daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods.

10.5.43 The LOAEL in terms of government policy is determined to occur at the point when the rating level (free-field) exceeds the background sound level. Where the calculated operational fixed plant sound effects at residential receptors lie above the LOAEL, taking into account context, consideration has been given to the items listed in paragraph 10.5.16 to evaluate the magnitude of significance in terms of EIA Regulations.

Non-residential receptors

10.5.44 Non-residential receptors identified in the vicinity of Thanet Extension onshore infrastructure include:

- Great Oaks Small School, Jutes Lane, Minster is located approximately 800 m west of Pegwell Bay Country Park (see ST1 in Figure 10.1 in section 10.7);
- The Stonelees Golf Centre, Ebbsfleet Lane, Ramsgate, is located between Richborough Way and Sandwich Road (see ST2 in Figure 10.1 in section 10.7).
- The Baypoint Club, Ramsgate Road, Sandwich is a sports club located 150 m west of Ebbsfleet roundabout (see ST3 in Figure 10.1 in section 10.7); and

10.5.45 The level of effect of noise or vibration on a non-residential receptor is dependent on:

- The overall sound level and the change in sound level (from the baseline) due to the proposed development;

- The receptor's generic sensitivity to noise or vibration, which is dependent on the use of the receptor; and
- The receptor's specific sensitivity to noise or vibration. For example, the location, construction and layout of an office.

10.5.46 The assessment has considered the noise and vibration exposure at each receptor and the receptor's generic sensitivity, using worst-case assumptions (for example, assuming that for an office building the working spaces are at the closest point to Thanet Extension onshore infrastructure, facing the route with windows open).

10.5.47 At Great Oaks Small School the most noise sensitive use of the receptor are teaching activities within classrooms at the school. At Baypoint Sports Centre and Stonelees Golf Centre, the most noise sensitive use of the buildings are offices at each site.

10.5.48 A set of noise and vibration impact screening criteria have been developed for the different types of non-residential receptor described above. If the relevant receptors are exposed to noise and/or vibration levels from the proposed development which are below the impact screening criteria, noise or vibration is unlikely to adversely impact activities within the building. The criteria take account of relevant design standards and guidance for the type of use and make precautionary assumptions about the design of the buildings. The criteria are set out in Table 10.11.

10.5.49 Where the predicted noise level at a non-residential receptor exceeds the impact screening criteria in Table 10.11, the magnitude of an impact and potential adverse effect is evaluated by the increase in sound levels over and above the relevant screening criterion.

10.5.50 The assessment of effects on non-residential receptors has been undertaken on a reasonable worst-case basis taking account of publicly available information about each receptor. The assessment is considered worst-case because in many cases, for example:

- The location of the sound sensitive area within the receptor may be subject to lower exposure from the proposed development than calculated at the selected assessment location;
- The design of the receptor may offer greater reduction of ground-borne sound or vibration; and/or
- The existing environment and design of the building may mean that existing sound levels already exceed the absolute screening criteria adopted or that ambient internal noise or vibration have some masking effect.

10.5.51 Impact screening criteria for cosmetic damage resulting from construction vibration at non-residential receptors are the same as the criteria for residential receptors. For impact screening criteria for the human perception of vibration in non-residential receptors a multiplying factor of two has been applied to the residential human perception PPV criteria set out in Table 10.5, this is consistent with the guidance on BS 6472-1 (BSI 2008).

Table 10.11: Construction and operational noise impact screening criteria for non-residential receptors (All sources of noise)

Type of receptor	Impact screening criterion (Free-field noise level)		Potential effect
	Day 07:00 - 23:00	Night 23:00 - 07:00	
Schools	50 dB[1)] $L_{pAeq,T}$ and a change > 3 dB	N/A	Disturbance
Offices	ABC[2)]/ 55 dB[3)] $L_{pAeq,T}$ and a change > 3 dB	N/A	Disturbance

1) Assuming 15 dB attenuation from a partially open window, an external level of 50 dB $L_{pAeq,T}$ incident on a classroom would correspond to an internal level of 35 dB $L_{pAeq,T}$ which is consistent with appropraite design aims for classrooms set out in Education Funding Agency (2012). Acoustics Performance Standards for the Priority Schools Building Programme. Department for Education.

2) For construction assess noise using A and B categories from BS 5228 which is consistent with Advisory Leaflet (AL) 72 (1976), Noise control on Building Sites.

3) Assuming 15 dB attenuation from a partially open window, an external level of 55 dB $L_{pAeq,T}$ incident on an office would correspond to an internal level of 40 dB $L_{pAeq,T}$ which is consistent with appropraie design aims for offices set out in British Council for Offices (2009). Guide to Specification.

Sensitivity of receptors

10.5.52 Table 10.12 sets out the sensitivity to construction (and decommissioning) noise and vibration of the different receptors considered in this assessment.

Table 10.12: Receptor sensitivity – construction noise and vibration

Sensitivity of receptor	Construction noise	Construction vibration
High	Education, healthcare facility	Listed buildings and non-earthwork Scheduled Monuments
Medium	Residential	Unreinforced or light framed structures
Low	Area used primarily for offices, leisure activities, including PRoW, sites of historic or cultural importance.	Residential or light commercial buildings
Negligible	Not applicable to this assessment	Not applicable to this assessment

10.5.53 Table 10.13 sets out the sensitivity of receptors considered in this assessment for operational noise.

Table 10.13: Receptor sensitivity – operational noise

Sensitivity of receptor	Receptor description
High	Such receptors include pupils in residential educational facilities and patients in healthcare facilities and are defined as a "vulnerable subgroup" with very high or continuous rates of occupancy. Receptors are categorised as high sensitivity where noise may be detrimental to vulnerable subgroups.
Medium	Residential receptors. Receptors are categorised as medium sensitivity where noise may cause disturbance and a level of protection is required but a level of tolerance is expected.
Low	Area used primarily for leisure activities including PRoW, sports facilities and sites of historic or cultural importance. Receptors are categorised as low sensitivity where noise may cause short duration effects in a recreational setting although particular high noise levels may cause a moderate effect.
Negligible	Not applicable to this assessment.

10.5.54 The assessment of significance of the predicted effects depends on the sensitivity of the receptor under consideration and is defined according to the matrix set out in Table 10.14.

Table 10.14 Significance of potential effects

		Sensitivity			
		High	Medium	Low	Negligible
Negative Magnitude	High	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
Beneficial Magnitude	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	High	*Major*	*Major*	*Moderate*	*Minor*

Note: Shaded cells are defined as significant effects in EIA terms

10.6 Uncertainty and technical difficulties encountered

Baseline sound survey

10.6.1 As advised in BS 4142:2014 (BSI 2014a), areas of uncertainty associated with measurement of sound levels include:

- The complexity and level of variability of the residual acoustic environment;
- The location(s) selected for taking the measurements;
- The distance between sources of sound and the measurement location and intervening ground conditions;
- The number of measurements taken;
- The measurement time intervals;
- The range of times when the measurements have been taken;
- The range of suitable weather conditions during which measurements have been taken;
- The measurement method and variability between different practitioners in the way the method is applied;

- The level of rounding of each measurement recorded; and
- The instrumentation used.

10.6.2 Measurement uncertainty was minimised during the baseline sound survey using the following steps:

- The measurement positions were located away from reflecting surfaces and leafy vegetation;
- The long-term measurements included daytime and night-time periods for a typical day and levels were measured for seven days;
- The short-term measurements were only completed for areas not used at night (e.g. schools, country parks, golf courses);
- Measurements undertaken during unsuitable weather conditions were excluded from the monitoring results; and
- The instrumentation was suitable according to BS 7445-1:2003 (BSI 2003).

Construction noise calculation

10.6.3 Construction noise and vibration predictions are based on the anticipated programme and construction methods. It has been necessary to make assumptions with the advice of the design team regarding some aspects of the construction process. These are considered to be precautionary and reflect the level of information that is typically available at this stage in the development of the proposed development.

Operational sound: onshore substation

10.6.4 There is uncertainty associated with the calculation of sound from the onshore substation due to the substation design and location. Uncertainty has been minimised by assuming typical equipment items for the onshore substation and by using layouts that are likely to be representative of a reasonable worst-case of the final layout.

10.7 Existing environment

10.7.1 The existing baseline survey has been characterised with a baseline sound survey which was undertaken in April 2017. The survey is described in detail in the Onshore Noise and Vibration Technical Report (Volume 5, Annex 10-1: Noise and Vibration Baseline Report (Document Ref: 6.5.10.1)). The findings of the survey are summarised in this section.

10.7.2 Noise survey data were obtained at locations representative of one or more noise sensitive receptors in the vicinity of Thanet Extension onshore infrastructure. These locations are shown in Figure 10.1 in relation to the proposed development Red Line Boundary.

10.7.3 The area in the vicinity of Thanet Extension onshore 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. The noise measurement locations for the existing ambient noise environment at each location is described below:

Long-term location LT1 – 33 Beech Grove

10.7.4 LT1 was located in the west of Cliffsend. LT1 is representative of approximately nine residential properties.

10.7.5 During the day 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.

10.7.6 During the night 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.

Long-term location LT2 – 9 Oakland Court

10.7.7 LT2 was located in the south-west of Cliffsend. LT2 is representative of approximately 12 residential properties.

10.7.8 During the day road traffic noise from the A299 (located 600 m north) was a dominant contributor to the acoustic environment. 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.

10.7.9 During the night 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.

Long-term location LT3 – 125 Sandwich Road

10.7.10 LT3 was located in the south of Cliffsend. LT3 is representative of approximately five residential properties.

10.7.11 During the day 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 were intermittent as well as sound from St. Augustine's Golf Club (which backs onto the rear garden of the property), which included golf buggies and lawn mowers.

10.7.12 During the night distant road traffic noise from the north remained dominant and traffic flow on Sandwich Road had reduced. Golf course activity was no longer audible, whilst a low breeze moving through the trees became audible.

Long-term location LT4 – Stonelees Cottage

10.7.13 LT4 was located on Ebbsfleet Lane. LT4 is representative of approximately eight residential properties.

10.7.14 During the day 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.

10.7.15 During the night 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.

Long-term location LT5 – Stonar Cottage

10.7.16 LT5 was located on the A256 next to the Stonar Cut in the River Stour and is the nearest sensitive receptor to the Richborough Energy Park. LT5 is representative of one residential property.

10.7.17 During the day 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 assumed to be related to the skip company located inside Richborough Business Park.

10.7.18 During the night road traffic noise was still dominant, however had reduced. Wind in trees was also audible.

Short-term location ST1 – Pegwell Bay Country Park

10.7.19 ST1 was located within Pegwell Bay Country Park. During the day 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. Measurements were not undertaken at night.

Short-term location ST2 –Great Oaks Small School

10.7.20 During the day 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. Measurements were not undertaken at night.

Short-term location ST3 –Baypoint Club

10.7.21 During the day 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. Measurements were not undertaken at night.

Short-term location ST4 –Stonelees Golf Centre

10.7.22 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. Measurements were not undertaken at night.

10.7.23 The numerical results of the sound monitoring are summarised in Table 10.15 and Table 10.16.

Table 10.15: Summary of the long-term 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	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					

Table 10.16: Summary of the short-term 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)*
ST1	Pegwell Bay Country Park	Daytime (07:00 – 23:00)	47	42	-
ST2	Great Oaks Small School	Daytime (07:00 – 23:00)	49	46	-
ST3	Baypoint Club*	Daytime (07:00 – 23:00)	58	55	-
ST4	Land at Stonelees Golf Centre	Daytime (07:00 – 23:00)	52	43	-

THANET EXTENSION OFFSHORE WIND FARM

Figure 10.1

The Onshore Route Corridor showing Noise Survey Locations and Study Area

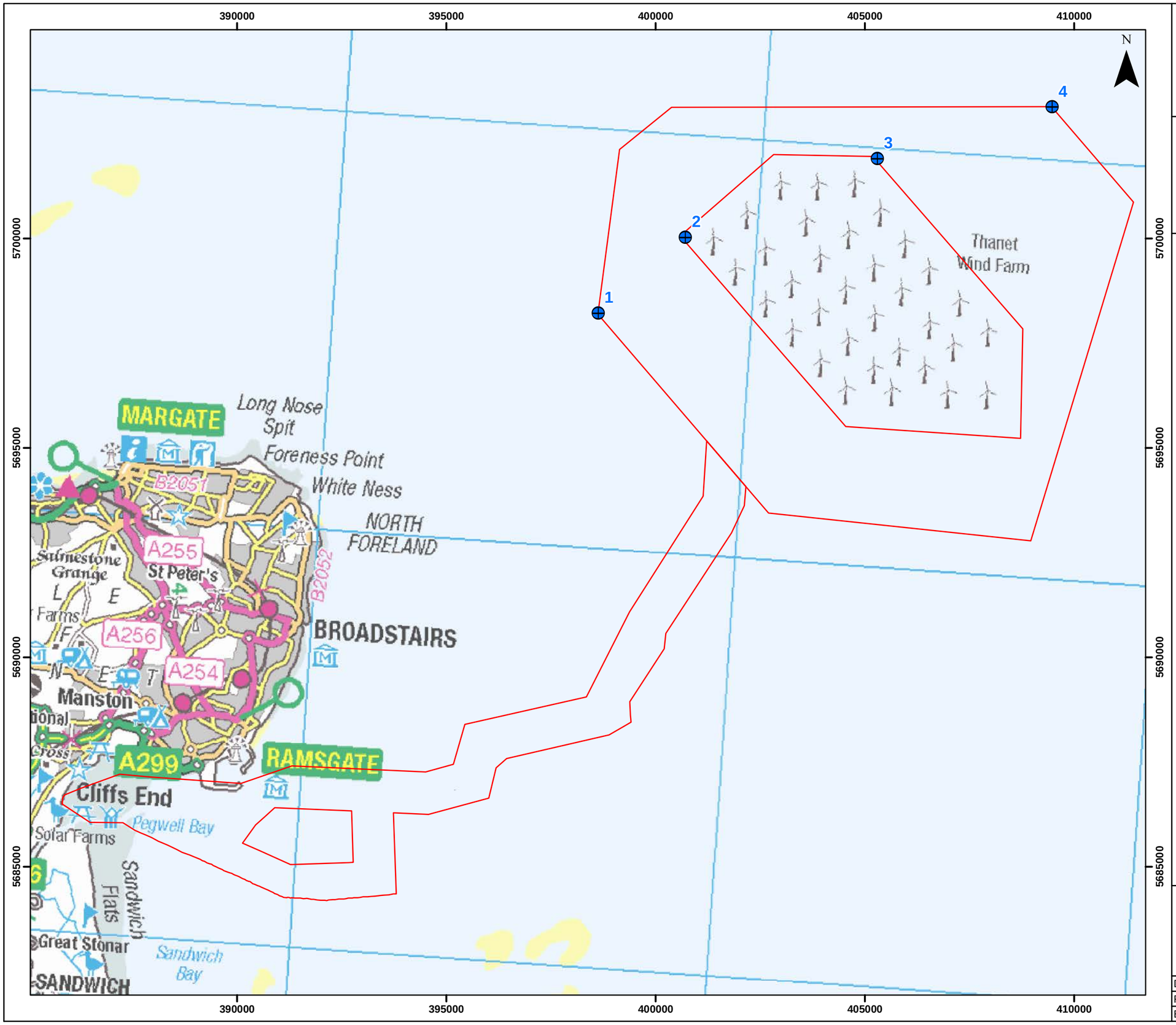
Legend

- Onshore Red Line Boundary
- 400 m study area for day time construction noise
- 1400 m study area for night time construction noise
- Onshore substation area
- Approximate extent of trenched cable
- Landfall area 350m from seawall
- Noise survey location / Noise sensitive receptors

Datum: OSGB 1936
Projection: BNG

1:15,000 0 0.4 0.8 km

Drg No	39080-Lon138			**Figure 10.1**
Rev	1.0	Date	02/05/2018	
By	JP	Layout	N/A	



amec foster wheeler

VATTENFALL

THANET EXTENSION OFFSHORE WIND FARM

Figure 10.2

Construction Assessment Locations for Offshore Piling

Legend

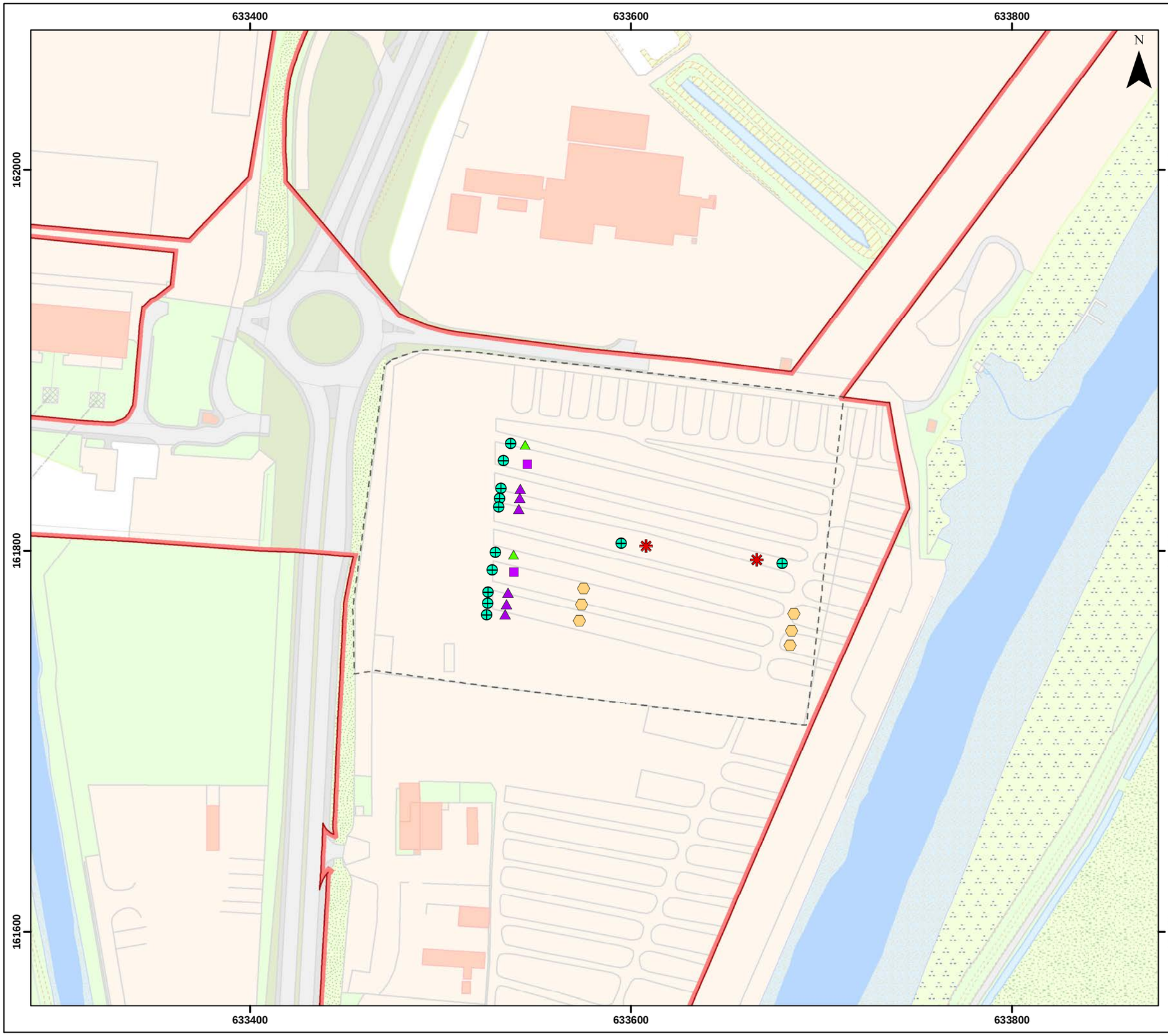
- Offshore Red Line Boundary
- Assessment location for offshore piling
  - 1: 8,300 m (4.5 nm)
  - 2: 11,000 m (5.9 nm)
  - 3: 15,900 m (8.6 nm)
  - 4: 20,200 m (10.9 nm)

Datum: ETRS 1989
Projection: UTM31N

1:90,000 0 1 2 km 0 0.55 1.1 nm

Drg No	39080-Lon139a		
Rev	1.0	Date	04/05/2018
By	JP	Layout	N/A

Figure 10.2



THANET EXTENSION OFFSHORE WIND FARM

Figure 10.3

Indicative Substation Layout

Legend

- Onshore Red Line Boundary
- Substation footprint
- Super Grid Transformer
- Harmonic Filter
- Shunt Reactor
- SVC Transformer
- SVC Reactor
- Cooler

Datum: OSGB 1936
Projection: BNG

1:2,000 0 0.05 0.1 km

Drg No	39080-Lon162		
Rev	1.0	Date	03/05/2018
By	JP	Layout	N/A

Figure 10.3

10.8 Key parameters for assessment

10.8.1 The maximum design scenarios identified in Table 10.17 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (Volume 3, Chapter 1: Onshore Project Description (Document Ref: 6.3.1)). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope to that assessed here be taken forward in the final design scheme.

Table 10.17: Design envelope scenario assessed for noise and vibration

Potential effect	Maximum design scenario assessed	Justification
Construction		
Temporary noise effects of construction at landfall	The construction noise assessment assumes that all construction activity is located at the extremity of the proposed development Red Line Boundary closest to NSRs. Impacts from all options at landfall for the Transition Joint Bays (TJBs) are likely to be similar in magnitude because plant and equipment used to construct the TJBs is similar to the plant required to construct the cable route (over ground or underground), hence a similar amount of construction is required for the development regardless of where the TJBs are within the proposed development Red Line Boundary. Options 1 and 3 provide the option for buried TJBs, installed in an excavated pit with piles. The construction noise assessments assume that impact piling will be required to construct a cofferdam associated with the construction of the TJBs in all options. Landfall construction for a maximum of 5 months. Standard working hours are assumed to be 07:00-19:00 6 days per week and will typically include a 1 hour set up period at 07:00 and a 1 hour set down period at 18:00, with the exception of piling associated with the cofferdam required for the removal of the seawall in the inter-tidal zone in Options 2 and 3 which will require night time working for three weeks.	The precise location of the cable route and TJBs is yet to be defined. Construction activities at the proposed development Red Line Boundary will result in greater noise impacts than construction in the centre of the proposed development. Impact piling is likely to generate relatively high levels of noise compared to other types of cofferdam construction methods.
Temporary noise effects of construction of the cable route.	The construction noise assessment assumes that all construction activity is located at the extremity of the proposed development Red Line Boundary closest to NSRs. Cabling from TJB to substation: 4 circuits (3 cables per circuit) carried in four trenches. Approximately 1 km cable by open trenching methods to bury the cables outside the landfill. Cable route construction 18 months. Standard working hours are assumed to be 07:00-19:00, 6 days a week and will typically include a 1 hour set up period at 07:00 and a 1 hour set down period at 18:00, with some occurrences of weekend and night working lasting for less than one month.	The maximum design envelope will predict the highest noise impact from the proposed development.
Temporary noise effects of construction onshore substation	The construction noise assessment assumes that all plant and equipment required to construct the substation is operating simultaneously. The construction noise and vibration assessments assume that impact piling will be required to construct the foundations. Substation construction approx. 24 months construction period but main heavy/ noisy construction works during the first 12 months. Standard working hours are assumed to be 07:00 - 19:00, 6 days a week and will typically include a 1 hour set up period at 07:00 and a 1 hour set down period at 18:00, with some occurrences of weekend and night working lasting less than one month.	The detailed construction programme is yet to be defined. The type of piling method for the substation foundations will not be known until the geotechnical conditions at the site are known. Impact piling is likely to generate relatively high levels of noise compared to other types foundation construction methods. Hence it is a worst-case assumption.

Potential effect	Maximum design scenario assessed	Justification
Temporary noise effects of construction traffic	Traffic will route to the site via the A256 (from either North or South). Upon reaching Richborough, HGVs and LV's (depending on the construction activity) will either enter the proposed site via the Richborough Energy Park roundabout or Sandwich Road. For the purposes of presenting a worst-case assessment, it has been assumed that all primary highway routes will carry the same peak traffic which are forecast to occur for the busiest month. The following two-way annual average weekly traffic data (AAWT)flows are predicted to occur during the busiest month and assume that the cable route and substation will be constructed simultaneously: • 317 HGVs and 189 LGVs	The values presented will result in the highest noise impact which would occur during the busiest month.
Temporary vibration effects of construction	The construction vibration assessments assume that impact piling will be required to construct the substation foundations. A four-ton hammer with a drop height of up to 1m has been assumed. It has also been assumed that piles will be driven into stiff cohesive soil.	The type of piling method for the substation foundations will not be known until the geotechnical conditions at the site are known. Impact piling is likely to generate relatively high levels of vibration compared to other types of foundation construction methods.
Temporary noise effects of offshore piling	The construction noise assessment assumes that monopile or piled quadropod foundations will be required. 24 our working has been assumed. Noise predictions have been made from noise measurements made of piling work undertaken by a Seajack barge. This has previously been used to assess the impact of piling noise from the Teesside Offshore Wind Farm. It has been assumed that the increase in hammer energy is proportional to the increase in sound energy (i.e. a doubling of hammer energy equates to a 3 dB increase of sound).	Noise from piling has the potential to travel large distances over water. The impact of piling noise is likely to be highest at night as background noise levels are lowest.
O&M		
Noise effects of operation onshore substation	The noise assessment of the O&M of the onshore substation assumes that the plant and equipment will be air cooled i.e. not enclosed within a transformer room and that no acoustic screening is provided. Predictions have been based on an indicative design layout presented in Figure 10.3.	An unscreened transformer would lead to the emission of higher noise levels during O&M than a screened transformer.
Decommissioning		
All decommissioning activities	It is assumed that cables would remain in the ground following decommissioning. The onshore substation will be removed and the site re-instated to original condition or for alternative use. Decommissioning assumes that the concrete foundations would be broken up using hydraulic peckers.	Concrete breaking is the noisiest activity likely to be associated with decommissioning.

10.9 Embedded mitigation

10.9.1 Mitigation measures that were identified and adopted as part of the evolution of the project design (embedded into the project design) and that are relevant to noise and vibration are listed in Table 10.18. General mitigation measures, which would apply to all parts of the electrical transmission works, are set out first. Thereafter mitigation measures that would apply specifically to noise and vibration issues associated with the cable route, and onshore substation, are described separately.

Table 10.18: Embedded mitigation relating to noise and vibration

Parameter	Mitigation measures embedded into the project design
Construction	
Construction noise and vibration all elements	The assessment assumes the implementation of the principles and management processes set out in a Code of Construction Practice (CoCP) which is be the subject to a DCO Requirement. A Noise and Vibration Management Plan (NVMP) (to be submitted and approved by the local authority under the DCO before construction starts, in line with the principles provided in the Code of Construction Practice (Document Ref: 8.1) will include requirements that: • BPM is applied during construction activities to minimise noise (including vibration) at neighbouring noise sensitive properties; • The NVMP would set out the steps to be taken to minimise construction noise and vibration as far as it is reasonable and practical to do so; • Contractors would undertake and report noise and vibration prediction and monitoring as is necessary to assure and demonstrate compliance with the NVMP. Monitoring data would be made available to the local authorities; • The use of plant fitted with effective silencers and noise insulation; • The use of pink noise reversing alarms that produce a “static” sound as opposed to a beep where practicable to reduce the noise generated by reversing bleepers on site vehicles; • All plant is regularly serviced and maintained, and operated in accordance with manufacturer’s instructions - plant that is intermittently used should be shut down in the intervening periods between work or throttled down to a minimum; • The use of local noise screening or site hoardings to reduce noise where necessary; • Appointment of a site contact to whom complaints/ queries about construction activity can be directed - any complaints should be investigated and action taken where appropriate; • All construction activity to be undertaken in accordance with good practice as described in BS 5228-1:2009+A1:2014 (BSI 2009a); • Local residents should be kept informed of construction activities, including working hours; • Construction works will be limited to 07:00 – 19:00hrs unless essential work (e.g. trenchless works to continue a bore) is required outside of these times; • All reasonable steps should be taken to limit the number of vehicles waiting to deliver materials to the proposed development; • Construction at the proposed development Red Line Boundary (which would be closest to nearby residential receptors), should be undertaken as efficiently and quickly as reasonably possible; and • With the exception of generators, pumps and electric plant, all plant and equipment should be shut down when not in use.
Construction offshore piling	In addition to the measures set out for onshore construction the following mitigation measures are to be implemented: • Planning of works to avoid significant adverse effects during night time hours at onshore receptors; and • Continuous monitoring of noise levels during work.
Decommissioning	
Onshore substation	As construction phase (although open cut and trenchless works will not be required).

10.10 Environmental assessment: construction phase

10.10.1 Construction of Thanet Extension onshore infrastructure is expected to commence in 2020 and last approximately 30 months.

10.10.2 Construction activities for the onshore cable route and substation will be conducted during working hours of 07:00 to 19:00 and will typically include a 1 hour set up period at 07:00 and a 1 hour set down period at 18:00. Evening or weekend working may be required to maintain programme progress and for specific time critical activities such as transformer oil filling and processing. Works outside of these hours are expected to be less than one month in duration so are unlikely to result in significant adverse effects.

10.10.3 Some periods night time working lasting longer than one month may be required for cable laying and trenching in the intertidal zone at landfall.

10.10.4 Offshore piling work may require 24 hour working and will be carried out over a period longer than one year.

10.10.5 Construction of Thanet Extension onshore infrastructure has been considered in terms of the following activities and sub-activities which have the potential to result in significant adverse effects. The activities are described in more detail in the project description (Volume 3, Chapter 1: Onshore Project Description (Document 3.6.1)).

Landfall, Onshore cable installation and Soil Storage

10.10.6 The landfall denotes the location where the offshore cables are brought ashore and joined to the onshore cables within the TJBs. A number of options are currently being assessed that will be refined in the detailed design stage following Site Investigation works. It has been assumed for the purpose of this assessment that all options have a requirement for a cofferdam during daytime construction which would require sheet piling. Options 2 and 3 may also require piling during the night-time to create a cofferdam in order to allow works to be carried out on the seawall.

10.10.7 The onshore export cables will be buried for the majority of the onshore cable route, except in Option 2 through Pegwell Bay Country Park, where cables would be laid in an artificial berm above ground. The main method of installation for buried cables as per Option 1 and Option 3 would be through the use of open-cut trenching with ducts installed, backfilled and cables pulled though the pre-laid ducts. Where the cable route crosses transport routes, waterways or underground services the standard open-cut trenching installation technique may not be suitable.

10.10.8 The cable burial depth may increase at crossing locations or an alternative trenchless method may be deemed preferable. Topsoil will be stripped from the entire corridor and stored and capped. The cable trenches will then be excavated, typically utilising tracked excavators and side cast for later use. Trenching within the Pegwell Bay Country Park may require the removal of material, transported via dump trucks. The excavated subsoil will be stored separately from the topsoil. Where water enters the trenches during installation, this will be pumped via settling tanks or ponds to remove sediment, before being discharged into local ditches or drains via temporary interceptor drains.

10.10.9 A stabilised backfill such as Cement Bound Sand (CBS) will be installed at the base of the trench. A duct for each cable core and a separate duct for a fibre optic bundle will be laid on the CBS base and backfilled with CBS. The trench will be backfilled with subsoil material excavated from the trench. The use of a vibratory compactor may be adopted where necessary to compact and level the land. The stored topsoil will be replaced upon the backfilled subsoil to reinstate the trench to pre-construction condition, so far as reasonably possible.

10.10.10 Once the cable routes are complete the cables will be pulled through the installed ducts late in the construction programme. Cable pulling does not require the trenches to be reopened, however access to and from the jointing pits along the running track will be required to facilitate the works. Cable drums will be delivered by HGV low loader to primary mobilisation areas for storage where necessary, then transported to the open joint pit locations. The cable drum will be located adjacent to the joint pit on a temporary hard standing and a winch attached to the cable, pulling the cable off the drum from one joint pit to another, through the buried ducts. The type of construction plant required to construct the landfall and onshore cable route includes dozers, tracked excavators and dump trucks. The total duration of the onshore cable route trenching, duct work, backfill and cable pulling is expected to be two years. The works are linear and the plant will move along the cable route. Daily noise levels will increase as the works approach a noise sensitive receptor and decrease as the works move away. Noise levels will be highest when the excavation works are closest to a noise sensitive receptor. Assuming that the 1,825 m cable route will take the 18 months to construct, as defined in the construction programme, the excavation works will move at a rate of approximately 100 m per month. In practice the construction rate is likely to be more rapid than this as the programme includes enabling works, trench construction and reinstatement phases.

Running track

10.10.11 The running track provides safe access for construction vehicles along the cable corridor, from mobilisation areas to cable installation sites. The running track could be up to 5 m wide and extend the full length of the cable route. Following topsoil stripping, the running track will be formed of protective matting, temporary metal road or permeable gravel aggregate. The running track will be required to remain cleared for the duration of the trenching activities to allow access along the cable route. Following construction completion, the running track will be removed and the topsoil reinstated.

Temporary construction compound

10.10.12 During construction of the onshore substation, temporary construction compounds will be established to support the works. The location of the onshore substation temporary construction compound will be sited next to the onshore substation.

Substation construction

10.10.13 The site will be stripped and graded. Stripped material will be reused on site where possible as part of bunding and shielding. Any excess material would be disposed of at a licenced disposal site. Excavations and laying of foundations, trenches and drainage will commence after grading is complete. At this stage it is not known whether the foundations would either be ground-bearing or piled based on the prevailing ground conditions. As a worst-case for noise and vibration it has been assumed that the foundations could be formed using impact piling. The specialist electrical equipment will then be delivered to site and installed and commissioned. Due to the size and weight of assets such as the transformers specialist delivery methods will be employed and offloaded at site with the use of a mobile gantry crane. An interconnecting cable from the onshore substation to Richborough Energy Park National Grid substation will be installed in accordance with the main cable laying and installation works.

10.10.14 The type of construction plant required to construct the onshore substation includes dozers, tracked excavators, piling rigs, cranes and dump trucks. The full programme for the construction of the substation and National Grid substation connection is 24 months and will happen in parallel to the construction of the cable route.

Offshore Piling

10.10.15 Piling may be required to construct the foundations of the WTGs for monopile or piled quadropod options. Noise from piling has the potential to travel large distances over water. The shortest distance from the offshore array to the shore is 8.3 km.

Construction noise assessment: mobile and fixed plant

10.10.16 Noise sensitive receptors within the study area for daytime and night-time construction noise shown in Figure 10.1 include:

- LT1 – 33 Beech Grove, representative of approximately nine residential properties which are approximately 770m from Thanet Extension onshore Red Line Boundary and 850m from the Potential Zone for Transition Joint Bay. The closest works to this receptor is the landfall operations.
- LT2 – 9 Oakland Court, representative of approximately 12 residential properties which are approximately 750 m from Thanet Extension onshore Red Line Boundary and 730m from the Potential Zone for Transition Joint Bay. The closest works to this receptor is the landfall operations.
- LT3 - 125 Sandwich Road, representative of approximately five residential properties which are approximately 580 m from Thanet Extension onshore Red Line Boundary and 590m from the Potential Zone for Transition Joint Bay. The closest works to this receptor is the landfall operations.
- LT4 – Stonelees Cottage, representative of approximately eight residential properties on Ebbsfleet Lane/ Sandwich Road which are approximately 60 m from Thanet Extension onshore Red Line Boundary and 550m from the Potential Zone for Transition Joint Bay. The closest works to this receptor is the trenched cable installation.
- LT5 – Stonar Cottage, a residential property on Ramsgate Road which is located 110m from Thanet Extension onshore Red Line Boundary. The closest works to this receptor is the remediation works to the southmost hardstanding area.
- ST3 – Baypoint Club which is located approximately 100m from Thanet Extension onshore Red Line Boundary. The closest works to this receptor is the trenched cable installation. The receptor is also located 35 m from the site access road which accesses the site from Ebbsfleet roundabout.

10.10.17 Table 10.19 presents construction noise predictions for the daytime construction period at these receptors. The predictions represent the worst-case scenario in that they assume that all plant and equipment is operating simultaneously and is located at the extremity of the proposed development Red Line Boundary at the closest point to the receptor location.

10.10.18 The assumptions and calculations supporting the predictions shown in Table 10.19 are provided in Volume 5, Annex 10-2: Noise and Vibration Supporting Information (Document Ref: 6.5.10.2).

10.10.19 The second and third columns of Table 10.19 present the 'ABC' category and corresponding 'ABC' threshold for each receptor. The 'ABC' category has been derived based on the existing ambient noise level according to Table 10.4 (residential receptors) or Table 10.11 (non-residential receptors). The 'ABC' threshold is the threshold for potential significant effects from construction noise. The maximum predicted construction noise level at each receptor is presented in the fourth column of Table 10.19. If the maximum noise level is less than the 'ABC' threshold then significant effects from construction noise are unlikely. If the maximum predicted construction noise level exceeds the 'ABC' threshold by more than 3 dB then there is a potential for a significant effect resulting from construction noise depending on the duration of the exceedance.

Table 10.19: Maximum daytime construction noise predictions at residential and non-residential receptors – Cable route and substation construction including piling for TJBs.

Receptor	Description	ABC Category (BS 5228)	ABC Threshold $L_{pAeq,16\ hour}$ (dB)	Maximum predicted construction noise level $L_{pAeq,16\ hour}$ (dB)	Exceedance of ABC threshold	Impact Classification (Table 10.5)
LT3	Residential property in the vicinity of 125 Sandwich Road	A	65	53	No	LOAEL
LT4	Residential property in the vicinity of Stonelees Cottage, Ebbsfleet Lane, Ramsgate	A	65	71	+ 6 dB	LOAEL
LT5	Residential property on Ramsgate Road	C	75	70	No	LOAEL
ST3	Offices at Baypoint Club	A	65	67	+2	LOAEL

10.10.20 At LT3 (residential property in the vicinity of 125 Sandwich Road) the predicted maximum construction noise level is less than the 'ABC' threshold and below the LOAEL. The magnitude of the impact was assessed as Negligible, because the noise level does not exceed the 'ABC' threshold, and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** significance, which is not significant in terms of the EIA Regulations.

10.10.21 At LT5 (residential property on Ramsgate Road) the predicted maximum construction noise level is less than the 'ABC' threshold and above the LOAEL. The magnitude was assessed as Negligible, because the noise level is less than the 'ABC' threshold and the sensitivity as Medium. The significance was therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

10.10.22 At ST3 (Offices at Baypoint Club) the predicted maximum construction noise level exceeds the 'ABC' threshold by 2 dB. The magnitude was assessed as Low, as the level does not exceed the 'ABC' threshold by more than 3 dB, and the sensitivity as Low. The significance is therefore deemed to be of **Minor** adverse significance which is not significant in terms of the EIA Regulations. It is assumed ST3 is occupied during the daytime hours only and therefore not sensitive to night time works as set out in the next table.

10.10.23 At LT4 (Residential property in the vicinity of Stonelees Cottage) worst-case maximum noise levels exceed the 'ABC' threshold criteria by 6 dB and exceeds the LOAEL. To understand the impact of these noise levels, resulting from the cable construction, consideration is given to the context of workings times and embedded mitigation below.

10.10.24 It was described above that the works associated with the trenching of the onshore cable route are linear and they will move along the line of the cable route. The slowest rate of construction is estimated to be 100 m per month (1,825 km cable route installed over 18 months). After two weeks of construction the works are expected to move 50 m along the cable route meaning that the works will be approximately 80 m from the residential properties. The daytime noise level when the cable route works are located 80 m away from the residential properties are estimated to be 69 dB $L_{pAeq,16\ hour}$, which is below the SOAEL threshold for construction noise and exceeds the category A LOAEL threshold by 4 dB. Furthermore, this indicates that without embedded mitigation, construction noise would exceed the 'ABC' threshold by more than 3 dB for a duration of longer than one month at receptor LT4.

10.10.25 The embedded mitigation measures for construction noise are described in Table 10.18. It will be a requirement for any contractor to use BPM to minimise construction noise. Prior to undertaking any works contractors will be required to plan their works. The plans will include predictions of noise at sensitive receptors and will set out the mitigation measures that will be employed to reduce construction noise. Measures which can be employed to reduce construction noise are also listed in Table 10.18. It is likely that one or a combination of these common mitigation measures will achieve a reduction in construction noise of at least 4 dB at the closest noise sensitive receptors (for example site hoardings can provide 5 – 10dB of mitigation). With this form of mitigation (a minimum of 5dB from screening) maximum predicted construction noise at LT4 would be 66dB $L_{pAeq,16\ hour}$ when the works are at their closest point to the receptor. Once the works have moved 50m along the cable route noise levels would be 64 dB $L_{pAeq,16\ hour}$, which is lower than the 'ABC' threshold.

10.10.26 This demonstrates that the 'ABC' threshold and LOAEL would not be exceeded for a period longer than one month at LT4 once the embedded mitigation is accounted for. Therefore, the magnitude was assessed as Negligible and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

Table 10.20: Maximum night-time construction noise predictions at residential and non-residential receptors resulting from piling works required at landfall in the inter-tidal zone.

Receptor	Description	ABC Category (BS 5228)	ABC Threshold $L_{pAeq,16\ hour}$ (dB)	Maximum predicted construction noise level $L_{pAeq,16\ hour}$ (dB)	Exceedance of ABC threshold	Impact Classification (Table 10.5)
LT1	Residential property in the vicinity of 33 Beech Grove	C	55	49	No	LOAEL
LT2	Residential property in the vicinity of 9 Oakland Court	B	50	50	No	LOAEL
LT3	Residential property in the vicinity of 125 Sandwich Road	C	55	53	No	LOAEL
LT4	Residential property in the vicinity of Stonelees Cottage, Ebbsfleet Lane, Ramsgate	C	55	49	No	LOAEL

10.10.27 At receptors LT1, LT 2, LT3 and LT4 the predicted maximum construction noise level is less than the 'ABC' threshold and below the SOAEL, therefore meaning that significant effects are unlikely to occur. The magnitude of the impact was assessed as Negligible, because the noise level does not exceed the 'ABC' threshold, and the sensitivity as Medium. The significance was therefore deemed to be of **Minor** adverse significance which is not significant in terms of the EIA Regulations.

Construction noise: offshore piling

Prediction method

10.10.28 A preliminary assessment of noise from offshore piling has been undertaken. Noise propagation from the piling operations has been assessed using the prediction methods set out in BS 5228-1 (2009) +A1: 2014 (BSI 2009a) and assuming that sound is propagating over hard ground. Furthermore, atmospheric absorption effects have not been accounted for which provides a conservative approach. Sound level data was obtained from a 1,200 kJ hammer operating on a Seajack barge and has been scaled accordingly to provide a sound power level for a 2,700 kJ and 5,000 kJ piling rig.

10.10.29 The assessment assumes a soft-start involving a ramp-up to full hammer energy and that after the soft-start, all piling is conducted at maximum hammer energy. The assessment also assumes that the total piling duration for a single foundation is a maximum of six hours for monopiles and ten hours for pin piles. These durations represent a realistic worst-case and experience from the existing TOWF suggests that the duration is likely to considerably shorter. It is also likely that only a small proportion of the piling time would require full hammer energy and that some piles will not require the full hammer energy at all (depending on the substrate type). It is also assumed that there will be no simultaneous piling meaning only one piling vessel will be piling at any time.

10.10.30 The closest point on the shore to the WTGs is Botany Bay, Beach, Broadstairs. This is a densely populated residential area. No baseline noise data is available for this location for the ES to define appropriate construction noise thresholds. In the absence of baseline data, the construction noise assessment has used the lowest 'ABC' thresholds for assessing the significance of construction noise. This reinforces a cautious approach.

10.10.31 Four distances have been assessed from the proposed WTGs to the closest noise sensitive receptors in order to provide context to the assessment as the works are completed. These are shown in Figure 10.2. Table 10.21 presents the predicted exceedance of the lowest 'ABC' thresholds for day, evening and night, for the two proposed hammer energies: 2,700kJ for pin piles and 5,000kJ for monopile foundations.

Table 10.21: Predicted exceedance of 'ABC' thresholds with respect to offshore piling

Distance to Shore (m)	Hammer Energy (kJ)	Exceedance of Daytime 'ABC' Threshold (65 dB)	Exceedance of Evening 'ABC' Threshold (55 dB)	Exceedance of Night-time 'ABC' Threshold (45 dB)
8300	2700	-	-	+8.1
	5000	-	+0.8	+10.8
11000	2700	-	-	+5.7
	5000	-	-	+8.4
15900	2700	-	-	+2.5
	5000	-	-	+5.2
20200	2700	-	-	+0.4
	5000	-	-	+3.1

Predicted noise levels from offshore piling

10.10.32 For all piling energies and distances, the predicted piling noise level at the closest receptor on shore does not exceed the lowest daytime and evening 'ABC' thresholds of 65 dB $L_{pAeq,16\ hour}$ and 55 dB $L_{pAeq,4\ hour}$ respectively, by greater than 3 dB. This is a Low magnitude impact on Medium sensitivity receptors. The significance of daytime and evening piling work is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

10.10.33 For night time works:

- For 5,000kJ piling energy the predicted noise level at the closest onshore receptor exceeds the lowest night time 'ABC' threshold of 45 dB $L_{pAeq,8hr}$ by 3.1 to 10.8 dB, depending on distance from shore. This would also exceed the SOAEL for construction noise of 55 $L_{pAeq,8hr}$ for distances closest to the shore. The magnitude of impact would be Low to High on a receptor of medium sensitivity.
- For 2,700kJ piling energy the predicted noise level at the closest onshore receptor exceeds the lowest night time 'ABC' threshold of 45 dB $L_{pAeq,8hr}$ by 0.4 to 8.1 dB, depending on distance from shore. The magnitude of impact would be Low to High on a receptor of medium sensitivity.

10.10.34 Considering these potential impacts in combination with the number of residential receptors in Broadstairs the night time works have the potential to result in significant adverse effects at the maximum piling energy.

Duration, temporal characteristics and respite

10.10.35 Offshore piling works would be undertaken within a 6 month period. For pin piles the maximum expected duration of piling is 10 hours per foundation, which would result in a total piling time of 280 hours for the WTGs, with a further two foundations for the offshore substation (if required) and the metmast (if required) resulting in a potential 300 hours of piling (just over 12 days of piling across the six-month programme). For monopiles the maximum expected duration of piling is 6 hours per foundation, which corresponds to a total piling time of 280 hours (seven days of piling across the six-month programme). If piling was continuous, in both cases the duration of piling would last less than one month and would not be significant in EIA terms.

10.10.36 A longer offshore foundation construction programme of up to six months is required to account for set-up and set-down times, moving the piling rig between foundation locations, time for the piling vessel to return to port to bring piles to the site and adverse weather conditions inclusive of maximum wave height constraints. This extends the piling works but also means that there will be long periods of respite between piling activities.

10.10.37 Annex E of BS 5228-1 (2009) +A1: 2014 (BSI 2009a) provides guidance on temporal thresholds for determining significance of construction noise. It recommends consideration of insulation and or temporary rehousing where noise levels exceed thresholds over a period of 10 or more days of working in any 15 consecutive days or a total number of days exceeding 40 in any 6 consecutive months.

10.10.38 A likely piling scenario will be discrete piling events followed by periods of no piling, whilst the vessel repositions and receives the next foundation. Hence there will be discernible breaks between piling activities. These breaks will be extended on occasions as a result of adverse weather conditions and maximum wave height constraints on working. It is therefore considered to be a very low risk that piling will occur over a period of 10 or more nights of working in any 15 consecutive nights. Furthermore, due to the number of piling events proposed it would not be possible for there to be a scenario where piling occurs over a total number of nights exceeding 40 in any 6 consecutive months. Therefore, taking account of the duration, temporal nature and likelihood of respite from piling noise, the significance of night time piling work is deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

Construction vibration: piling for substation

10.10.39 At this stage it is not known if piling is required to construct the foundations of the new onshore substation at Richborough Port. Piling methods which generate appreciable levels of vibration include impact piling and vibratory piling. Typically impact piling is likely to generate higher levels of vibration than vibratory piling. The vibration generated by impact piling can be reduced by reducing the hammer energy of the piling. This is achieved by reducing the weight of the drop hammer or reducing the height from which the hammer is dropped. These measures will reduce the vibration generated by the piling and increase the duration of the piling.

10.10.40 Typically ground vibration generated by piling will decrease with increasing distance from the source of vibration. Table 10.22 presents predictions of ground vibration from a typical impact piling rig operating at different hammer energies. The predictions are a worst-case because they assume that the piles are driven into stiff cohesive soil. The table shows the maximum distance from the piling rig at which there is a risk to cosmetic damage to buildings from transient vibration. For the highest hammer energy there is no risk of cosmetic damage to buildings when the piling occurs more than 35 m from sensitive buildings. The closest sensitive building to the proposed piling works is Baypoint Club which is located approximately 350 m from the proposed onshore substation. Considering the distance of sensitive receptors from the potential piling works significant adverse effects in the form of cosmetic damage to buildings have not been predicted.

10.10.41 Table 10.23 presents predictions of the vibration that would be experienced inside a building at the centre of a loaded floor from a typical impact piling rig operating at different hammer energies. The predictions take account of the amplification of vibration due to structural resonances of the building. The predictions show the distance from the piling at which there is a risk that the SOAEL for the human perception of vibration will be exceeded inside sensitive buildings. As described above the closest sensitive receptors are approximately 400 m from the piling works. For the highest hammer energy the predictions demonstrate that there is a risk of significant adverse effects from construction vibration up to 400 m from the works. If the drop height is reduced to 0.5 m, the distance reduces to 300 m. This demonstrates that it will be possible to avoid adverse impacts at the closest sensitive receptors by controlling the hammer energy of piling works, this is consistent with the application of BPM as proposed as embedded mitigation in Table 10.18. Further detail is provided in the CoCP (Document Ref: 8.1).

10.10.42 Considering that adverse effects can be avoided by employing energy reduction techniques to piling, significant adverse effects resulting from construction vibration associated with the proposed development have not been identified. The magnitude was assessed as Low and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

Table 10.22: Distance at which there is a risk that impact piling will result in cosmetic damage to buildings

Hammer drop weight (kg)	Drop height (m)	Hammer Energy (kJ)	PPV (mm/s)	Distance from piling activity (m)
4,000	1	40	6[1]	35
4,000	0.5	20	6[1]	26
4,000	0.25	10	6[1]	20

1) Conservative threshold for the onset of cosmetic damage to buildings from transient vibration (Table 10.6)

Table 10.23: Distance at which there is a risk that impact piling will exceed the SOAEL for human exposure to construction vibration in residential environments

Hammer drop weight (kg)	Drop height (m)	Hammer Energy (kJ)	PPV (mm/s)[1]	Distance from piling activity (m)
4,000	1	40	1[2]	400
4,000	0.5	20	1[2]	300
4,000	0.25	10	1[2]	230

1) Determined at the worst location on a normally loaded floor inside a sensitive building (usually the centre of the floor)

2) SOAEL for the human perception of construction vibration (Table 10.5)

10.10.43 The assumptions and calculations supporting the predictions shown in Table 10.22 and Table 10.23 are provided in Volume 5, Annex 10-2: Noise and Vibration Supporting Information (Document Ref: 6.5.10.2).

Construction road traffic noise

10.10.44 It is expected that construction traffic routeing from the west will travel via the M2/ A299 before joining with the A256 at Cliffsend. From the south, it is expected that construction traffic routeing from the south will travel via the A2/ A256 from the Dover area. Upon reaching the roundabout with the A299/ A256, construction traffic can access Pegwell Bay Cable Corridor from the north via the A299/ Sandwich Road roundabout, or from the south via the A256/ Sandwich Road junction.

10.10.45 For construction of the onshore cable route and substation it is expected that there would be peak daily traffic flows of up to 189 two-way personnel movements (Light vehicles) and 317 HGV two-way movements per day during construction, and consecutively for longer than 1 month. There are periods where higher numbers of vehicles are forecast however these periods are expected to be short duration. See Chapter 8: Traffic and Access (Document Ref: 6.3.8)

10.10.46 Table 10.24 presents the Basic Noise Level (BNL) adjacent to the sections of road likely to be used by construction traffic. The BNL is the noise level 10 m from the road and is not intended to be representative of noise sensitive receptors. The BNL has been calculated using the CRTN (DoT 1988) prediction methodology using traffic data set out in Volume 5, Chapter 8: Traffic and Access (Document Ref: 6.3.8). BNLs have been predicted for the baseline scenario, using the Department for Transport's table *TRA0307:* (DoT 2016) to scale the AADT data to 18 hour AAWT, and the do something scenario, by adding the forecast construction traffic data to the baseline. The predictions assume that the onshore cable route and substation will be constructed simultaneously. The forecast change in noise level is also shown.

10.10.47 The predictions show that the highest forecast change in noise level on the assessed roads is 2.3 dB. According to the impact criteria in Table 10.8 in section 10.5.36 *et seq* this is a Minor magnitude of impact for a short-term change in road traffic noise levels which would not be significant at noise sensitive receptors. The magnitude was assessed as Low and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

Table 10.24: Prediction of change in road traffic noise resulting from construction vehicles.

Road	Speed (mph)	Baseline			Do something (Baseline + construction traffic)			Change in BNL dB $L_{A10,18h}$
		Flow (vehicles AAWT)	%HGV	BNL dB $L_{A10,18h}$	Flow (vehicles)	%HGV	BNL dB $L_{A10,18h}$	
A299 Hengist Way (N)	34	18961	7.5	70.6	19151	8.6	71.1	+ 0.5
A299 Hengist Way (E)	34	28805	4.7	71.5	28995	4.7	71.9	+ 0.4
A256 Richborough Way	40	23672	5.5	71.2	23862	6.4	71.7	+ 0.5
A256 (S)	40	26826	5.1	71.6	27016	5.9	72.0	+ 0.4
Sandwich Road	34	3168	8.9	63.2	3674	8.9	65.5	+ 2.3

10.11 Environmental assessment: operational phase

Operational sound proposed fixed plant

10.11.1 Table 10.25 presents predictions of sound emitting elements from the proposed substation (which operate 24 hours per day) at noise sensitive receptors. Predictions are presented for night time operation as the impact of proposed plant and equipment is likely to be highest at night because background noise levels are lowest. The third column of Table 10.25 presents the predicted rating level resulting from the substation. The fourth and fifth columns present the background sound level and the difference between the rating level and the background sound level respectively at each receptor location. The last column presents the impact classification according to the BS 4142 criteria set out in Table 10.10.The assumptions and calculations supporting the predictions shown in Table 10.25 are provided in Volume 5, Annex 10-2: Noise and Vibration Supporting Information (Document Ref: 6.5.10.2).

10.11.2 At LT4, representative of approximately eight medium sensitivity residential properties off Sandwich Road and LT5, representative of approximately one medium sensitivity residential properties off Ramsgate Road, the rating level from the substation is above the modal background sound level by 3 dB and 4 dB respectively. This would give rise to a permanent minor (Low) magnitude impact at nine Medium sensitivity receptors and a **Minor** effect which would be not significant in terms of the EIA Regulations. However, the effect may be perceived as a change in the quality and character of the existing environment during the quieter night-time period. It should be further noted that the predicted sound level outside the receptors is below the WHO guideline level (WHO 2009) of 40 dB $L_{night,\ outside}$ of which is equivalent to the LOAEL for night noise. Taking into account a minimal attenuation of 10 dB afforded by a partially open window, the predicted internal sound level will be below the 30 dB(A) internal sound criterion of the WHO guidelines (WHO 1999). Therefore, operational impacts of the substation are unlikely to impact upon quality of sleep.

10.11.3 At all other receptors, either no impact or a Negligible impact is predicted. The magnitude was assessed as Low and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations.

Table 10.25: Prediction of night time operational sound from transformers at the onshore substation.

	Location Description	Predicted rating level dB $L_{Aeq,Tr}$	Modal average background sound level dB $L_{A90,T}$	Rating level above background sound level dB	Impact classification (10.4.25)
LT1	33 Beech Grove, Cliffsend	19	26	-7	Negligible impact
LT2	9 Oakland Court, Ramsgate	19	26	-7	Negligible impact
LT3	125 Sandwich Road	20	31	-11	No impact
LT4	Stonelees Cottage, Ebbsfleet Lane, Ramsgate	34	31	+3	Minor impact (Low)
LT5	Stonar Cottage	36	32	+4	Minor impact (Low)

Operational road traffic noise

10.11.4 O&M visits are expected to occur at the substation site once per week. Maintenance of the onshore cable route is expected to take place annually. This will have a negligible effect on the number of vehicles using the roads in the vicinity of the proposed development. Therefore, significant effects from traffic resulting from the operation of Thanet Extension onshore infrastructure have not been identified.

10.12 Environmental assessment: decommissioning phase

10.12.1 It is assumed that following decommissioning, cables would remain in the ground hence no excavation work would be required along the cable route during decommissioning.

10.12.2 The onshore substation equipment would be dismantled and removed and the site re-instated to its original condition or for alternative use. Decommissioning may require the concrete foundations to be broken up using hydraulic peckers. This activity is likely to generate less noise than the impact piling required to construct the substation. As significant adverse effects were not predicted for the construction of the substation; they are not anticipated during the decommissioning phase.

10.13 Environmental assessment: cumulative effects

10.13.1 Cumulative effects refer to effects upon receptors arising from Thanet Extension onshore infrastructure when considered alongside other Thanet Extension activities (such as offshore works) and any other *reasonably foreseeable project(s)* proposals. In this context the term *projects* is considered to refer to any project with comparable effects and is not limited to offshore wind projects.

10.13.2 The approach to cumulative assessment for Thanet Extension onshore infrastructure takes into account the Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013, together with comments made in response to other renewable energy developments within the Southern North Sea, and PINS 'Advice Note 9: Rochdale Approach'. The relevant projects, the suggested tiers, and the Cumulative Impact Assessment approach conducted for Thanet Extension have been agreed with the stakeholders under the auspices of the EIA Evidence Plan (Document Ref: 8.5).

10.13.3 In assessing the potential cumulative impact(s) for Thanet Extension onshore infrastructure, it is important to bear in mind that some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans that are already under construction are likely to contribute to cumulative impact with Thanet Extension onshore infrastructure (providing effect or spatial pathways exist), whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

10.13.4 For this reason, all relevant projects/ plans considered cumulatively alongside Thanet Extension onshore infrastructure have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the cumulative impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each scenario (Tier) in the decision-making process when considering the potential cumulative impact associated with Thanet Extension onshore infrastructure (e.g. it may be considered that greater weight can be placed on the Tier 1 assessment relative to Tier 2).

10.13.5 The projects and plans selected as relevant to the assessment of impacts to noise and vibration are based upon an initial screening exercise undertaken on a long list. Each project, plan or activity has been considered and scoped in or out on the basis of effect–receptor pathway, data confidence and the temporal and spatial scales involved. The shortlist of other developments to be considered for cumulative effects is presented in Volume 1, Chapter 3: Cumulative Impact Assessment – Methodology and Project List (Document Ref: 6.1.3.1) of this ES.

10.13.6 The proposed tier structure that is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in Thanet Extension onshore infrastructure ES is as follows:

Tier 1

10.13.7 Thanet Extension onshore infrastructure considered alongside other projects/ plans currently under construction and/ or those consented but not yet implemented, and/ or those submitted but not yet determined where data confidence for the projects falling within this category is high.

10.13.8 Built and operational projects will be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/ or any residual impact may not have yet fed through to and been captured in estimates of 'baseline' conditions or there is an ongoing effect.

Tier 2

10.13.9 All projects included in Tier 1 plus other projects/ plans consented but not yet implemented and/ or submitted applications not yet determined where data confidence for the projects falling into this category is medium.

Tier 3

10.13.10 The above plus projects on relevant plans and programmes (the PINS Programme of Projects) or other appropriate planning portal sources. Specifically, all projects where the developer has advised PINS in writing that they intend to submit an application in the future were considered.

10.13.11 The specific projects scoped into this cumulative impact assessment, and the tiers into which they have been allocated are presented in Table 10.26. All other developments shortlisted in projects identified in the vicinity of the Thanet Extension onshore infrastructure (Volume 1, Chapter 3: Cumulative Impact Assessment – Methodology and Project List (Document Ref: 6.1.3.1)) have been scoped out of the cumulative assessment for noise because:

- The projects are located at least 1,800 m from the Red Line Boundary meaning that cumulative effects from construction noise or operational noise in combination from noise from the proposed development are unlikely to result in adverse effects at sensitive receptors in the vicinity of the proposed development; and/ or
- No potential cumulative traffic and transport impacts were predicted in Chapter 8: Traffic and Access (Document Ref: 6.3.8) as a result of the developments. Traffic flows from other developments are considered small enough that any effect on total traffic noise levels combined with vehicles associated with Thanet Extension vehicles would be negligible.

Table 10.26: Projects for cumulative assessment

Development type	Project	Status	Data confidence assessment/ phase	Tier
Solar Farm	Thanet Solar Ltd, Land West of Richborough Power Station, Ramsgate Road	Permission granted and construction commenced	High - Third party project details published in the public domain.	Tier 1
Electrical connection	Richborough Connection Project, Sandwich Road	Permission granted and construction commenced	High - Third party project details published in the public domain.	Tier 1

10.13.13 Table 10.27 presents the potential noise sources that when Thanet Extension onshore infrastructure is considered alongside other projects could result in noise effects at sensitive receptors.

Table 10.27: Cumulative Rochdale Envelope

Impact	Scenario	Justification
Cumulative increase in future baseline traffic noise	Assess committed development that would impact the highway network during the construction phase of the development when proposed trips are assumed to be at their highest and result in increased road traffic noise levels.	To incorporate project baseline traffic flow increases and assess a worst-case scenario in terms of road traffic noise.
Cumulative increase in construction noise	Assess committed development that may be under construction simultaneously to Thanet Extension onshore infrastructure.	To determine if cumulative noise from multiple construction sites would result in significant adverse effects at noise sensitive receptors.
Cumulative increase in noise from industrial noise sources	Assess committed development in the vicinity of Thanet Extension onshore infrastructure which includes potentially noise fixed plant and equipment.	To determine if cumulative noise from multiple industrial sites would result in significant adverse effects at noise sensitive receptors.

Cumulative construction and operational road traffic noise

10.13.14 Cumulative effects on traffic are discussed in detail in Chapter 8: Traffic and Access (Document Ref: 6.3.8). The developments listed in Table 10.26 have been reviewed and, whilst there is some programme overlap with the Thanet Extension construction programme, the peak construction movements associated with Richborough Connection Project occur well in advance of the proposed development. As such, the cumulative effect would be no more than predicted for construction traffic noise from the Thanet Extension alone. Hence the developments should not contribute to a significant increase in road traffic noise when considered alongside Thanet Extension onshore infrastructure.

Cumulative construction noise

10.13.15 Construction noise from consented or planned projects have the potential to result in cumulative effects when considered alongside Thanet Extension onshore infrastructure if:

- The planned projects will be under construction at the same time as Thanet Extension onshore infrastructure; and
- Noise sensitive receptors are within the screening distance for construction noise from both the planned projects and Thanet Extension.

10.13.16 The only consented projects which meet these criteria are the Solar Farm and Richborough Connection Project.

10.13.17 The commencement date of Richborough Solar Farm is not known. No details of the construction methodology are available as part of the planning submission. No construction noise assessment was available as part of the planning documentation from which to undertake a quantitative assessment of cumulative effects.

10.13.18 The proposed location of Richborough Solar Farm is approximately 300 m away from the nearest noise sensitive receptor (ST3 – Baypoint Club). Construction works associated with Thanet Extension are further from this receptor. Considering the separation distances of Richborough Solar Farm and Thanet Extension onshore infrastructure works from the closest noise sensitive receptors, cumulative construction noise effects are considered unlikely.

10.13.19 More details are known about the Richborough Connection Project. Works are due to be completed in the second quarter of 2021. The NGET works associated with the TOWF proposed development are due to commence in this area in the second quarter of 2021. This means that cumulative construction noise effects are considered unlikely.

Cumulative operational noise

10.13.20 Operational noise from consented or planned projects have the potential to result in cumulative effects when considered alongside Thanet Extension onshore infrastructure if:

- The planned projects incorporate plant and equipment which generate appreciable levels of environmental noise; and
- The separation distance between noise sensitive receptors, the planned projects and Thanet Extension onshore infrastructure works are such that noise from multiple projects will contribute to the noise environment at the noise sensitive receptors.

10.13.21 The only consented project which meet these criteria are the Richborough Solar Farm and the Richborough Connection Project.

10.13.22 The Screening opinion for Richborough Solar Farm states that "*No noise will be generated as a result of the equipment included within the development. The transformer equipment is within a self-contained unit, minimising any potential risk of audible noise being heard from outside of the site.*" On this basis cumulative effects resulting from operational noise from Richborough Solar Farm in combination with the proposed Thanet onshore infrastructure are considered unlikely.

10.13.23 For the Richborough Connection Project, new overhead lines will connect into the existing substations at the existing operational Richborough Energy Park. This is also the case for the proposed Thanet onshore infrastructure. The project has not identified modifications to the Richborough Energy Park which would lead to an increase in environmental noise. Operational noise surveys undertaken for the Proposed Thanet onshore infrastructure in the vicinity of Richborough Energy Park has taken account of existing operation at the Richborough Energy Park and noise generating components of the Thanet onshore infrastructure have been demonstrated to have no impact on existing background noise levels in this area. Hence cumulative effects resulting from the Richborough Energy Park in combination with Thanet onshore infrastructure are considered unlikely.

10.14 Inter-relationships

10.14.1 Inter-related impacts concern the accumulation of impacts on a single receptor between noise and vibration and other environmental disciplines. It is considered likely that during the construction phase, human receptors impacted by noise and vibration are also likely to be affected by traffic and air quality impacts, which is considered in in Volume 3 Chapter 8: Traffic and Access (Document Ref: 6.3.8) and in Volume 3 Chapter 9: Air Quality (Document Ref: 6.3.9) respectively. It is not anticipated that these inter-relationships will lead to any significant effects.

10.15 Mitigation

Construction phase

10.15.1 The embedded mitigation measures described in Table 10.18 have been demonstrated to avoid significant adverse effects of construction noise and vibration.

Operational phase

10.15.2 No significant effects have been identified therefore no additional mitigation is proposed.

10.16 Summary of effects

Construction phase

10.16.1 Considering the proposed development incorporating the embedded mitigation measures set out in Table 10.18 no significant effects resulting from construction noise and vibration have been identified.

Operational phase

10.16.2 At Stonelees Cottage (Receptor LT4), representative of approximately eight medium sensitivity residential properties off Ramsgate Road and Stonar Cottage (Receptor LT5), representative of approximately one medium sensitivity residential properties off Ramsgate Road, the noise rating level from the substation exceeds the background noise level by 3 dB and 4 dB respectively. This would give rise to a permanent minor (Low) magnitude impact at nine Medium sensitivity receptors. The magnitude was assessed as Low and the sensitivity as Medium. The significance is therefore deemed to be of **Minor** adverse significance, which is not significant in terms of the EIA Regulations. However, the effect may be perceived as a change in the quality and character of the existing environment during the quieter night-time period.

10.16.3 A summary of the predicted impacts of the proposed development is provided in Table 10.28.

Decommissioning phase

10.16.4 Considering the proposed development and incorporating the embedded mitigation measures set out in Table 10.18 no significant effects resulting from decommissioning noise and vibration have been identified.

Table 10.28: Summary of predicted impacts of Thanet Extension onshore infrastructure

Description of Impact	Effect	Additional Mitigation measures	Residual effect
Construction			
Construction noise	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Construction traffic noise	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Construction vibration	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Offshore piling noise	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
O&M			
Operational noise from fixed plant	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Decommissioning			
Construction noise	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Construction traffic noise	**Minor** adverse (not significant)	None required	**Minor** adverse (not significant)
Cumulative effects			
None	N/A	N/A	N/A

10.17 References

- BCO 2014 - British Council for Offices (2014), 'Guide to Specification'.
- BSI 2008 - British Standards Institution (2008), 'BS 6472-1, Guide to Evaluation of Human Exposure to Vibration in Buildings, Part 1: Vibration Sources other than Blasting'.
- BSI 2009a - British Standards Institution (2009), 'BS 5228-1-2009 (+A1: 2014), Code of practice for noise and vibration control on construction and open sites = Part 1 Noise'.
- BSI 2009b - British Standards Institution (2009), 'BS 5228-2 (2009) +A1: 2014, Code of practice for noise and vibration control on construction and open sites – Part 2 Vibration'.
- BSI 2014a - British Standards Institute (2014), 'BS 4142, Method for rating industrial noise affecting mixed residential and industrial areas'.
- BSI 2014b - British Standards Institution (2014), 'BS 8233, Guidance on sound insulation and noise reduction for Buildings'.
- BSI 1993 - British Standards Institution (1993), 'BS 7385-2:1993 Evaluation and measurement for vibration in buildings: Part 2 Guide to damage levels from ground-borne vibration'
- BSI 2003 – British Standard Institution (2003), 'BS 7445-1:2003Description and measurement of environmental noise. Guide to quantities and procedures'
- DCLG 2012 - Department for Communities and Local Government (2012), 'National Planning Policy Framework, The Stationary Office Limited'. [Accessed: March 2018]

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
- DCLG 2014 - Department for Communities and Local Government (2014), 'Noise Planning Practice Guidance'. https://www.gov.uk/guidance/noise--2 [Accessed: March 2018]
- DE / EFA 2014 - Department for Education / Education Funding Agency (2014), 'Building Bulletin 93, Acoustic design of schools: Performance standards'.
- DEFRA 2010 - Department for the Environment, Food and Rural Affairs (2010), 'Noise Policy Statement for England, DEFRA'. [Accessed: March 2018]

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf
- Defra 2011 – Moorhouse A T, Waddington D C, Adams M D, 'Proposed criteria for the assessment of low frequency noise disturbance'. Report for Defra, NANR45, Revision 1. [Accessed: April 2018]

  http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=12621
- DECC 2011a - Department of Energy and Climate Change (2011), Overarching National Policy Statement for Energy (EN-1),

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf [Accessed: March 2018]
- DECC 2011b - Department of Energy and Climate Change (2011), National Policy Statement for Renewable Energy Infrastructure (EN-3),

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf [Accessed: March 2018]
- DECC 2011b - Department of Energy and Climate Change (2011), National Policy Statement for Electrical Networks Infrastructure (EN-5),

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47858/1942-national-policy-statement-electricity-networks.pdf [Accessed: March 2018]
- DoT 1988 - Department of Transport (1988), 'Calculation of Road Traffic Noise, HMSO'.
- DoT 2016 - Department for Transport (2016) 'TRA0307: Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2016'
- DoE 1976 - Department of the Environment (1976), 'Advisory Leaflet (AL) 72 (1976), Noise control on Building Sites, HMSO, first published 1968, Third edition 1976'.
- EC 2014 - European Commission (2014), 'EC Directive 85/337/EEC, as amended by 97/11/EC, 2003/35/EC, 2011/92/EC and 2014/52/EU ('the EIA Directive')'.
- IEMA 2014 - Institute of Environmental Management and Assessment (IEMA) (2014), 'Guidelines for Environmental Noise Impact Assessment'.
- HA 2011 - Highways Agency (2011), 'Design Manual for Road and Bridges HD 213/11 A5/25'.
- HMG 1974 - HM Government (1974), 'Control of Pollution Act 1974'.
- ISO 1996 - International Standards Organisation (1996), 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: general Method of Calculation, International Standard ISO 9613-2: 1996 (E)'.
- NIR 1988 – Noise Insulation (Amendment) Regulations 1988.
- TLP 2018 – Thanet District Council, 'Draft Thanet Local Plan to 2031 – Preferred Options Consultation'. [Accessed: May 2018]

  https://consult.thanet.gov.uk/consult.ti/TPODLP/viewCompoundDoc?docid=6048884&partid=6053940&sessionid=&voteid=
- WHO 2009 - World Health Organization (2009), 'Night Noise Guidelines for Europe, WHO Regional Office for Europe, ISBN 978 92 890 4173 7'.

- WHO 1999 - World Health Organization (1999), ‘Guidelines for Community Noise, World Health Organization, Geneva’.

10.18 Glossary:

Acceleration (Arms)	A measurement of the rate of change of velocity and is a vector quantity, usually measured in rms ms^{-2} or in terms of the acceleration due to gravity (g, = 9.80665ms-2).
Accelerometer	A sensor which has an electrical output that is proportional to acceleration, and is intended for the measurement of vibration.
Accelerometer block	A Weighted block containing three accelerometers (geophones) orientated in the three orthogonal planes, longitudinal, transverse and vertical (or x, y and z axes).
Acoustic calibrator	A device which 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	The sound emitted from all sources as modified by the environment.
Ambient sound	The 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.
Background sound level	The underlying level of sound over a period, T, and is represented by LA90, T.
dB	A measure of sound pressure level in decibels, as specified BS EN 61672-2:2003 Electroacoustics. Sound level meter.
dB(A)	The A-weighted sound pressure level in decibels. An A-weighting is a frequency weighting derived to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies.
Displacement (m)	A measurement of the change in position of a vibrating object or particle which is also a vector quantity.
Façade level	A measurement that is undertaken within the acoustic influence of a reflective façade. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings 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 milliseconds (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 façade.
Ground-borne noise	An audible noise caused by the vibration of elements of a structure, whereby the propagation path of the vibration from the source is either wholly or partially through the ground.
Ground-borne vibrations	The term used to describe mostly man-made vibrations in the ground (in contrast to natural vibrations studied by seismology). Can be measured in terms of acceleration, velocity or displacement.
Hertz (Hz)	The unit of measurement for frequency of a sound wave which measures the number of waves per second.
Impulsive	A sound characterised by a sudden onset rate of sound. In BS 4142:2014 Methods for rating and assessing industrial and commercial sound the onset rate of a sound must exceed a slope gradient of 10 dB per second on the positive slope for a sound to be characterised as impulsive. A penalty of up to 9 dB can be applied to an impulsive sound dependant on impulse prominence.
Intermittent	A sound which comes from a source that has on and off conditions that are readily distinctive against the residual acoustic environment. In BS 4142:2014 Methods for rating and assessing industrial and commercial sound a penalty of 3 dB can be applied to a sound where it is determined to be intermittent.
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 LA10 over the period 0600-2400 (local time), with a fast time weighting.
$L_{A10, T}$	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 timeweighting.
$L_{Aeq, 18hr}$/ $L_{Aeq, 6hr}$	The L_{Aeq} over the periods 0600-2400 (local time), and 2400-0600 (local time), respectively, measured using a fast timeweighting.

$L_{Aeq, T}$	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.
$L_{Amax,T}$	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, i.e add up the numbers and divide by the number of numbers.
Modal (average)	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 (Ln 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 Hertz.
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.
Peak particle velocity (PPV)	The peak particle velocity is the greatest instantaneous particle velocity during a given time interval.
Rating level, $L_{Ar, T}$	The specific sound level, plus any adjustments for the characteristic features of the sound, (such as tonality, impulsivity or intermittency).
Root Mean Square (rms)	The Root Mean Square of a time-varying quantity is obtained by squaring the amplitude at each instant, obtaining the average of the squared values over the interval of interest, and then taking the Square Root of this average.
Slow time weighting	A time interval of 1 second (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/s. In liquids and solids, the propagation velocity is greater - 1480 m/s in water and 5120 m/s in steel, for example.
Sound Exposure Level (SEL)	Is the $L_{Aeq, T}$ noise level normalised to 1 second and is commonly used to determine noise levels from trains, for example.
Sound level meter (SLM)	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 0dB SPL.
Tonal	A sound which contains one or more distinct tones. In BS 4142:2014 Methods for rating and assessing industrial and commercial sound, a tone can be identified where a frequency band contains more energy and is shown to have a certain level difference over its neighbouring bands. A penalty of up to 6 dB can be applied to a tonal sound dependant on tonal prominence.
Tri-axial accelerometer	One sensor containing three accelerometers mounted at right angles to each other in the three orthogonal planes (x, y and z axes).
Velocity (mms-1)	The rate of change of position and is a vector quantity as both speed and direction are required to define it.
Vibration Dose Value (VDVms-1.75)	A relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration. It has been shown to correlate well with subjective response.

Weighting network	An electronic filter in a sound level meter, which approximates, under defined conditions, the frequency response of the human ear. The A-weighting network is most commonly used.