Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 3, Chapter 8: Noise and Vibration

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8.1	Hornsea Four Baseline Noise Survey

Glossary

Term	Definition
Commitment	A term used interchangeably with mitigation. Commitments are Embedded Mitigation Measures. Commitments are either Primary (Design) or Tertiary (Inherent) and embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR). The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSE's), in EIA terms.
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Project Four.
Design Envelope	A description of the range of possible elements that make up the Hornsea Project Four design options under consideration, as set out in detail in the project description. This envelope is used to define Hornsea Project Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Energy balancing infrastructure (EBI)	The onshore substation includes energy balancing Infrastructure. These provide valuable services to the electrical grid, such as storing energy to meet periods of peak demand and improving overall reliability.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement.
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Term	Definition
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Haul Road	The track along the onshore ECC which the construction traffic would use to access work fronts.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Project Four offshore wind farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound.
Orsted Hornsea Project Four Ltd.	The Applicant of proposed Hornsea Project Four offshore wind farm.
Maximum design scenario	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR).
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Onshore substation (OnSS)	Located as close as practical to the NGET substation at Creyke Beck and will include all necessary electrical plant to meet the requirements of the National Grid.
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
Trenchless Techniques	Also referred to as trenchless crossing techniques or trenchless methods. These techniques include HDD, thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

Acronyms

Acronym	Definition
AAWT	Annual Average Weekday Traffic
BNL	Basic Noise Level
BPM	Best Practicable Means
CRTN	Calculation of Road Traffic Noise
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
ERYC	East Riding Yorkshire Council
ES	Environmental Statement
LOAEL	Lowest Observed Adverse Effect Level
MHWS	Mean High Water Springs
MDS	Maximum Design Scenario
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Project
NSR	Noise Sensitive Receptors
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PPV	Peak Particle Velocity
SOAEL	Significant Observed Adverse Effect Level
TRL	Transport Research Laboratory
VDV	Vibration Dose Value

Units

Unit	Definition
dB(A)	A representation of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level the reference quantity is 20 µPa. Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness.
GW	Gigawatt (power)
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
LAeq	A-weighted equivalent continuous sound level in decibels measured over a stated period of time
LAmax	Maximum A - weighted sound pressure level recorded over the period stated
LA10	The noise level just exceeded for 10% of the measurement period, A-weighted and calculated by statistical analysis
LA90	The noise level just exceeded for 90% of the measurement period, A-weighted and calculated by statistical analysis

8.1 Introduction

8.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents a preliminary assessment of the potential impacts of the Hornsea Project Four offshore wind farm (hereafter referred to as Hornsea Four) on noise and vibration. Specifically, this chapter considers the potential impact of Hornsea Four landward of Mean High Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

8.1.1.2 Orsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Four. Hornsea Four will include both offshore and onshore infrastructure including offshore generating stations (wind turbines), electrical export cables to landfall and on to a connection to the electricity transmission network at National Grid Creyke Beck substation (please see **Volume 1, Chapter 4: Project Description** for full details on the Project Design).

8.1.1.3 This chapter summarises information contained within the baseline noise technical report, which are included at **Volume 6, Annex 8.1: Baseline Noise Survey Report**.

8.2 Purpose

8.2.1.1 This PEIR presents the preliminary environmental information for Hornsea Four and sets out the findings of the Environmental Impact Assessment (EIA) to date to support the pre-Development Consent Order (DCO) application consultation activities required under the Planning Act 2008.

8.2.1.2 The feedback from this consultation will be used to inform the final project design and the associated EIA (which will be reported in an Environmental Statement (ES)) that will accompany the DCO application to PINS.

8.2.1.3 This PEIR chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects of Noise and Vibration arising from Hornsea Four, based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

8.3 Planning and Policy Context

8.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to noise and vibration, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1) DECC, 2011a), the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b) and the NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

8.3.1.2 NPS EN-1 and NPS EN-5 include guidance on what matters are to be considered in the assessment. These are summarised in **Table 8.1**. With regard to noise and vibration assessment, NPS EN-3 refers to NPS EN-1.

Table 8.1: Summary of NPS provisions.

Summary of NPS EN-1 and EN-5 provisions	How and where considered in the PEIR
"*Where noise impacts are likely to arise, the applicant should include:* • *A description of the noise generating aspects of the development proposal leading to noise impacts including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;* • *Identification of noise sensitive premises and noise sensitive areas that may be affected;* • *The characteristics of the existing noise environment;* • *A prediction of how the noise environment will change with the proposed development;* • *In the shorter term such as during the construction period;* • *In the longer term during the operating life of the infrastructure;* • *At particular times of the day, evening and night as appropriate;* • *An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and* • *Measures to be employed in mitigating noise.* *The nature and extent of the noise assessment should be proportionate to the likely noise impact*" (EN-1, paragraph 5.11.4)	**Table 8.18** contains information on the noise generating aspects of Hornsea Four. Refer to **Section 8.10** for the potential noise and vibration assessment methodology, **Section 8.7.2** for details on the existing noise environment including the identification of noise sensitive receptors, and **Section 8.11** where any changes in noise levels as a result of the project are assessed, and any potential effects and potential mitigation measures are identified.
"*The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered*" (EN-1, paragraph 5.11.5)	Refer to **Section 8.11** where any changes in noise levels as a result of Hornsea Four from ancillary works, for example vehicle movements, are assessed and any potential impacts and potential mitigation measures are identified.
"*Operational noise, with respect to human receptors, should be assessed using the principles of the relevant*	The current relevant British Standards have been used within this assessment, as detailed in **Section 8.3**.

Summary of NPS EN-1 and EN-5 provisions	How and where considered in the PEIR
British Standards and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there are assessment guidance for specific features of those technologies. 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" (EN-1, paragraph 5.11.6)	
"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" (EN-1, paragraph 5.11.7)	Noise impacts on terrestrial protected species or other wildlife is considered within **Chapter 3: Ecology and Nature Conservation**.
"While standard methods of assessment and interpretation using the principles of the relevant British Standards are satisfactory for dry weather conditions, they are not appropriate for assessing noise during rain. This is when overhead line noise mostly occurs, and when the background noise itself will vary according to the intensity of the rain. Therefore, an alternative noise assessment method to deal with rain-induced noise is needed, such as the one developed by National Grid as described in report TR (T) 94,199319. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991) and in that respect, is consistent with BS 4142:1997. The IPC [hereafter the Secretary of State] is likely to be able to regard it as acceptable for the applicant to use this or another methodology that appropriately addresses these particular issues" (EN-5, paragraph 2.9.8 – 2.9.9)	Construction of a new overhead line will not be required, and operational assessment of rain-induced noise is not considered necessary.

8.3.1.3 NPS EN-1 also highlights several factors relating to the determination of an application and in relation to mitigation. These provisions are summarised in **Table 8.2**.

Table 8.2: Summary of NPS EN-1 policy on decision making relevant to noise and vibration.

Summary of NPS EN-1 provisions	How and where considered in the PEIR
"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. *The Secretary of State 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.* *When preparing the development consent order, the Secretary of State 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"* (EN-1, paragraph 5.11.8 – 5.11.10)	Refer to **Section 8.11** for the impact assessment. Good design is embedded through the route planning and site selection process (**Volume 1, Chapter 3: Site Selection and Consideration of Alternatives**). It is secured through **Volume 1, Chapter 4: Project Description** and **Volume 4, Annex 4.6: Outline Design Vision Statement**.
"The Secretary of State should consider whether mitigation measures are needed both for operational and construction noise over and above any which may form part of the project application. In doing so the Secretary of State may wish to impose requirements. Any such requirements should take account of the guidance set out in Circular 11/95 (see Section 4.1) or any successor to it. *Mitigation measures may include one or more of the following:* • *engineering: reduction of noise at point of generation and containment of noise generated;* • *lay-out: adequate distance between source and noise-sensitive receptors; incorporating good design to minimise noise transmission through screening by natural barriers, or other buildings; and* • *administrative: restricting activities allowed on the site; specifying acceptable noise limits; and taking into account seasonality of wildlife in nearby designated sites.* *In certain situations, and only when all other forms of noise mitigation have been exhausted, it may be appropriate for the Secretary of State to consider requiring noise mitigation through improved sound insulation to dwellings"* (EN-1, paragraph 5.1.11 – 5.11.13)	Where concluded as necessary through the assessment process, mitigation is addressed in **Section 8.11**

8.3.2 National Planning Policy Framework

8.3.2.1 The National Planning Policy Framework (NPPF) (as revised in 2019) forms the basis of the Government's planning policies for England and how these should be applied. Paragraph 170 of the NPPF states planning policies and decisions should contribute to and enhance the natural and local environment by:

".....preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution....."

8.3.2.2 Furthermore, Paragraph 180 states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- *limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

8.3.2.3 The NPPF also refers to the Noise Policy Statement for England (NPSE) (Defra, 2010).

8.3.3 Noise Policy Statement for England, 2010

8.3.3.1 The NPSE document was published by Defra in 2010 and paragraph 1.7 states three policy aims:

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

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life."*

8.3.3.2 The first two points require that significant adverse impacts should not occur and that, where a noise level falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect:

"...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur." (Paragraph 2.24, NPSE March 2010).

8.3.3.3 Section 2.20 of the NPSE introduces key phrases including 'significant adverse' and 'adverse' and two established concepts from toxicology that are being applied to noise impacts:

- *"NOEL – No Observed Effect Level; this is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise"*; and
- *"LOAEL – Lowest Observed Adverse Effect Level; this is the level above which adverse effects on health and quality of life can be detected"*.

8.3.3.4 Paragraph 2.21 of the NPSE extends the concepts described above and leads to a significant observed adverse effect level (SOAEL), which is defined as the level above which significant effects on health and quality of life occur.

8.3.3.5 The NPSE states:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations". (Paragraph 2.22, NPSE March 2010).

8.3.3.6 Furthermore, paragraph 2.22 of the NPSE acknowledges that:

"Further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise".

8.3.3.7 However not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

8.3.4 National Planning Practice Guidance for Noise, 2014

8.3.4.1 The National Planning Practice Guidance for Noise (NPPG Noise, December 2014), issued under the NPPF, states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or making decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

8.3.5 Local Planning Policy

8.3.5.1 The proposed onshore development area falls under the jurisdiction of East Riding of Yorkshire Council (ERYC) local planning authority.

8.3.5.2 The ERYC Local Plan 2012 – 2029 Strategy Document (Adopted April 2016) contains strategic policies to guide decisions on planning applications.

8.3.5.3 Policy EC5 (Supporting the Energy Sector) states, in relation to noise:

"Proposals for the development of the energy sector, excluding wind energy but including the other types of development listed in Table 7, will be supported where any significant adverse impacts are addressed satisfactorily and the residual harm is outweighed by the wider benefits of the proposal. Developments and their associated infrastructure should be acceptable in terms of:

- *1. The cumulative impact of the proposal with other existing and proposed energy sector developments;*
- *……*
- *3. The effects of development on:*
- *i. local amenity, including noise, air and water quality, traffic, vibration, dust and visual impact;…."*

8.3.5.4 Wind energy as referenced in the Policy relates to onshore wind developments.

8.3.6 Legislation

8.3.6.1 This section provides details on key pieces of legislation which are relevant to this assessment.

Environmental Protection Act 1990

8.3.6.2 Section 79 of the Environmental Protection Act 1990 (the EPA 1990) defines statutory nuisance with regard to noise and determines that local planning authorities have a duty to detect such nuisances in their area.

8.3.6.3 The EPA 1990 also defines the concept of 'Best Practicable Means' (BPM) as:

- *"Practicable" means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;*
- *The means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;*
- *The test is to apply only so far as compatible with any duty imposed by law; and*
- *The test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances."*

8.3.6.4 Section 80 of the EPA 1990 provides local planning authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

The Control of Pollution Act 1974

8.3.6.5 Section 60 of the Control of Pollution Act 1974 provides powers to local planning authority officers to serve an abatement notice in respect of noise nuisance from construction works.

8.3.6.6 Section 61 provides a method by which a contractor can apply for 'prior consent' for construction activities before commencement of works. The 'prior consent' is agreed between the local planning authority and the contractor and may contain a range of agreed working conditions, noise limits and control measures designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for a 'prior consent' is a commonly used control measure in respect of potential noise impacts from major construction works.

8.3.7 Guidance

8.3.7.1 The guidance in Table 8.3 has been applied to the noise and vibration assessment.

Table 8.3: Relevant guidance.

Document	Description
British Standard (BS) 4142:2014 – Method for Rating and Assessing Industrial and Commercial Sound	Describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incidental.
BS 5228-1:2007+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise	Part 1 provides recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and/or vibration levels. The legislative background to noise and vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This British Standard provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it.
BS 5228-1:2007+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration	Part 2 gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels.

Document	Description
	The Standard includes tables of vibration levels measured during piling operations throughout the UK. It provides guidance concerning methods of mitigating vibration from construction, particularly with regard to percussive piling.
BS 6472-1:2008 – Guide to Evaluation of Human Exposure to Vibration in Buildings	Provides general guidance on human exposure to building vibration in the range of 1Hz to 80Hz and includes curves of equal annoyance for humans. It also outlines the measurement methodology to be employed. It introduces the concept of Vibration Dose Value (VDV) and estimated Vibration Dose Value (eVDV) for the basis of assessment of the severity of impulsive and intermittent vibration levels, such as those caused by a series of trains passing a given location.
BS 7445: Parts 1 and 2 – Description and Measurement of Environmental Noise	Provides details of the instrumentation and measurement techniques to be used when assessing environmental noise and defines the basic noise quantity as the continuous A-weighted sound pressure level (LAeq). Part 2 of BS 7445 replicates International Standards Organisation (ISO) 1996-2.
BS 8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings	Provides a methodology to calculate the noise levels entering a building through facades and facade elements and provides details of appropriate measures for sound insulation between dwellings. It includes recommended internal noise levels which are provided for a variety of situations and is based on World Health Organisation (WHO) recommendations.
Calculation of Road Traffic Noise (CRTN) 1988	Provides a method for assessing noise from road traffic in the UK and a method of calculating noise levels from the Annual Average Weekday Traffic (AAWT) flows and from measured noise levels. Since publication in 1988 this document has been the nationally accepted standard in predicting noise levels from road traffic. The calculation methods provided include correction factors to take account of variables affecting the creation and propagation of road traffic noise, accounting for the percentage of heavy goods vehicles (HGV), different road surfacing, inclination, screening by barriers and relative height of source and receiver.
Design Manual for Roads and Bridges (DMRB), 2011	Volume 11, Part 3, Section 7 provides guidance on the environmental assessment of noise impacts from road schemes. DMRB contains advice and information on transport-related noise and vibration, which has relevance with regard to the construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing traffic related noise impacts.

Document	Description
ISO 3744	Specifies a method for measuring the sound pressure levels on a measurement surface enveloping a noise source, under essentially free field conditions near one or more reflecting planes, in order to calculate the sound power level produced by the noise source.
ISO 717	Defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors, and windows.
ISO 9613-2	Specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a noise source.
WHO (1999) Guidelines for Community Noise	These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55dB LAeq during the day, related to annoyance, and 45dB LAeq or 60dB LAmax at night, related to sleep disturbance. The Guidance states: *"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB LAeq for continuous noise and 45dB LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the source."* The WHO guidance also highlights that: *"Night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15dB.* *To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB LAeq. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas.* *To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB LAeq.* *Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."*
WHO (2009) Night Noise Guidelines for Europe	An extension to the WHO Guidelines for Community Noise (1999). It concludes that:

Document	Description
	"Considering the scientific evidence on the thresholds of night noise exposure indicated by Lnight outside as defined in the Environmental Noise Directive (2002148/EC), an Lnight outside of 40dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. *Lnight outside value of 55dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach."*

8.4 Consultation

8.4.1.1 Consultation is a key part of the DCO application process. Consultation regarding noise and vibration has been conducted through the Scoping Report (Ørsted, 2018) . Full details of the project consultation process are presented within **Volume 1, Chapter 6: Consultation**.

8.4.1.2 Following receipt of the Scoping Opinion (PINS, 2018) consultation regarding noise and vibration has been conducted through a Hornsea Four Human Environment Technical Panel in January 2019 in addition to email correspondence with ERYC.

8.4.1.3 A summary of the key issues raised during consultation specific to noise and vibration is outlined below in **Table 8.4**, together with how these issues have been considered in the production of this PEIR. Scoping opinions are addressed within **Table 8.16.**

Table 8.4 Consultation Responses.

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the PEIR
PINS	November 2018 Scoping Opinion 4.20.2	*"Temporary noise and vibration from haul route access construction: construction phase:* *It is not clear how the distance restrictions in Co133 and 135 can practically operate given the estimated working width provided in the Scoping Report. Given the uncertainty that the proposed commitments can successfully reduce noise and vibration to below the standard criteria set out in the Scoping Report, the Inspectorate considers that the ES should assess this matter where significant effects are likely to occur."*	Refer to **Section 8.8.1** for further details regarding the scoping out of this impact. Co133 and Co135 were embedded into the design of Hornsea Four to maintain the distance restrictions, as detailed in **Volume 4, Annex 3.3: Selection and Refinement of the Onshore Infrastructure**.

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the PEIR
PINS	November 2018 Scoping Opinion 4.20.7	*"Noise and vibration from operation of offshore HVAC booster:* *The location (and need for) the HVAC booster substation is not yet determined, although reference is made to a distance of 20km offshore in Section 7.8. However, no parameters have been presented in the Scoping Report for the booster substation location and design. This reduces confidence that significant effects will be avoided, and the Inspectorate expects to see an assessment of the impacts of the booster substation within the ES incorporating this information. "*	Refer to **Section 8.8.1** for further details regarding the scoping out of this impact.
PINS	November 2018 Scoping Opinion 4.20.9	*"Baseline:* *The description in the Scoping Report lacks detail and does not highlight the settlements and other receptors identified in other topic chapters which may be relevant to the noise and vibration assessment. The Inspectorate would expect to see a robust baseline comprising a description of all potential receptors identified by the study area reported in the ES."*	Addressed in **Section 8.7.2**.
Natural England	November 2018	Consideration should be given to noise levels and timings with regards noise sensitive receptors including designated sites and protected species. For example, the River Hull Headwaters SSSI supports a diverse breeding bird community and therefore consideration should be given to the degree and timing of disturbance of species.	Disturbance to species (including birds) is addressed in **Chapter 3: Ecology and Nature Conservation**
ERYC	January 2019 (late Scoping Opinion)	The Council's Public Protection Officers have considered the Scoping Report and are agreeable with the approach and the potential impacts. Suitable noise assessment locations have been agreed separately with the Applicant.	Noted and agreed.
ERYC	January 2019 Human Environment Technical Panel	Noise from temporary construction compounds: ERYC confirmed that they were satisfied with the proposal to scope out noise from temporary construction compounds.	Agreed
ERYC	January 2019 Human Environment Technical Panel	ERYC requested that a complaints procedure be implemented for construction noise	Relevant best-practice measures are

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the PEIR
			detailed within Section 8.11
ERYC	January 2019 Human Environment Technical Panel	ERYC requested that evidence be provided to support the scoping out of effects from the offshore HVAC Booster	Addressed in Table 8.16
ERYC	January 2019 Human Environment Technical Panel	ERYC confirmed they do not typically expect to see assessment of non-residential receptors.	Disturbance to species (including birds) is addressed in Chapter 3: Ecology and Nature Conservation
ERYC	February 2019 Baseline Noise Survey Technical Note	ERYC confirmed via email correspondence (21 February 2019) that the methodology and scope of the baseline noise survey, including survey locations (presented within the Technical Note), were appropriate.	A summary of the baseline noise survey is presented within Section 8.7.
ERYC	July 2019 Email correspondence	ERYC confirmed via email correspondence (22 July 2019) that they had no comments on the Impact Register (presented in Volume 4, Annex 5.1: Impacts Register).	The Noise and Vibration assessment has been undertaken in line with the Impacts Register.

8.4.2 Hornsea Four Design Evolution – Stakeholder Consultation

8.4.2.1 As identified in Volume 1, Chapter 3: Site Selection and Consideration of Alternatives and Volume 1, Chapter 4: Project Description, the Hornsea Four design envelope has been refined significantly and is anticipated to be further refined for the DCO submission. This process is reliant upon stakeholder consultation feedback.

8.4.2.2 Design amendments of relevance to noise and vibration comprise:

- Landfall – the Hornsea Four PEIR boundary currently comprises two landfall options (shown in Volume 1, Chapter 4: Project Description, Figure 4.13), which have been assessed in the respective PEIR receptor chapters A decision on the preferred landfall (A3 or A4) will be made post-PEIR and the Project Description and assessments updated for the ES and DCO for the preferred 40,000 m^2 compound within the landfall location.

- OnSS Operation and Maintenance Access - Hornsea Four are currently investigating the possibility of making the temporary construction access off the A1079 a permanent operational access and utilising the operation access from Dunswell and Cottingham for limited construction works associated with HDD from the ECC to the OnSS.

- OnSS Design: The design of the Hornsea Four OnSS mitigation (inclusive of measures set out in Volume 4, Annex 4.6: Outline Design Vision Statement) will be further evolved

based on the results of the PEIR assessments, in addition to stakeholder feedback and suggestions.

8.5 Study area

8.5.1.1 The onshore noise and vibration study area was defined by the extent of the proposed onshore development which includes the following elements:

- Landfall;
- Onshore Electrical Cable Corridor (ECC); and
- Onshore substation (OnSS) and Electrical Balancing Infrastructure (EBI).

8.5.1.2 The spatial scope of the construction noise assessment included the following geographic coverage:

- 500m buffer around the onshore ECC;
- 2km buffer around the landfall and OnSS; and
- Traffic routes subject to significant changes in traffic flows (and / or percentage HGV) associated with construction.

8.5.1.3 The extent of the noise and vibration study area for the construction phase road traffic noise and vibration assessment was based on details provided in **Chapter 7: Traffic and Transport** and agreed through traffic-specific consultation.

8.5.1.4 The noise and vibration study area is shown in **Figure 8.1** to **Figure 8.5.**

8.5.1.5 The noise and vibration assessment draws on the information provided within **Volume 1 Chapter 4: Project Description** in order to define Maximum Design Scenarios (MDSs) for each potential impact, which is subsequently assessed in this chapter.

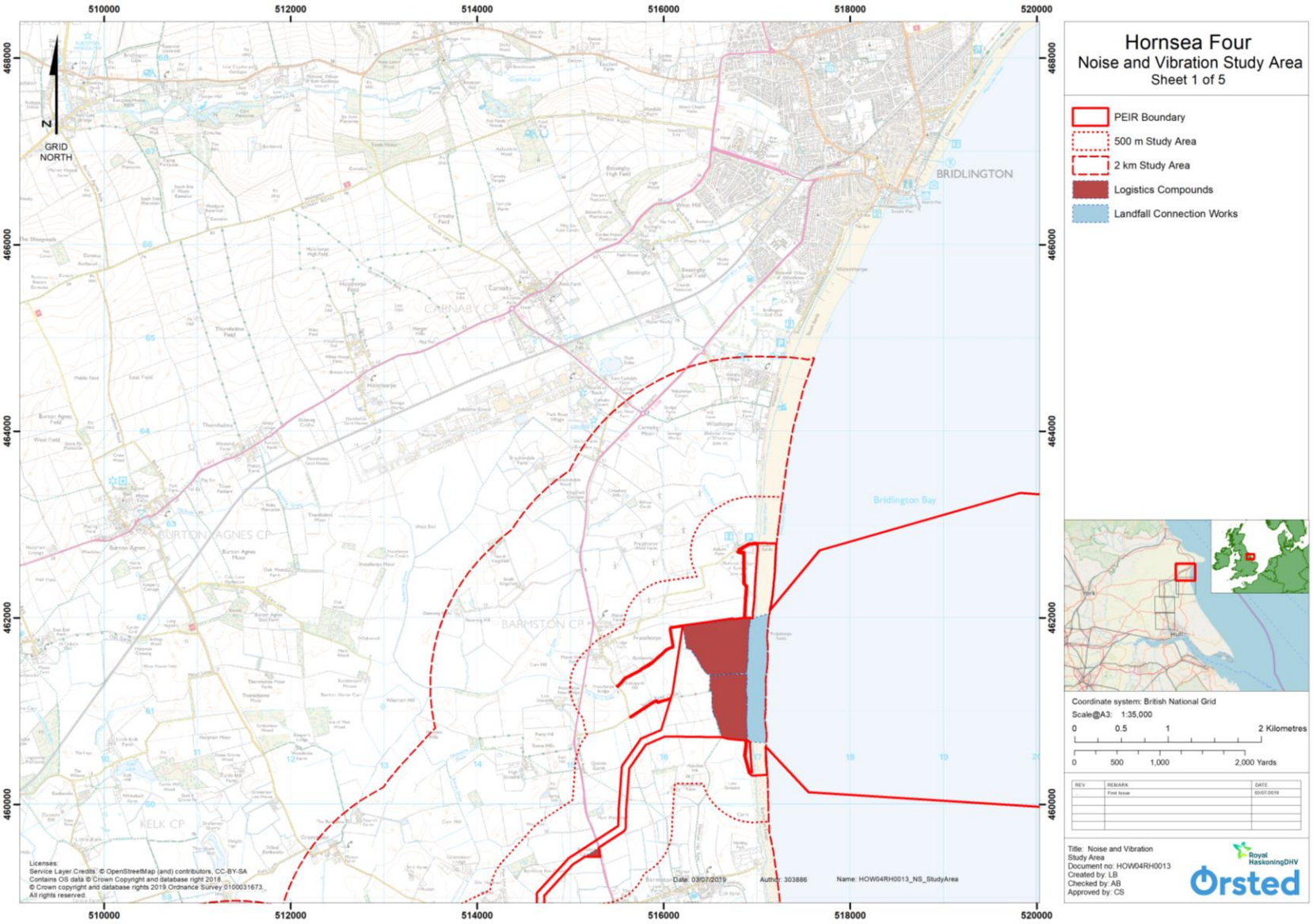

Figure 8.1: Noise and Vibration Study Area (Landfall) (not to scale).

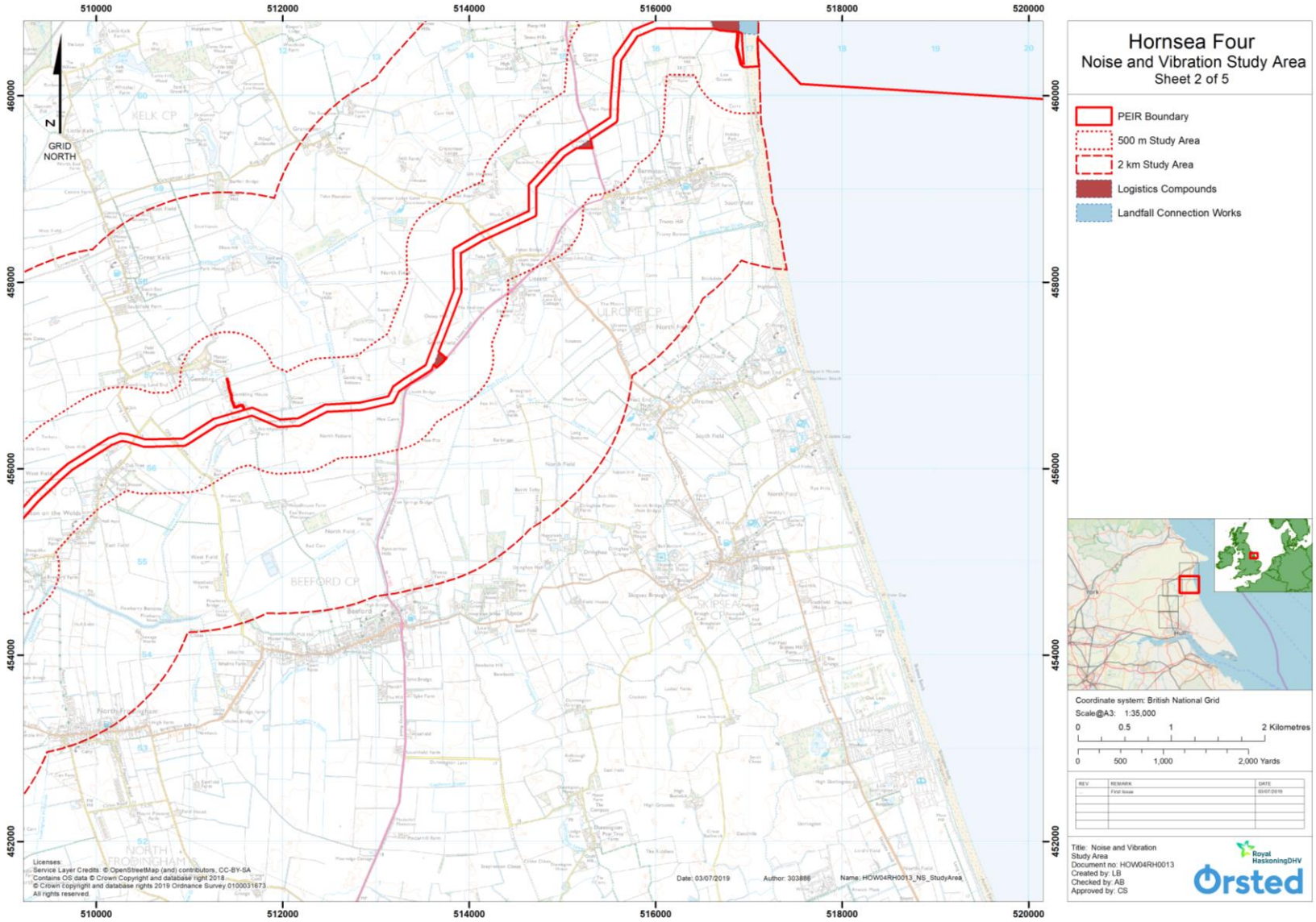

Figure 8.2: Noise and Vibration Study Area (Landfall/Onshore ECC) (not to scale).

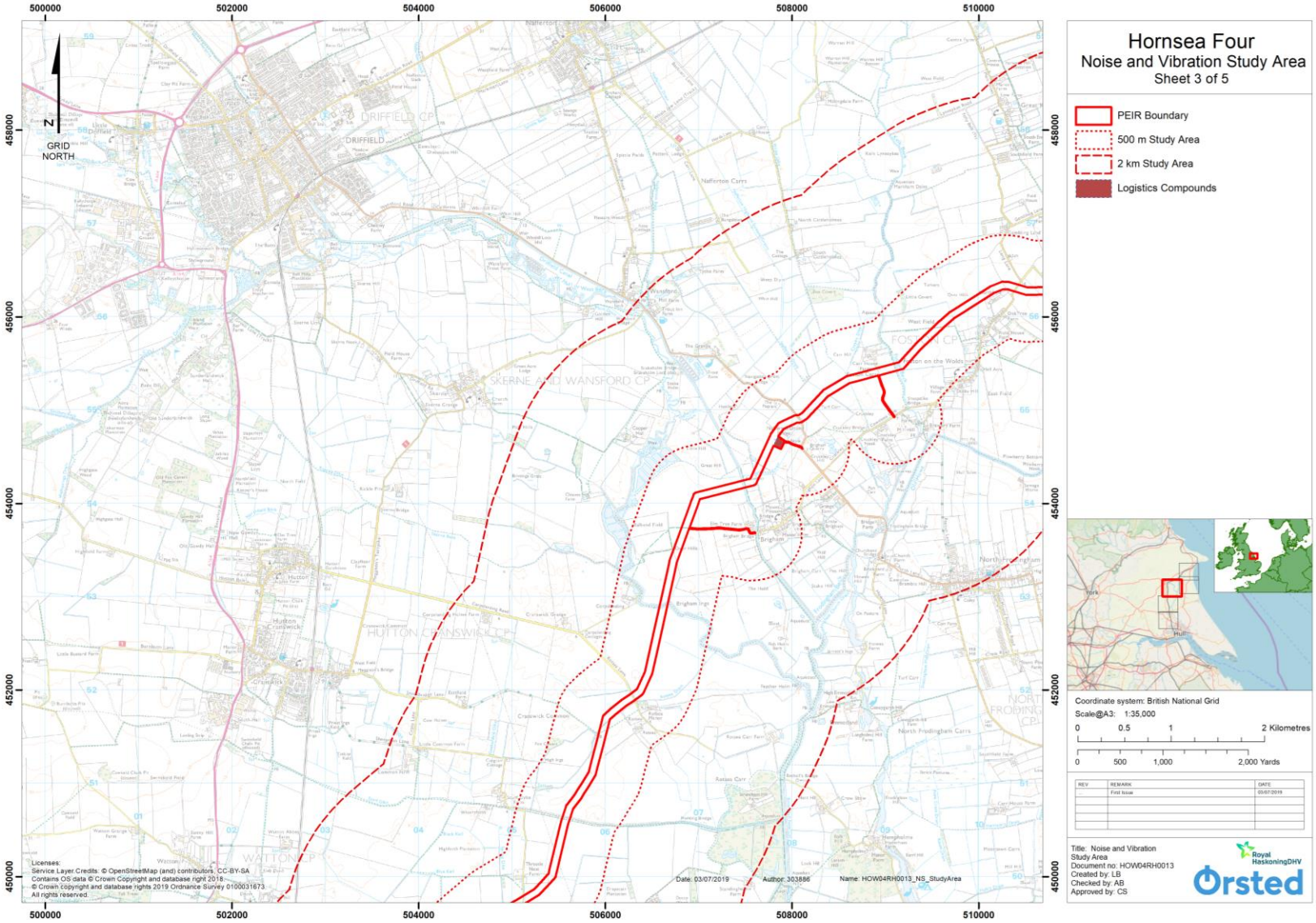

Figure 8.3: Noise and Vibration Study Area (Onshore ECC 1) (not to scale).

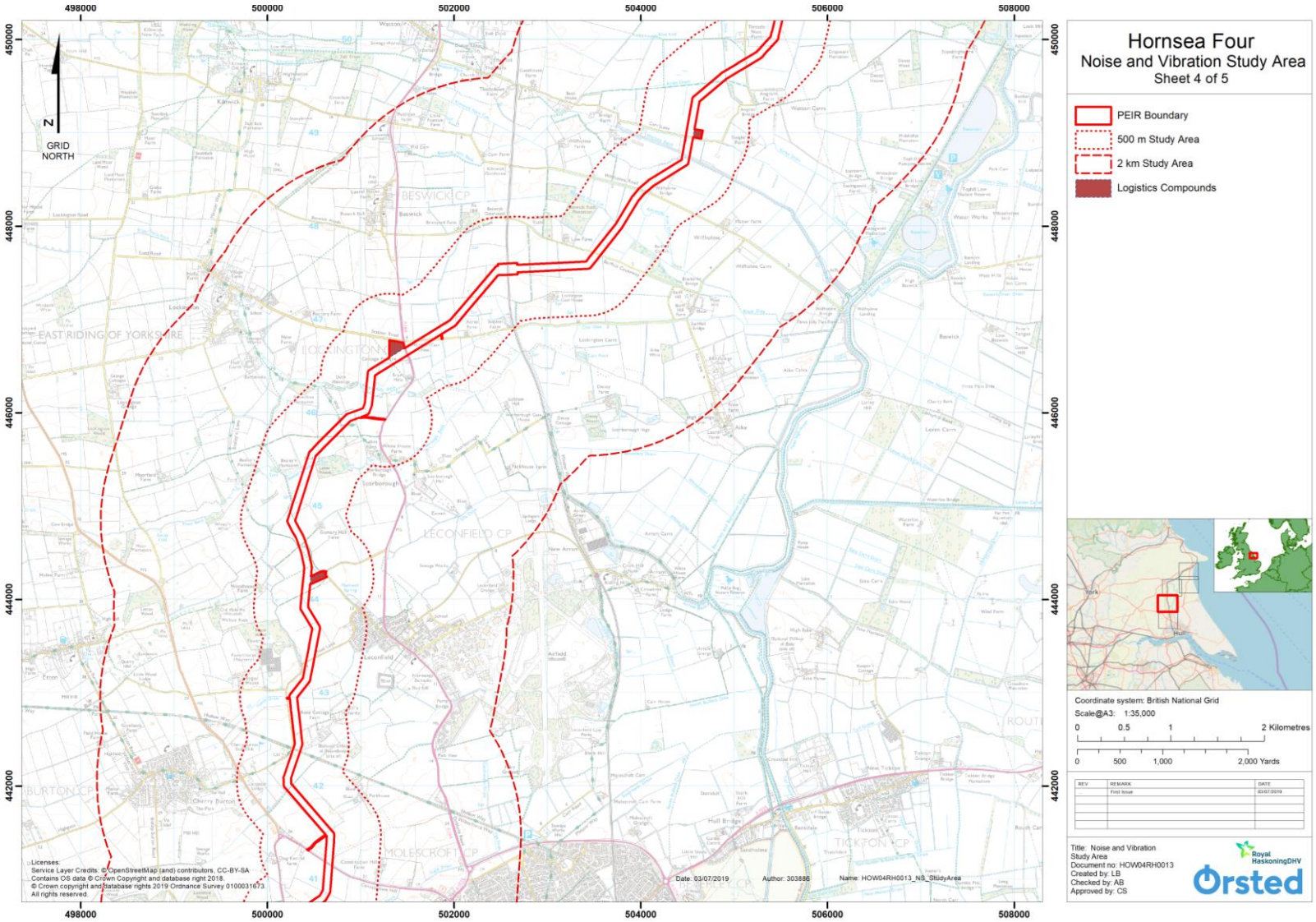

Figure 8.4: Noise and Vibration Study Area (Onshore ECC 2) (not to scale).

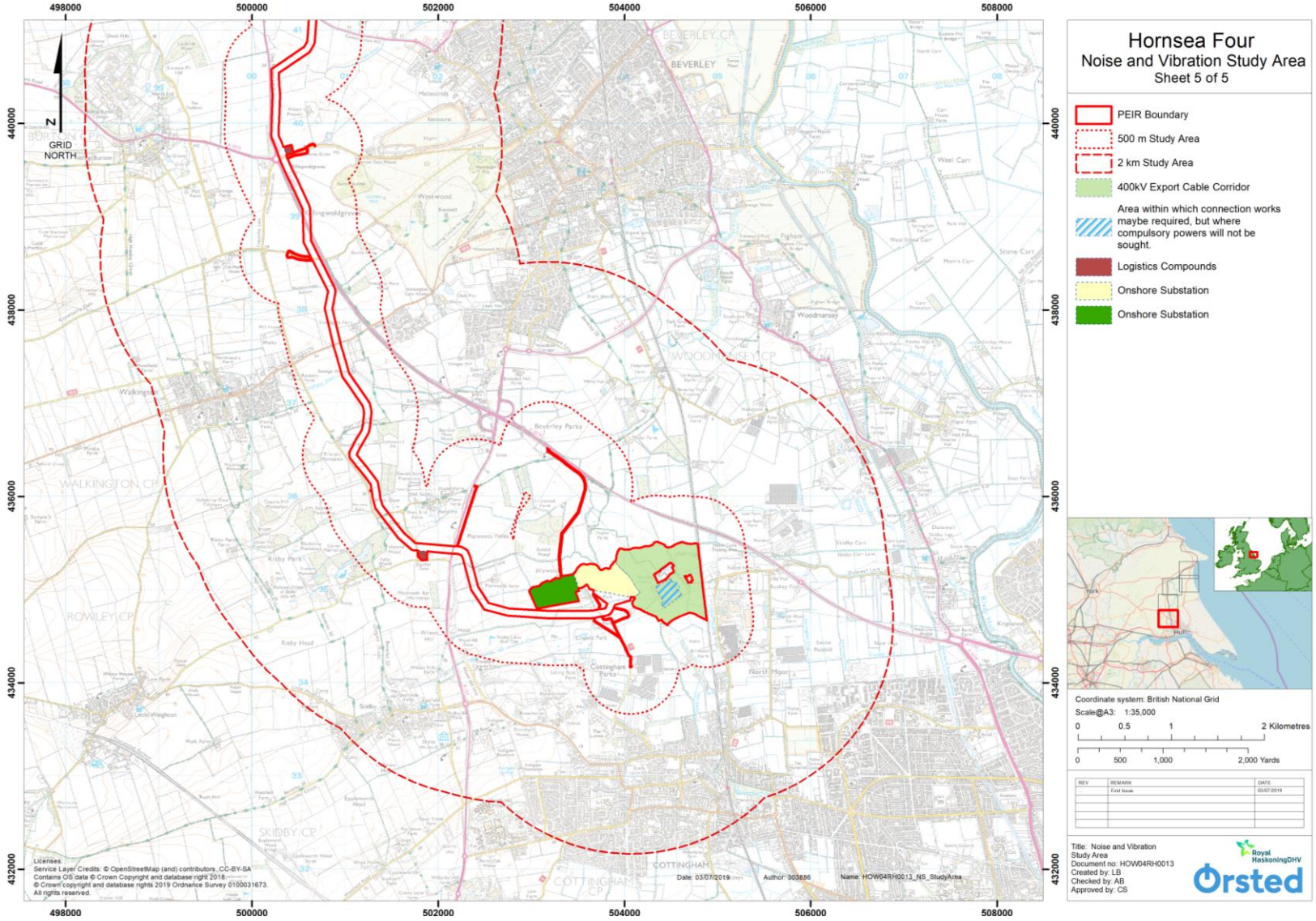

Figure 8.5: Noise and Vibration Study Area (OnSS) (not to scale).

8.6 Methodology to inform baseline

8.6.1 Desktop Study

8.6.1.1 A desk study was undertaken to obtain information on noise and vibration. Data were acquired within the onshore noise and vibration study area through a detailed desktop review of existing studies and datasets.

8.6.1.2 The following sources of information in Table 8.5 were consulted.

Table 8.5: Key Sources of Noise and Vibration Data.

Source	Summary	Coverage of Hornsea Four development area
Google Maps Aerial Photography, 2019	Location of noise and vibration sensitive receptors within the noise and vibration study area	Onshore noise and vibration study area
Environment Agency Lidar Data	Digital Terrain Model, 2m	
Project infrastructure location data	Construction: • Landfall • Onshore ECC • Joint bays • Crossing points • OnSS • EBI Operation: • OnSS • EBI	

8.6.2 Site Specific Surveys

8.6.2.1 To inform the EIA, site-specific surveys were undertaken, as agreed with ERYC. A summary of surveys is outlined in Table 8.6. The baseline noise survey monitoring locations are shown in Figure 8.6 and Figure 8.7

Table 8.6: Summary of site-specific survey data.

Title, year and reference	Summary	Coverage of Hornsea Four development area
Hornsea Four Baseline Noise Survey, 2019 See Volume 6, Annex 8.1: Baseline Noise Survey Report.	Long term unattended and short term attended noise measurements and weather measurements, 3 to 12 April 2019.	Six locations within 2 km of the OnSS, three locations within 400 m of the onshore ECC and three locations within 800 m of landfall.

8.7 Baseline environment

8.7.1 Existing baseline

8.7.1.1 The existing baseline environment of the Hornsea Four onshore infrastructure, including the landfall, onshore ECC, OnSS and 400kV ECC is described within **Volume 6, Annex 8.1: Baseline Noise Survey Report** where details of monitoring locations, survey dates, durations and monitoring results are provided. The baseline noise survey monitoring locations are shown in **Figure 8.6** and **Figure 8.7.**

8.7.2 Baseline noise survey monitoring results

8.7.2.1 **Table 8.7** and **Table 8.8** provide a summary of the measured baseline noise data at the landfall during both the daytime and night-time surveys respectively.

Table 8.7: Baseline Noise Monitoring Data – Landfall, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
LMP1	11 April 2019	16:14:34	16:44:34	52.1	79.2	47.9	34.3
LMP2	11 April 2019	14:48:58	15:18:58	49.5	78.7	40.9	35.7
LMP3	11 April 2019	15:37:55	16:07:55	51.0	73.3	49.4	39.2

Table 8.8: Baseline Noise Monitoring Data – Landfall, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
LMP1	12 April 2019	00:54:00	01:10:00	37.1	63.3	33.8	30.2
LMP2	12 April 2019	00:12:16	00:27:16	34.4	56.0	34.4	29.7
LMP3	12 April 2019	00:34:09	00:50:09	42.2	65.7	37.3	31.0

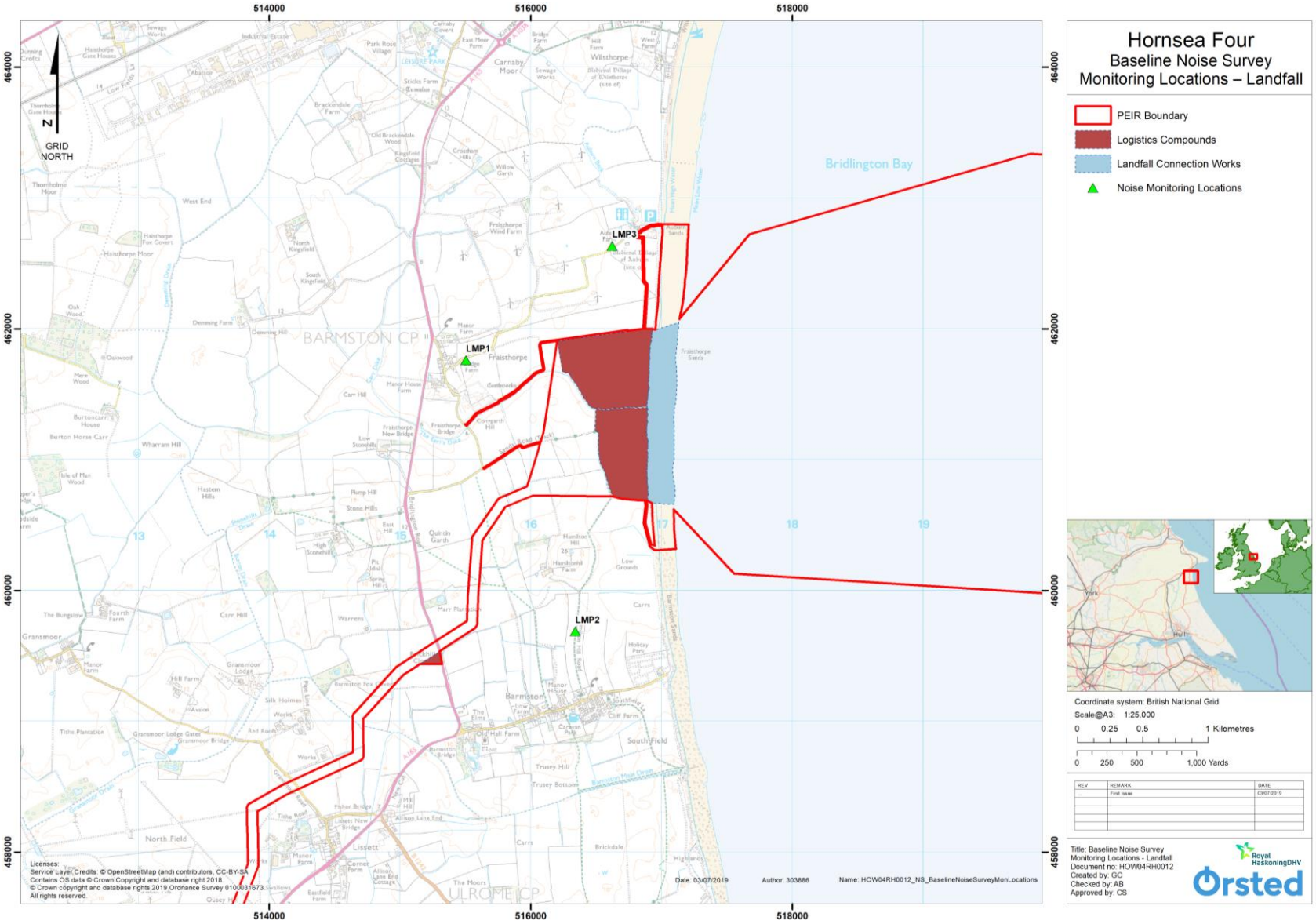

Figure 8.6: Baseline Noise Survey Monitoring Locations – Landfall (not to scale).

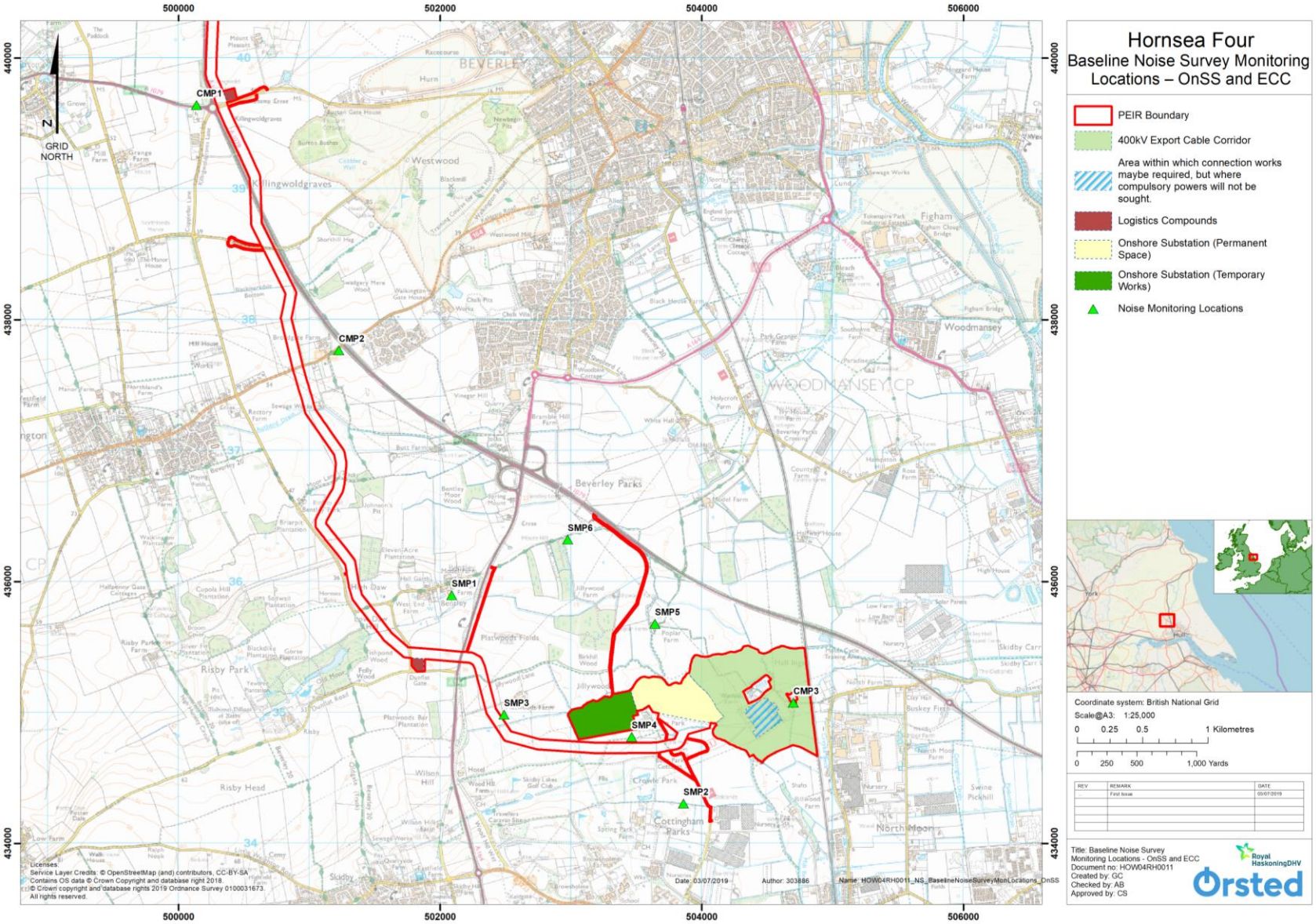

Figure 8.7: Baseline Noise Survey Monitoring Locations – OnSS and Onshore ECC (not to scale).

8.7.2.2 Table 8.9 and Table 8.10 summarise the measured baseline noise data along the onshore ECC during both the daytime and night-time respectively. Result data at CMP1, CMP2 and CMP3 includes a distance correction accounting for the monitoring positions being closer to the road than the respective receptors at those locations. CMP3 is most relevant for the 400kV ECC, which is included as part of this assessment.

Table 8.9: Baseline Noise Monitoring Data – Onshore ECC, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
CMP1	11 April 2019	12:16:11	12:46:11	56.1	73.2	59.2	48.1
CMP2	11 April 2019	12:54:32	13:27:32	58.6	71.2	62.8	47.4
CMP3	12 April 2019	13:02:47	14:02:47	50.8	73.1	50.4	46.2

Table 8.10 Baseline Noise Monitoring Data – Onshore ECC, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
CMP1	12 April 2019	23:02:02	23:17:02	50.1	69.0	51.3	39.3
CMP2	12 April 2019	23:24:35	23:39:35	54.2	74.8	53.9	36.0

** Note: no night time noise monitoring was undertaken at CMP3 as agreed with ERYC.*

8.7.2.3 Table 8.11 and Table 8.12 provides a summary of the measured baseline noise data at the OnSS during both daytime and night-time respectively.

Table 8.11: Baseline Noise Monitoring Data – OnSS, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
SMP1	3 – 11 April 2019	12:15:00	11:45:00	56.8	100.7	55.5	50.4
SMP2	3 – 11 April 2019	14:50:23	10:45:23	45.0	86.3	44.0	37.6
SMP3	3 – 11 April 2019	13:00:00	10:10:00	45.1	85.4	44.2	39.2
SMP4	3 – 11 April 2019	15:10:07	10:50:07	44.2	86.2	41.4	36.5
SMP5	3 – 11 April 2019	13:30:02	10:30:02	51.7	89.0	50.3	43.0
SMP6	3 – 11 April 2019	16:10:03	12:00:03	53.9	84.0	55.4	48.4

Table 8.12: Baseline Noise Monitoring Data – OnSS, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
SMP1	3 – 11 April 2019	23:00:00	07:00:00	53.5	99.6	49.9	37.3
SMP2	3 – 11 April 2019	23:00:23	07:00:23	42.4	76.3	39.1	33.4
SMP3	3 – 11 April 2019	23:00:00	07:00:00	43.5	88.0	39.3	32.7
SMP4	3 – 11 April 2019	23:00:07	23:00:07	41.8	86.8	37.2	32.4
SMP5	3 – 11 April 2019	23:00:02	07:00:02	49.4	79.1	43.8	32.7
SMP6	3 – 11 April 2019	23:00:03	07:00:03	52.6	85.3	49.7	38.0

Deriving Background Levels

8.7.2.4 Table 8.13 and Table 8.14 contain statistical analysis of the measured background noise levels, L_{A90}, at the OnSS during both daytime and night-time respectively. The mean, mode and mean +/- one standard deviation are presented to show the variability of background noise at each location. Statistical analysis is undertaken to ascertain a representative background sound level.

Table 8.13: L_{A90} Statistical Analysis – OnSS, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	Average LA_{90}	Mode	Average – 1 standard deviation	Average + 1 standard deviation
SMP1	3 – 11 April 2019	12:15:00	11:45:00	50.4	50.0	46.4	54.4
SMP2	3 – 11 April 2019	14:50:23	10:45:23	37.6	37.0	34.4	40.8
SMP3	3 – 11 April 2019	13:00:00	10:10:00	39.2	37.0	35.9	42.4
SMP4	3 – 11 April 2019	15:10:07	10:50:07	36.5	37.0	33.9	39.2
SMP5	3 – 11 April 2019	13:30:02	10:30:02	43.0	45.0	38.5	47.5
SMP6	3 – 11 April 2019	16:10:03	12:00:03	48.4	50.0	44.6	52.2

Table 8.14: L_{A90} Statistical Analysis – OnSS, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	Average LA_{90}	Mode	Average – 1 standard deviation	Average + 1 standard deviation
SMP1	3 – 11 April 2019	12:15:00	11:45:00	37.3	30.0	28.4	46.3
SMP2	3 – 11 April 2019	14:50:23	10:45:23	33.4	34.0	29.7	37.1
SMP3	3 – 11 April 2019	13:00:00	10:10:00	32.7	30.0	27.2	38.1
SMP4	3 – 11 April 2019	15:10:07	10:50:07	32.4	31.0	28.7	36.2
SMP5	3 – 11 April 2019	13:30:02	10:30:02	32.7	29.0	24.5	40.9
SMP6	3 – 11 April 2019	16:10:03	12:00:03	38.0	34.0	30.1	45.8

8.7.2.5 The road links identified by the transport assessment as carrying construction traffic are presented below in **Table 8.15** and in **Chapter 7: Traffic and Transport, Figure 7.1**. Road links likely to experience an increase in traffic flows greater than 25% were assessed further by undertaking calculations of basic noise level (BNL). Within **Chapter 7: Traffic and Transport** It has been identified that the earliest date construction could commence would be 2023. A baseline year for background traffic growth of 2023 has therefore been adopted in order to consider the greatest potential for change. Background traffic growth for a later

start date would be subject to further growth and therefore increases in Hornsea Four traffic would be less significant.

Table 8.15: Peak Construction Road Traffic Flows – 2023 the proposed Hornsea Project Four.

Link ID	Description	2023 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	Total HGVs	Total Vehicles	Total HGVs	Total Vehicles	Total HGVs
1	A165 - Kingsgate	12,136	298	48	0	0.4%	0.0%
2	Unnamed Road running south in Fraisthorpe	501	3	311	115	62.2%	3399.8 %
3	Unnamed Road from its junction with A165 south of Fraisthorpe	501	3	339	151	67.7%	4469.0 %
4	A165 - Bridlington Road	12,136	298	48	0	0.4%	0.0%
5	A165 - Bridlington Road	12,136	298	379	151	3.1%	50.8%
6	A165 - New Cut	11,446	444	524	203	4.6%	45.6%
7	A165 - New Cut	9,725	308	520	203	5.3%	65.7%
8	A165 - Lissett Lane / Bridlington Road	9,725	308	616	248	6.3%	80.5%
9	B1249 - Main Street	2,555	53	490	122	19.2%	230.1%
10	Foston Lane / Old Howe Lane	316	9	387	19	122.3%	207.9%
11	B1249 - North Frodingham Road	4,384	82	103	103	2.4%	125.4%
12	B1249 - Main Street	4,384	82	103	103	2.4%	125.4%
13	B1249 - Church Lane	4,384	82	103	103	2.4%	125.4%
14	Cruckley Lane / Cowslam Lane	547	8	404	36	73.9%	458.3%
15	Sheepdike Lane	547	8	368	0	67.3%	0.0%
16	Old Howe Lane	316	9	387	19	122.3%	207.9%
17	Long Lane	316	9	117	19	36.9%	207.9%
18	Gambling Lane	316	9	117	19	36.9%	207.9%
19	Out Gates	316	9	117	19	36.9%	207.9%
20	B1249	4,384	82	301	103	6.9%	125.4%
21	B1249	4,384	82	206	103	4.7%	125.4%
22	B1249	4,384	82	109	103	2.5%	125.4%
23	B1249 - Wansford Road	5,832	92	109	103	1.9%	113.0%
24	B1249 - Wansford Road / Scarborough Road	5,832	92	109	103	1.9%	113.0%
25	Brigham Lane	547	8	119	21	21.8%	271.6%
26	A164	11,087	539	180	103	1.6%	19.2%
27	Beverly Road	11,384	206	0	0	0.0%	0.0%
28	Anderson Street / River Head	11,384	206	0	0	0.0%	0.0%
29	A164	11,087	539	180	103	1.6%	19.2%
30	Station Road / Main Street	2,498	35	144	46	5.7%	130.3%
31	Corpslanding Road / Howl Lane / Church Street / Hutton Road	555	8	0	0	0.0%	0.0%
32	Maeggison's Turnpike	2,498	35	144	46	5.7%	130.3%

Link ID	Description	2023 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	Total HGVs	Total Vehicles	Total HGVs	Total Vehicles	Total HGVs
33	Corpslanding Road / Rotsea Lane	555	8	144	46	25.9%	577.1%
34	Carr Lane / Church Lane	308	18	148	50	47.9%	275.0%
35	Church Lane	308	18	148	50	47.9%	275.0%
36	A164 - Beverly Road	11,234	546	503	149	4.5%	27.3%
37	A164 - Beverly Road	11,234	546	454	199	4.0%	36.4%
38	Wilfholme Road	80	0	106	8	132.2%	n/a
39	A164	10,205	251	552	207	5.4%	82.5%
40	Beswick Road / Barfhill Causeway	37	0	109	11	291.6%	n/a
41	AA164	10,205	251	546	218	5.4%	86.7%
42	Station Road	313	9	130	32	41.6%	356.4%
43	Station Road	677	5	138	40	20.4%	892.2%
44	A164	10,205	251	672	304	6.6%	121.0%
45	A164 Main Street	8,438	410	520	364	6.2%	88.8%
46	Old Road	3,936	19	368	0	9.3%	0.0%
47	Unnamed Road west of junction with A164 to Old Road	3,936	19	428	60	10.9%	314.8%
48	Miles Lane	3,936	19	368	0	9.3%	0.0%
49	Miles Lane	3,936	19	381	13	9.7%	69.9%
50	B1248	13,735	310	381	13	2.8%	4.3%
51	A1035 - Constitution Hill	11,741	1,100	763	395	6.5%	35.9%
52	Beverly Northern Bypass	11,741	1,100	732	364	6.2%	33.1%
53	A1035 - Dog Kennel Lane	16,462	1,081	776	408	4.7%	37.8%
54	A1174	6,586	58	274	51	4.2%	88.6%
55	A1079	22,803	1,321	854	486	3.7%	36.8%
56	Newbald Road	1,750	1	223	27	12.7%	2376.2 %
57	Killingwoldgraves Lane / Coppleflat Lane	3,291	75	395	27	12.0%	36.0%
58	Coppleflat Lane	3,291	75	368	0	11.2%	0.0%
59	Coppleflat Lane	3,291	75	301	20	9.1%	27.0%
60	A164	36,649	1,458	1,406	1,038	3.8%	71.2%
61	Unnamed Road south of Coppleflat Lane to junction with A164	2,513	25	354	56	14.1%	227.0%
62	A164	36,649	1,458	1,406	1,038	3.8%	71.2%
63	A164	35,220	1,401	1,462	1,094	4.2%	78.1%
64	A165 - Beverly Road / Bridlington Road	9,519	607	738	370	7.8%	61.1%
65	Main Street / Froddingham Road	2,098	18	0	0	0.0%	0.0%
66	A165	19,147	1,148	738	370	3.9%	32.3%
67	A165	19,147	1,148	738	370	3.9%	32.3%
68	A1035	22,295	1,337	738	370	3.3%	27.7%
69	A1035 - Grange Way	13,118	1,229	368	0	2.8%	0.0%

Link ID	Description	2023 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	Total HGVs	Total Vehicles	Total HGVs	Total Vehicles	Total HGVs
70	A1174 - Swinemoor Lane	17,887	924	699	370	3.9%	40.1%
71	A1174 - Hull Road	16,156	835	699	370	4.3%	44.4%
72	Minster Way	10,761	516	561	370	5.2%	71.8%
73	A164	24,555	977	977	630	4.0%	64.5%
74	A1079	21,496	1,197	627	259	2.9%	21.7%
75	A1174 - Beverly Road / Hull Road	16,772	904	18	0	0.1%	0.0%
76	A164	36,649	1,458	1,356	1,097	3.7%	75.2%
77	A164	36,649	1,458	1,465	1,097	4.0%	75.2%
78	A164	19,466	1,043	1,460	1,097	7.5%	105.2%
79	A164	19,466	1,043	1,455	1,097	7.5%	105.2%
80	A15 - Boothferry Road	30,551	2,424	1,097	1,097	3.6%	45.3%
81	A63	56,817	7,367	1,097	1,097	1.9%	14.9%
82	A63 - Clive Sullivan Way	72,675	7,610	1,097	1,097	1.5%	14.4%
83	A15 - Humber Bridge	26,573	1,962	347	0	1.3%	0.0%
84	A614	12,274	642	102	0	0.8%	0.0%
85	Bridlington bay Road	9,167	811	48	0	0.5%	0.0%
86	A614	13,311	1,006	218	103	1.6%	10.3%
87	A1079	11,681	767	302	0	2.6%	0.0%
88	B1233 Harland Way / Northgate	12,932	151	297	3	2.3%	1.8%
89	Park Lane	1,254	24	297	3	23.7%	11.3%
90	B1230 - East End	3,291	75	368	0	11.2%	0.0%

8.7.3 Predicted future baseline

8.7.3.1 The baseline noise monitoring survey provides a clear representation of the existing soundscape within the noise and vibration study area of the project. Traffic flow data provided for use within the noise assessment incorporates a future baseline.

8.7.3.2 Noise is managed and driven by EU, UK and local legislation and policies. The UK's noise strategy and standards are enacted through management actions at a local authority level. There is a policy trend towards the achievement and maintenance of the noise environment across the UK, which is reflected in national planning policies. Predicted noise levels due to a change in land use, new developments and associated vehicles are assessed as part of the development planning and consent process.

8.7.3.3 Potential impacts to the prevailing soundscape should be minimised, avoided, or mitigated to suitable levels (in accordance with current legislation, policy and guidance), avoiding an adverse impact, where possible. In addition to planning controls there is a clear trend for noise from vehicle, commercial and industrial sources to be driven down in compliance with stricter legislation and guidance. Consequently, in relation to the project and its immediate

receiving environment it is reasonable to predict a general steady baseline soundscape would be maintained.

8.7.4 Data Limitations

8.7.4.1 The key data limitation with the baseline data and their ability to materially influence the outcome of the EIA is the inherent variability of the noise environment. To manage this variability and provide representative noise data for the OnSS area, data were collected over a week to allow for day to day variability.

8.8 Project basis for assessment

8.8.1 Impact register and impacts "scoped out"

8.8.1.1 Based on the baseline environment, the project description outlined in **Volume 1, Chapter 4: Project Description** and the Commitments Register in **Volume 4, Annex 5.2: Commitments Register**, a number of impacts are proposed to be "scoped out" of the PEIR assessment for noise and vibration. These impacts are outlined, together with a justification for scoping them out, in **Table 8.16.** Further detail is provided in the Impacts Register in **Volume 4, Annex 5.1: Impacts Register**.

8.8.1.2 Please note that the term "scoped out" relates to the Likely Significant Effect (LSE) in EIA terms and not "scoped out" of the EIA process *per se*. All impacts "scoped out" of LSE are assessed for magnitude, sensitivity of the receiving receptor and conclude an EIA significance in the I&E Register (see **Volume 4, Annex 5.1**). This approach is aligned with the Hornsea Four Proportionate approach to EIA (see **Volume 1, Chapter 5: EIA Methodology**).

Table 8.16: Noise and vibration Impact Register

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
Indicative temporary works area - temporary noise and vibration from onshore cable installation (excluding HDD works) (NV-C-1)	Not significant	Scoped Out	No likely significant effect. Agreed by PINS to be scoped out.
Temporary noise and vibration from constructing the haul road access points (NV-C-5)	Not significant	Scoped Out	Construction access points from the highway network will be located at least 150 m from noise sensitive properties (Co 135). Plant required for construction of the access points/roads will be no greater in number and nature to that assessed for HDD and Joint bay construction. At this distance and based on the calculations undertaken for the HDD/Jointing Bays, noise levels are predicted to

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			be below the construction threshold and, therefore, no significant impacts are expected.
Operation: Noise from buried cable (NV-O-9)	Not significant	Scoped Out	No likely significant effects. Agreed by PINS to be scoped out.
Operational Traffic Noise (NV-O-10)	Not significant	Scoped Out	
Noise and vibration from routine maintenance activities (NV-O-11)	Not significant	Scoped Out	
Operational Vibration (NV-O-12)	Not significant	Scoped Out	
Noise from operation of the offshore HVAC booster (NV-O-13)	Not significant	Scoped Out	No likely significant effects due to the distance (>20km) offshore are predicted. Simple calculations based on the plant and equipment located at the OnSS shows that predicted noise levels from the booster are expected to be below 15 dB at onshore receptors.
Decommissioning: Temporary noise and vibration from plant along the cable route (NV-D-14)	Not significant	Scoped Out	Decommissioning of the onshore infrastructure for Hornsea Four will comprise the following activities: • Buried export cables left in situ, with cable ends cut, sealed and securely buried. Partial removal of cables at landfall occur for aluminium/steel recycling; • Joint Bays and Link boxes will typically be left in situ, or removed if feasible; and • The OnSS above ground electrical equipment and infrastructure will be removed, along with building foundations and security fencing. The site will be returned to its previous condition. Further details will be provided and secured within a Decommissioning Plan, agreed with stakeholders prior to decommissioning commencing. The construction of Hornsea Four presents the highest potential for significant environmental effects. Impacts during decommissioning would result in an effect of equal significance, at worst.
Decommissioning: Temporary noise and vibration from plant at the onshore substation (NV-D-15)	Not significant	Scoped Out	

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			Primary, tertiary and secondary mitigation measures that are necessary to reduce significant effects during construction to acceptable levels would be secured for decommissioning activities. In line with the proportionate approach to EIA, effects during decommissioning are therefore scoped out of the EIA for Hornsea Four.

Notes:
Grey - Potential impact is scoped out and both PINS and Hornsea Four agree.
Red – Potential impact is scoped out with no consensus between PINS and Hornsea Four at EIA Scoping.

8.8.2 Commitments

8.8.2.1 Hornsea Four has made several Commitments (primary design principles inherent as part of the project, installation techniques and engineering designs/modifications as part of their pre-application phase), to reduce or eliminate impacts as far as possible. Further Commitments (adoption of best practice guidance) are embedded as an inherent aspect of the EIA process. The full list of Commitments can be found in **Volume 4, Annex 5.2: Commitments Register.**

8.8.2.2 The commitments adopted by Hornsea Four in relation to noise and vibration are presented in **Table 8.17**.

Table 8.17: Relevant Noise and Vibration Commitments

Commitment ID	Measure Proposed	How the measure will be secured
Co36	Primary: Core working hours for the construction of the onshore components of Hornsea Four will be as follows: • Monday to Friday: 07:00 - 18:00 hours; • Saturday: 07:00 - 13:00 hours; Up to one hour before and after core working hours for mobilisation ("mobilisation period"), i.e. 06:00 to 19:00 weekdays and 06:00 to 14:00 Saturdays; and • Maintenance period 13:00 to 17:00 Saturdays. *Activities carried out during mobilisation and maintenance will not generate significant noise levels (such as piling, or other such noisy activities).* In certain circumstances outside of normal working practices, specific	DCO Requirement 16 (CoCP)

Commitment ID	Measure Proposed	How the measure will be secured
	works may have to be undertaken outside the normal working hours. ERYC will be informed in writing of such circumstances.	
Co41	Primary: All HDD crossings will be undertaken by non-impact methods in order to minimise construction vibration beyond the immediate location of works.	DCO Requirement 16 (CoCP)
Co123	Tertiary: Based on noise modelling results, where noise has the potential to cause significant adverse effects, mufflers and acoustic barriers will be used where HDD is being undertaken.	DCO Requirement 16 (CoCP)
Co124	Tertiary: A CoCP will be developed in accordance with the outline CoCP. The outline CoCP will include measures to reduce temporary disturbance to residential properties, recreational users, and existing land users.	DCO Requirement 16 (CoCP)
Co133	Primary: The onshore ECC will be routed to avoid residential receptors by at least 50 m.	DCO Works Plan - Onshore
Co134	Primary: Cable installation works at the landfall area will be located at least 200 m from residential receptors.	DCO Works Plan - Onshore
Co135	Primary: Temporary construction highway access points along the onshore ECC will be located at least 150m from residential receptors, with the exception of two receptors; Bridge Farm Holiday Cottages, Brigham, Driffield, and a receptor off the A1035 Malton Road, Beverley.	DCO Requirement 17 (Construction traffic management plan)
Co137	Tertiary: HGV movements associated with operation and planned maintenance of the onshore infrastructure will operate only between the hours of. 0700 – 2300. HGV movements may however be subject to unscheduled maintenance activities outside these hours. In this event the council will be informed via writing.	DCO Requirement 17 (Construction traffic management plan)
Co144	Tertiary: A Construction Traffic Management Plan (CTMP) will be developed in accordance with the outline CTMP to be submitted with the DCO application. The CTMP will set standards and procedures for: 1. Managing the numbers and routeing of HGVs during the construction phase; 2. Managing the movement of employee traffic during the construction phase; 3. Details of localised road improvements necessary to facilitate safe use of the existing road network; and 4. Details of measures to manage the safe passage of HGV traffic via the local highway network	DCO Requirement 17 (Construction traffic management plan)
Co159	Secondary: Operational noise from the onshore substation will be at a noise level no greater than 5dB above the representative background ($L_{A90,T}$) during the day time and night at the Noise Sensitive Receptors (NSRs), as stated within the onshore noise assessment (document reference A3.8).	DCO requirement 20 (Control of noise during operational phase)

Commitment ID	Measure Proposed	How the measure will be secured
Co169	Secondary: Piling at the OnSS will not be undertaken within 180m of any noise sensitive receptors.	DCO Requirement 6 (Detailed design approval onshore)

8.9 Maximum Design Scenario (MDS)

8.9.1.1 This section describes the parameters on which the noise and vibration assessment has been based. These are the parameters which are judged to give rise to the maximum levels of effect on noise and vibration sensitive receptors. Should Hornsea Four be constructed to different parameters within the design envelope, then impacts would be the same or reduced, but they would not be any greater. The MDS for noise and vibration is presented **Table 8.18** and a summary presented in **Volume 4, Annex 5.1: Impacts Register**.

Table 8.18: MDS for impacts on Noise and Vibration

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
Construction			
Indicative temporary works area - temporary noise and vibration from HDD works and other trenchless technologies (NV-C-2)	Primary: Co36 Co41 Co133 Tertiary: Co123 Co124	**Onshore Export Cable Corridor:** • Construction duration: 30 months • Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months • ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m^2 • HDDs: Number: 112, HDD compounds (entry and exit): 56 x 70 x 70m compounds, Duration of HDD Compound: 1 month each • HDD required at night, using largest equipment, required at all crossings, compound required at all crossings; **Construction Equipment (Per HDD):** • Maximum HDD noise: 120dB • Tracked Excavator: Number: 1, Noise Level: 107dB(A), 50% ontime • Backhoe Loader: Number: 1, Noise Level: 96dB(A), 50% ontime • Bulldozer: Number: 1, Noise Level:108dB(A), 50% ontime • Dumper: Number: 1, Noise Level: 101dB(A), 50% ontime • Mobile Crane: Number: 1, Noise Level: 106dB(A), 25% ontime • Cement Mixer Truck (Discharging): Number: 1, Noise Level: 103dB(A), 25% ontime • Truck Mounted Concrete Pump and Boom Arm: Number: 1, Noise Level: 108dB(A), 25%ontime • Drilling Rig: Number: 1, Noise Level 105dB(A), 75% ontime • Water Pump: Number: 1, Noise Level: 93dB(A), 75% ontime • Generator: Number: 1, Noise Level: 105dB(A), 100% ontime	HDD involves the most equipment/complexity and has the potential for night-time working which creates the biggest impacts on residential receptors.
Landfall, nearshore and intertidal area - temporary noise and	Primary: Co134	**Landfall:** • Construction duration: 32 months	HDD involves the most equipment/complexity and has the potential for

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
vibration from cable installation works. (NV-C-3)	Tertiary: Co123 Co124	• Landfall compound: Number: 1, Total Area: 40,000 m^2, Duration: 32 months • Beach closure: 32 months • HDD Number: 8 • HDD required at night, using largest equipment, pit open two months, 8 vessels near (5km^2 area) shore **Construction Equipment (Per HDD):** • Maximum HDD noise: 120dB • Tracked Excavator: Number: 1, Noise Level: 107dB(A), 50% ontime • Backhoe Loader: Number: 1, Noise Level: 96dB(A), 50% ontime • Bulldozer: Number: 1, Noise Level:108dB(A), 50% ontime • Dumper: Number: 1, Noise Level: 101dB(A), 50% ontime • Mobile Crane: Number: 1, Noise Level: 106dB(A), 25% ontime • Cement Mixer Truck (Discharging): Number: 1, Noise Level: 103dB(A), 25% ontime • Truck Mounted Concrete Pump and Boom Arm: Number: 1, Noise Level: 108dB(A), 25% ontime • Drilling Rig: Number: 1, Noise Level 105dB(A), 75% ontime • Water Pump: Number: 1, Noise Level: 93dB(A), 75% ontime • Generator: Number: 1, Noise Level: 105dB(A), 100% ontime	night-time working which creates the biggest impacts on residential receptors.
Temporary noise and vibration from constructing the jointing bays. (NV-C-4)	Primary: Co36 Co41 Co133 Co134 Tertiary: Co124	**Onshore Export Cable Corridor:** • Joint Bays area 384,000 m^2 (240 x 40m x 40m): • Joint Bays Volume 960,000m3 (384,000 m^2 x 2.5m) **Construction Equipment (Joint Bays):** • Bulldozer: Number: 1, Noise Level:108dB(A) • Tracked Excavator: Number: 1, Noise Level: 107dB(A), • Generator: Number: 1, Noise Level: 105dB(A), 100% ontime • Water Pump: Number: 1, Noise Level: 93dB(A), 75% ontime • Dump Truck: Number: 1, Noise Level: 115dB(A)	The MDS uses the highest potential number of JBs that will required to be constructed as these would produce the greatest noise.

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
		• Cement Mixer Truck (Discharging): Number: 1, Noise Level: 103dB(A), 25% ontime • Truck Mounted Concrete Pump and Boom Arm: Number: 1, Noise Level: 108dB(A), 25%ontime	
Temporary noise and vibration from construction of the onshore substation. (Includes the temporary impacts of pre-cast concrete piling (percussive piling) (NV-C-6)	Primary: Co36 Tertiary: Co124 Secondary: Co169	**Onshore Substation and Energy Balancing Infrastructure:** • Maximum construction period: 36 months **Construction Equipment (OnSS and EBI):** • Tracked Excavator: Number: 2, Noise Level: 107dB(A), 75% ontime • Backhoe Loader: Number: 2, Noise Level: 96dB(A), 75% ontime • Bulldozer: Number: 2, Noise Level: 108dB(A,), 75% ontime • Dumper: Number: 2, Noise Level: 101dB(A), 75% ontime • Mobile Crane: Number: 2, Noise Level: 106dB(A), 75% ontime • Cement Mixer Truck (Discharging): Number: 1no, Noise Level: 103dB(A), 50% ontime • Truck Mounted Concrete Pump and Boom Arm: Number: 1, Noise Level: 108dB(A), 50% ontime • Piling – pre-cast concrete piles	The MDS accounts for the maximum-case construction methods and noise levels.
Traffic noise (NV-C-7)	Primary: Co135 Tertiary: Co144	The derivation of the peak construction flows has been carried out as part of the Traffic and Transport assessment (Chapter 7: Traffic and Transport) in accordance with the MDS for that assessment. Traffic flows are provided as both peak traffic AAWT and more detailed Average flow AAWT to present two cases (MDS and then average provided for context).	The MDS relates to the maximum number of movements on any one link to create the AAWT.
Operation			
Noise from the onshore substation (NV-O-8)	Secondary: Co159	**Operational Noise Onshore Substation (HVAC):** • Variable Shunt Reactor: Number: 12, Noise Level: 97dB(A) • Fixed Shunt Reactor: Number: 4, Noise Level: 93dB(A) • DRC: Number: 6, Noise Level: 93dB(A) • DRC Transformer: Number: 6, Noise Level: 91dB(A)	The HVAC is considered to be the MDS due to the amount of external equipment compared to HVDC.

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
		• DRC Reactor: Number: 6, Noise Level: 84dB) • Super Grid Transformer: Number: 6, Noise Level: 95dB(A) • Harmonic Filter: Number:10, Noise Level: 91dB(A) **Energy Balancing Infrastructure:** • MV/LV Transformers: Number:100, Noise Level: 65dB(A) • Power Converters: Number: 100, Noise Level: 85dB(A) • Battery Area: Noise Level: 84dB(A) • Central AC Units: Number: 2, Noise Level: 80dB(A)	
Decommissioning			
Scoped out of assessment			

8.10 Assessment methodology

8.10.1.1 The assessment methodology for noise and vibration is consistent with that presented in Annex C of the Scoping Report (Ørsted, 2018).

8.10.1.2 Potential noise and vibration impacts associated with onshore construction was assessed using the guidance contained in BS 5228:2009+A1:2014 (Code of Practice for Noise and Vibration Control on Construction and Open Sites), which defines the accepted prediction methods and source data for various construction plant and activities.

8.10.1.3 Construction noise and vibration impacts were based on the identified construction programme and associated activities and plant, including earthworks, piling (if required at the OnSS), directional drilling, cable trenching and associated construction traffic.

8.10.1.4 Operational impacts include noise generation associated with the onshore substation. The guidance and methodology contained in BS 4142:2014 (BSI, 2014c) Methods for rating and assessing industrial and commercial sound was used to assess potential noise impacts.

8.10.1.5 Following the identification of the proposed onshore development area, liaison with the Human Environment Technical Panel (attended by Hornsea Four and ERYC), including the ERYC Environmental Health Officer, was undertaken to agree the approach and methodology to baseline noise surveys and the criteria to be used for the noise and vibration assessment.

8.10.1.6 A SoundPLAN noise model has been used in the construction and operational phase assessment. The model incorporated the MDS for each identified impact (as described in **Table 8.18**), nearby residential dwellings and other buildings, intervening ground cover and topographical information.

8.10.1.7 Noise levels for the construction phase were calculated using the methods and guidance in BS 5228-1:2009+A1:2014. This Standard provides methods for predicting receptor noise levels from construction works based on the number and type of construction plant and activities operating on site, with corrections to account for:

- The "*on-time*" of the plant, as a percentage of the assessment period;
- Distance from source to receptor;
- Acoustic screening by barriers, buildings or topography; and
- Ground type.

8.10.2 Impact assessment criteria

8.10.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude

are based on those used in the Design Manual for Roads and Bridges (DMRB) methodology, which is described in further detail in **Volume 1, Chapter 5: EIA Methodology**.

8.10.2.2 The aims of the NPPF and the NPSE require that a SOAEL should be "*avoided*" and that where a noise level which falls between SOAEL and LOAEL, then according to the explanatory notes in the statement:

> *"...reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."*

8.10.2.3 Further guidance can be found in the Planning Practice Guidance (PPG) notes which summarise the noise exposure hierarchy based on the likely average response, as summarised in **Table 8.19**.

Table 8.19: Definitions of Sensitivity Levels for Noise Exposure Hierarchy (reproduced from the PPG).

Perception	Examples of outcomes	Increasing effect levels	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise.	Significant Observed Adverse Effect	Avoid

Perception	Examples of outcomes	Increasing effect levels	Action
	Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.		
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

8.10.2.4 Sensitive receptors, in the context of noise and vibration, are typically residential premises but can also include schools, places of worship and noise sensitive commercial premises. **Table 8.20** presents the definitions used relating to the sensitivity of the receptor. Ecological and heritage receptors are assessed within the respective chapters (**Chapter 3: Ecology and Nature Conservation** and **Chapter 5: Historic Environment**).

Table 8.20: Definition of terms relating to receptor sensitivity.

Sensitivity	Definition	Examples
High	Receptor has very limited tolerance of effect	Noise Receptors have been categorised as high sensitivity where noise may be detrimental to vulnerable receptors. Such receptors include certain hospital wards (e.g. operating theatres or high dependency units) or care homes at night. Vibration Receptors have been categorised as high sensitivity where the receptors are listed buildings or Scheduled Monuments.
Medium	Receptor has limited tolerance of effect	Noise Receptors have been categorised as medium sensitivity where noise may cause disturbance and a level of protection is required but a level of tolerance is expected. Such subgroups include residential accommodation, private gardens, hospital wards, care homes, schools, universities, research facilities, national parks, (during the day); and temporary holiday accommodation at all times. Vibration Receptors have been categorised as medium sensitivity where the receptor is not a listed building or Scheduled Monument
Low	Receptor has some tolerance of effect	Noise Receptors have been categorised as low sensitivity where noise may cause short duration effects in a recreational setting although particularly high noise levels may cause a moderate effect.

Sensitivity	Definition	Examples
		Such receptors include offices, shops, outdoor amenity areas, long distance footpaths, doctor's surgeries, sports facilities and places of worship. Vibration Receptors have been categorised as low sensitivity where the structural integrity of the structure is expected to be high. The level of vibration required to cause damage is very high and such levels are not expected to be reached during the project.
Negligible	Receptor generally tolerant of effect.	Noise Receptors have been categorised as negligible sensitivity where noise is not expected to be detrimental. Such subgroups include warehouses, light industry, car parks, and agricultural land. Vibration Receptors have been categorised as negligible sensitivity where vibration is not expected to be detrimental.

8.10.2.5 All identified noise receptors considered within this assessment are classed as being of medium sensitivity.

8.10.2.6 The criteria for defining magnitude of an effect in this chapter are outlined below.

Construction Phase Noise Assessment

8.10.2.7 The assessment approach utilised in this assessment is the threshold based "*ABC method*". The method is detailed within BS 5228-1:2009+A1:2014, which specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels were assessed against noise limits derived from advice within Annex E of BS 5228. **Table 8.21**, reproduced from BS 5228-1:2009+A1:2014 Table E.1 (BSI, 2014a), presents the criteria for selection of a noise limit for a specific receptor location.

Table 8.21: Construction Noise Threshold Levels Based on the ABC Method (BS 5228:2009+A1:2014).

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A[A)]	*Category B[B)]*	*Category C[C)]*
Night time (23.00 – 07.00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A[A)]	*Category B[B)]*	*Category C[C)]*
C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			
D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

8.10.2.8 The "*ABC method*" described in BS 5228-1:2009+A1:2014 (BSI, 2014a) establishes that there is no impact below the three thresholds presented above.

8.10.2.9 BS 5228-1:2009+A1:2014 (BSI, 2014a) states:

> *"If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect."*

8.10.2.10 Construction noise impacts were assessed using the impact magnitude presented in **Table 8.22** for the daytime period, **Table 8.23** for the evening and weekend periods, and **Table 8.24** for the night time.

Table 8.22: Day time Construction Noise Impact Magnitude Criteria.

Impact magnitude	Construction noise level, decibels (dB)		
	A 65dB threshold	*B 70dB threshold*	*C 75dB threshold*
Negligible Impact	<65.9	<70.9	<75.9
Minor Impact	>66.0 - <67.9	>71.0 - <72.9	>76.0 - <77.9
Moderate Impact	>68.0 - <69.9	>73.0 - <74.9	>78.0 - <79.9
Major Impact	>70	>75	>80

Table 8.23: Evening and Weekends Construction Noise Impact Magnitude Criteria.

Impact magnitude	Construction noise level, decibels (dB)		
	A 65dB threshold	*B 70dB threshold*	*C 75dB threshold*
Negligible Impact	<55.9	<60.9	<65.9
Minor Impact	>56.0 - <57.9	>61.0 - <62.9	>66.0 - <67.9
Moderate Impact	>58.0 - <59.9	>63.0 - <64.9	>68.0 - <69.9
Major Impact	>60	>65	>70

Table 8.24: Night-time Construction Noise Impact Magnitude Criteria

Impact magnitude	Construction noise level, decibels (dB)		
	A 65dB threshold	*B 70dB threshold*	*C 75dB threshold*
Negligible Impact	<45.9	<50.9	<55.9
Minor Impact	>46.0 - <47.9	>51.0 - <52.9	>56.0 - <57.9
Moderate Impact	>48.0 - <49.9	>53.0 - <54.9	>58.0 - <59.9
Major Impact	>50	>55	>60

8.10.2.11 Details of plant and equipment requirements for each construction activity is provided in **Table 8.18**. Noise modelling was undertaken based on the MDS for HDD activities, Joint Bay construction and OnSS construction.

Construction Phase Traffic Noise and Vibration Impact Magnitude

8.10.2.12 Following the methodology contained in DMRB (Volume 11, Section 3, Chapter 7 of DMRB) an initial screening assessment was undertaken to assess whether there would be any significant changes in traffic volume and composition on surrounding local roads as a result of the project. Any road links with a predicted increase in traffic volume of 25% or a decrease of 20% were identified. Such changes in traffic volume would correspond to a 1 dBA change in noise level at the relevant road link. A change in noise level of less than 1 dBA in the short term is regarded as being imperceptible, and therefore of negligible magnitude. If there are no increases greater than 25% or a decrease of 20% or greater, then the DMRB guidance indicates that no further assessment needs to be conducted.

8.10.2.13 Links showing an increase of greater than 25% were assessed following the BNL calculation procedure within the Department of Transport (Welsh Office) Technical Memorandum Calculation of Road Traffic Noise (CRTN), 1988 to predict a dB change for each link. The calculation also incorporates a correction for mean traffic speed and the percentage of heavy vehicles.

8.10.2.14 Construction phase road link dB change was assessed using the impact magnitude criteria in **Table 8.25.** The thresholds for differentiating the criteria are taken from DMRB for short-term impacts and are an indication of the relative change in ambient noise as a result of the project.

Table 8.25: Magnitude Criteria for Relative Change Due to Road Traffic (Short Term)

Change in noise level ($L_{A10\,(18\,hour)}$ dB)	Impact magnitude
0.1 – 0.9	Negligible Impact
1.0 – 2.9	Minor Impact
3.0 – 4.9	Moderate Impact
5.0+	Major Impact

8.10.2.15 Paragraph 3.32 of DMRB states that:

> *"[peak particle velocity (PPV)] PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic".*

8.10.2.16 Vibration effects on buildings along the transport routes are, therefore, not considered further within this assessment.

Construction Phase Vibration Impact Magnitude

8.10.2.17 Ground-borne vibration can result from construction works and may lead to perceptible levels of vibration at nearby receptors, which at higher levels can cause annoyance to residents. In extreme cases, cosmetic or structural building damage can occur, however vibration levels must be of a significant magnitude for this effect to be manifested and such cases are rare.

8.10.2.18 High vibration levels generally arise from 'heavy' construction works such as piling, deep excavation, or dynamic ground compaction. The use of piling during the construction of the onshore substation may be required.

8.10.2.19 Annex E of BS 5228-2:2009+A1:2014 (BSI, 2014b) contains empirical formulae derived by Hiller and Crabb (2000) from field measurements relating to resultant PPV with a number of other parameters for vibratory compaction, dynamic compaction, percussive and vibratory piling, the vibration of stone columns and tunnel boring operations. Use of these empirical formulae enables resultant PPV to be predicted and for some activities (vibratory compaction, vibratory piling and vibrated stone columns) they can provide an indicator of the probability of these levels of PPV being exceeded.

8.10.2.20 The empirical equations for predicting construction-related vibration provide estimates in terms of PPV. Therefore, the consequences of predicted levels in terms of human perception

and disturbance can be established through direct comparison with the BS 5228-2:2009+1A:2014 guidance vibration levels.

8.10.2.21 Ground-borne vibration assessments may be drawn from the empirical methods detailed in BS 5228-2:2009+1A:2014, in the Transport and Road Research Laboratory (TRRL) report 246: Traffic induced vibrations in buildings, and within the Transport Research Laboratory (TRL) Report 429 (2000): Ground-borne vibration caused by mechanical construction works.

8.10.2.22 It is noted that these calculation methods rely on detailed information, including the type and number of plants being used, their location and the length of time they are in operation. Given the mobile nature of much of the plant that has the potential to impart sufficient energy into the ground, and the varying ground conditions in the immediate vicinity of the construction works, it was considered that an accurate representation of vibration conditions using these predictive methods was not possible.

8.10.2.23 Consequently, a series of calculations, following the methodologies referred to above, were carried out based on typical construction activities that have the potential to impart sufficient energy into the ground, applying reasonable worst-case assumptions in order to determine set-back distances at which critical vibration levels may occur.

8.10.2.24 Humans are very sensitive to vibration, which can result in concern being expressed at energy levels well below the threshold of damage. Guidance on the human response to vibration in buildings is found in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting.

8.10.2.25 BS 6472 describes how to determine the vibration dose value (VDV) from frequency-weighted vibration measurements. VDV is defined by the following equation:

$$VDV_{b/d,\ day/night} = (\int_0^T a^4(t)dt)^{0.25}$$

8.10.2.26 The VDV is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

8.10.2.27 BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

8.10.2.28 BS 6472 contains a methodology for assessing the human response to vibration in terms of either the VDV, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as PPV. The VDV is determined over a 16-hour daytime period or 8-hour night-time period.

8.10.2.29 The response of a building to ground-borne vibration is affected by the type of foundation, ground conditions, the building construction and the condition of the building. For

construction vibration, the vibration level and effects detailed in **Table 8.26** were adopted based on BS 5228-2:2009+1A:2014. Limits for transient vibration, above which cosmetic damage could occur, are given numerically in terms of PPV.

Table 8.26: Transient Vibration Guide Values for Cosmetic Damage.

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4Hz to 15Hz	*15Hz and above*
1	Reinforced or framed structures Industrial and heavy commercial buildings	50mms^{-1} at 4Hz and above	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15mms^{-1} at 4Hz increasing to 20mms^{-1} at 15Hz	20mms^{-1} at 15Hz increasing to 50mms^{-1} at 40Hz and above

8.10.2.30 **Table 8.27** lists the minimum set-back distances at which vibration levels of reportable significance for other typical construction activities may occur. BS 5228-2:2009+1A:2014 calculation methods were used to derive the set-back distances outlined in **Table 8.27**.

Table 8.27: Predicted Distances at Which Vibration Levels May Occur.

Name	Set-back distance at which vibration level (PPV) occurs			
	0.3 mm/s	*1.0 mm/s*	*10 mm/s*	*15 mm/s*
Vibratory Compaction (Start-up)	166m	65m	9m	6m
Vibratory Compaction (Steady State)	102m	44m	8m	6m
Percussive Piling	48m	19m	3m	2m
HGV Movement* on uneven Haul Route	277m	60m	3m	2m

*Vibration level based on a HGV moving at 5mph

8.10.2.31 **Table 8.28**, reproduced from research (Rockhill et al., 2014), details minimum safe separation distance for piling activities from sensitive receptors to reduce the likelihood of cosmetic damage occurrence.

Table 8.28: Receptor Proximity for Indicated Piling Methods.

Building type (limits on vibrations from Eurocode 3)	Piling Method		
	Press-in	*25kJ drop hammer*	*170 kW 27Hz vibrohammer*
Architectural merit	2.6m	29.6m	27.7m
Residential	0.5m	11.8m	13.8m

Building type (limits on vibrations from Eurocode 3)	Piling Method		
	Press-in	*25kJ drop hammer*	*170 kW 27Hz vibrohammer*
Light commercial	0.14m	5.9m	5.5m
Heavy industrial	0.06m	3.9m	3.7m
Buried services	0.03m	2.9m	2.2m

8.10.2.32 For construction vibration from sources other than blasting, the vibration level and effects presented in **Table 8.29** were adopted based on Table B-1 of BS 5228-2:2009+1A:2014. These levels and effects are based on human perception of vibration in residential environments.

Table 8.29: Construction Vibration - Impact Magnitude.

Vibration limit PPV (mm/s)	Interpreted significance to humans	Impact magnitude
< 0.3	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction	Negligible Impact
0.3 to 1.0	Vibration might just be perceptible in residential environments	Minor Impact
1.0 to <10.0	It is likely that vibration at this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	Moderate Impact
>10.0	Vibration is likely to be intolerable for any more than a brief exposure to this level	Major Impact

Operational Phase Noise Impact Magnitude

8.10.2.33 Where there are noise sources such as fixed plant associated with onshore assets, the most appropriate assessment guidance is BS 4142:2014 (BSI,2014c). The guidance describes a method of determining the level of noise of an industrial noise source and the existing background noise level.

8.10.2.34 BS 4142:2014 (BSI,2014c) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident, and combines procedures for assessing the impact in relation to sound from:

- industrial and manufacturing processes;
- fixed installations which comprise mechanical and electrical plant and equipment;
- the loading and unloading of goods and materials at industrial and/or commercial premises; and

- mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

8.10.2.35 This standard is applicable to the determination of the following levels at outdoor locations:

- *"a) rating levels for sources of sound of an industrial and/or commercial nature; and*
- *b) ambient, background and residual sound levels, for the purposes of:*
  - *investigating complaints;*
  - *assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and*
  - *assessing sound at proposed new dwellings or premises used for residential purposes."*

8.10.2.36 The standard incorporates a requirement for the assessment of uncertainty in environmental noise measurements and introduces the concepts of "*significant adverse impact*" rather than likelihood of complaints. Common principles with the previous edition are the consideration of the characteristics of the sound under investigation, time of day and frequency of occurrence.

8.10.2.37 The standard applies to industrial/commercial and background noise levels outside residential buildings and for assessing whether existing and new industrial/commercial noise sources are likely to give rise to significant adverse impacts on the occupants living in the vicinity.

8.10.2.38 Assessment is undertaken by subtracting the measured background noise level from the rating level; the greater this difference, the greater the magnitude of the impact.

8.10.2.39 BS 4142:2014 (BSI,2014c) refers to the following:

- *"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 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".*

8.10.2.40 When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. Section 9.1 of BS 4142:2014 (BSI,2014c) states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where

such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."

8.10.2.41 An operational assessment in accordance with BS 4142:2014 (BSI,2014c) has been undertaken for the OnSS (including the EBI) as it is the only noise source associated with the operation and maintenance phase. Due to the separation distance and existing ambient soundscape no penalty corrections for intermittency, tonality or impulsivity have been included. These acoustic features are added based on perceptibility at the receptor location.

8.10.2.42 The determination of the specific sound level free from sounds influencing the ambient sound at the assessment location is obtained by measurement or a combination of measurement and calculation. This is to be measured in terms of the $L_{Aeq,T}$, where 'T' is a reference period of:

- 1 hour during daytime hours (07:00 to 23:00 hours); and
- 15 minutes during night-time hours (23:00 to 07:00 hours).

8.10.2.43 The assessment of noise from proposed fixed plant associated with the project was considered at the nearest receptors.

8.10.2.44 To predict the noise from the operational aspects of the project, SoundPLAN noise modelling software was utilised. The model incorporated proposed fixed plant associated with the project. The model also included nearby residential dwellings and other buildings in the onshore project area, intervening ground cover and topographical information.

8.10.2.45 Noise levels for the operational phase were predicted at the same NSR locations detailed in **Section 8.7.2**. The calculation algorithm described in ISO 9613 was used in the operational noise propagation modelling exercise.

8.10.2.46 The magnitude of impacts that will be applied to the operational assessment, based on a quantitative assessment of noise impact using BS 4142:2014 (BSI,2014c), are summarised in **Table 8.30**.

Table 8.30: Substation Operational Noise Impact Magnitude Criteria.

BS4142 Rating level (LAr, Tr dB)	BS4142 Impact magnitude
<3 dB above L90 dBA	Negligible Impact
> L90 dBA + >3 dB to <5 dB	Minor Impact
> L90 dBA + >5 dB to 9.9 dB	Moderate Impact
L90 dBA + ≥10 dB	Major Impact

8.10.2.47 Noise levels associated with any maintenance activities are not expected to be greater than the noise of the operational substation itself. Therefore, specific reference to maintenance activity is not considered further in this assessment.

8.10.2.48 The significance of the effect upon noise and vibration sensitive receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in **Table 8.31**. Where a range of significance of effect is presented in **Table 8.31** the final assessment for each effect is based upon expert judgement.

8.10.2.49 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Table 8.31: Matrix used for the assessment of the significance of the effect

		Magnitude of Impact/Degree of Change			
		Negligible	**Minor**	**Moderate**	**Major**
Value, Importance, Sensitivity	**Low**	Not Significant	Not Significant or Minor (Not Significant)	Minor (Not Significant)	Minor (Not Significant) or Moderate (Significant)
	Medium	Not Significant	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant) or Major (Significant)
	High	Not Significant	Minor (Not Significant) or Moderate (Significant)	Moderate (Significant) or Major (Significant)	Major (Significant) or Substantial (Significant)
	Very High	Not Significant	Moderate (Significant) or Major (Significant)	Major (Significant) or Substantial (Significant)	Substantial (Significant)

8.11 Impact assessment

8.11.1 Construction

8.11.1.1 The noise and vibration impacts of the onshore construction of Hornsea Four have been assessed. The environmental impacts arising from the construction of Hornsea Four are listed in **Table 8.32** to **Table 8.36** along with the MDS against which each construction phase impact has been assessed.

8.11.1.2 A description of the potential noise and vibration effect receptors caused by each identified impact is given below.

Indicative temporary works area - Temporary noise and vibration from HDD works and other trenchless technologies (NV-C-2)

AND

Landfall, nearshore and intertidal area - Temporary noise and vibration from cable installation works. (NV-C-3)

8.11.1.3 These two effects are assessed jointly as they share the same MDS and assessment method.

Magnitude of impact

Noise

8.11.1.4 As a MDS, HDD has been assumed to be in operation at the HDD locations for 24 hours a day and assessed accordingly; for all other construction activities at the landfall and onshore ECC the assessment is based on construction between the hours of 07:00 to 18:00 Monday to Friday and 07:00 to 13:00 Saturday.

8.11.1.5 Whilst HDD activities have been assessed as operational 24 hours a day this would be an extremely rare occurrence (if at all). Commitment Co 36 details the commitment to daytime working hours only, except in particular circumstances.

8.11.1.6 HDD activities would be planned to occur during working hours (as detailed in Co 36); HDD would only occur outside of these hours should an unforeseen overrun occur.

8.11.1.7 **Table 8.32** presents the predicted noise level due to HDD at the nearest residential receptors to the landfall.

Table 8.32: Landfall Construction Noise for Hornsea Four – Predicted Impacts HDD.

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude
LFR1	Daytime	A (65)	34.6	Negligible
	Evening	A (55)	34.6	Negligible
	Night	A (45)	35.3	Negligible
LFR2	Daytime	A (65)	41.4	Negligible
	Evening	A (55)	41.4	Negligible
	Night	A (45)	42.0	Negligible
LFR3	Daytime	A (65)	27.2	Negligible
	Evening	A (55)	27.2	Negligible
	Night	A (45)	27.2	Negligible

8.11.1.8 For receptors along the onshore ECC the closest receptor (CCR11) to the ECC 80m wide corridor/HDD/Joint bay locations has been chosen to represent the potential worst-case impacts. Table 8.33 presents the predicted noise level at the nearest residential receptors to the ECC corridor.

Table 8.33 ECC Construction Noise for Hornsea Four – Predicted Impacts HDD.

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude	Worst Case Impact Significance
CCR11	Daytime	A (65)	58.4	Negligible	Negligible
	Evening	A (55)	58.4	Medium	Moderate
	Night	A (45)	58.9	High	**Major**

8.11.1.9 The results show that predicted noise levels from construction works for Hornsea Four at the landfall location are below the derived threshold limits.

8.11.1.10 Along the ECC corridor the noise levels from construction works are predicted to be below the threshold during the daytime and above the threshold during the evening and night.

8.11.1.11 The impact at landfall receptors is predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**. Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (Table 8.31; Volume 1, Chapter 5: EIA Methodology) and is not considered further in this assessment.

8.11.1.12 The impact at onshore ECC receptors is predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible** during the daytime, **moderate** during the evening and **major** during the night. This is based on the closest receptor (CCR11)

8.11.1.13 As identified above, HDD activities would be planned to occur during working hours (as detailed in Co 36); HDD would only occur outside of these hours should an unforeseen overrun occur due to site specific causes.

Vibration

8.11.1.14 Operation of HDD rigs and ancillary equipment is expected to produce the greatest vibration impacts and is therefore taken forward as the MDS for the vibration assessment.

8.11.1.15 Vibration levels decay very rapidly with distance from a source (BS 5228-2:2009+A1:2014). A representative example of HDD given within BS 5228-2:2009+A1:2014 (BSI, 2014b) is for boring through silts overlying sandstone with a PPV of 8 mm/s at 4.5m from the source, decreasing to a PPV of 2.7mm/s at 7m from the source and 1.8mm/s at 12m from the source.

8.11.1.16 Given the distances between sources of vibration (commitment Co 133, Co 134 and Co 135) during the construction works and the NSRs it is clear that PPV levels would be below the criteria outlined in **Table 8.29** at the NSRs along the proposed onshore development area. Vibration impacts from construction works would be of negligible magnitude. Therefore, no additional mitigation is required.

8.11.1.17 Vibration impacts from construction works would be of **negligible** magnitude. Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (**Table 8.31**; **Volume 1, Chapter 5: EIA Methodology**) and is not considered further in this assessment.

Sensitivity of the receptor

8.11.1.18 The receptors at landfall and along the onshore ECC are deemed to be of **medium** sensitivity.

Significance of the effect

8.11.1.19 Overall, it is predicted that the sensitivity of the receptors is **medium**, and the magnitude is **negligible** to **major**. The effect is generally **not significant** with the potential, during unforeseen overruns to HDD during evening and night time, for effects of **major adverse** significance, which are significant in EIA terms.

Further mitigation

8.11.1.20 During the night and evening at the closest receptor to the onshore ECC significant effects are predicted, albeit only infrequently should HDD overruns occur. Subject to a site by site appraisal to ascertain potential significant impacts at other receptors, the following good construction practice will be applied as mitigation measures (secured via Co124 and Co123) at those locations where the potential for a significant impact is present:

- Informing local residents about the construction works, including the timing and duration of any particularly noisy elements, and providing a contact telephone number to them;
- Avoiding operating particularly noisy equipment at the beginning and end of the day;
- Keeping potentially noisy deliveries, such as skips and concrete, to the middle or less sensitive times of the day where possible;
- Locating noisy static plant, such as diesel generators, away from residential properties;
- Using the most modern equipment available and ensuring equipment is properly maintained; and
- Where possible, using silencers/mufflers on equipment and acoustic barriers (Co123).

8.11.1.21 Although the combined effect of adopting such methods cannot be quantified, it is expected that these methods would reduce noise levels by some 5 – 10 dB.

8.11.1.22 Careful scrutiny of plant selection at procurement stage would ensure that the associated noise impact of the aforementioned plant is reduced as much as reasonably possible.

8.11.1.23 In order to ensure impacts are mitigated as far as reasonably possible at locations where a potential significant impact is identified the aforementioned good practice mitigation, coupled with more site-specific solutions such as the use of screening and temporary noise barriers will be applied.

8.11.1.24 As an example of the relative effectiveness of applying a temporary localised noise barrier BS 5228 states:

"as a working approximation, if there is a barrier or other topographic feature between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10 dB when the noise screen completely hides the sources from the receiver. High topographical features and specifically designed and positioned noise barriers could provide greater attenuation."

8.11.1.25 There are a number of 'best practice' measures that should always be implemented to minimise vibration impacts while retaining productive efficiency. Examples include:

- choosing alternative, lower impact equipment or methods wherever possible;
- scheduling the use of vibration-causing equipment, at the least sensitive time of day;

- routing, operating or locating high vibration sources as far away from sensitive areas as possible;
- sequencing operations so that vibration-causing activities do not occur simultaneously;
- isolating the equipment causing the vibration on resilient mounts; and,
- keeping equipment well maintained.

8.11.1.26 Following application of mitigation, residual impacts are predicted to be **not significant**.

Temporary noise and vibration from constructing the jointing bays (NV-C-4)

Magnitude of impact

8.11.1.27 Table 8.34 presents the predicted noise level due to Jointing Bay construction at the nearest residential receptor to the onshore ECC

Table 8.34: Onshore ECC Construction Noise proposed Hornsea Project Four – Predicted Impacts Joint Bay construction.

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude
CCR11	Daytime	A (65)	56.7	No Impact

8.11.1.28 The results show that predicted noise levels from Joint Bay construction works during the proposed Hornsea Project Four at onshore ECC locations are below the derived threshold limits and are therefore considered to be of **negligible** magnitude. Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (Table 8.31; Volume 1, Chapter 5: EIA Methodology) and is not considered further in this assessment.

Temporary noise and vibration from construction of the onshore substation (NV-C-6)

Magnitude of impact

8.11.1.29 Table 8.35 presents the predicted noise level due to construction of the OnSS at the nearest residential receptors. Piling of pre-cast concrete piles has been included as MDS and has been assessed at a minimum distance of 180m from residential receptors (Co169).

Table 8.35: OnSS Construction Noise from Hornsea Four – Predicted Impacts.

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude
SSR1	Daytime	A (65)	45.9	Negligible
SSR2	Daytime	A (65)	46.0	Negligible
SSR3	Daytime	A (65)	50.9	Negligible
SSR4	Daytime	A (65)	64.4	Negligible
SSR5	Daytime	A (65)	57.7	Negligible
SSR6	Daytime	A (65)	56.6	Negligible
SSR7	Daytime	A (65)	51.6	Negligible
SSR8	Daytime	A (65)	47.3	Negligible

8.11.1.30 Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (Table 8.31; Volume 1, Chapter 5: EIA Methodology) and is not considered further in this assessment.

8.11.1.31 However, during detailed design, and within the EIA process, more detailed information regarding the construction programme, plant, phasing and duration will be available and additional assessment will be undertaken.

Further mitigation

8.11.1.32 The effect is Not Significant and will not generally require further mitigation. However, subject to further assessment during the EIA process, and with greater detail of the construction methodology, mitigation may be proposed.

Traffic noise (NV-C-7)

8.11.1.33 Table 8.36 shows road links identified as carrying construction traffic. Only road links likely to experience an increase in traffic flows greater than 25% have been assessed further by undertaking calculations of BNL. Assessment against the 2023 baseline is presented in Table 8.36. This is considered the MDS year for assessment as this is the earliest year for the start of construction so provides for the baseline with lowest predicted noise without the Hornsea Four construction traffic. Any later years would have higher baseline traffic flows and therefore a lesser impact magnitude.

Table 8.36: Calculated BNL – 2023 Baseline vs. 2023 Baseline and Hornsea Four Traffic.

Link ID	Description	2024 Baseline BNL, dBA L10,18hr	2024 Baseline and the proposed Hornsea Project Four BNL, dBA, L10,18hr	Overall Change dBA	Impact Magnitude
2	Unnamed Road running south in Fraisthorpe	53.1	55.4	2.3	Minor
3	Unnamed Road from its junction with A165 south of Fraisthorpe	53.1	55.5	2.4	Minor
5	A165 - Bridlington Road	72.1	72.4	0.3	Negligible
6	A165 - New Cut	71.9	72.2	0.3	Negligible
7	A165 - New Cut	71.2	71.6	0.4	Negligible
8	A165 - Lissett Lane / Bridlington Road	71.2	71.6	0.4	Negligible
9	B1249 - Main Street	60.2	61.1	0.9	Negligible
10	Foston Lane / Old Howe Lane	56.3	59.8	3.5	Moderate
11	B1249 - North Frodingham Road	67.7	68.0	0.3	Negligible
12	B1249 - Main Street	62.5	62.8	0.3	Negligible
13	B1249 - Church Lane	67.7	68.0	0.3	Negligible
14	Cruckley Lane / Cowslam Lane	58.7	61.2	2.5	Minor
15	Sheepdike Lane	58.7	61.0	2.3	Minor
16	Old Howe Lane	56.3	59.8	3.5	Moderate
17	Long Lane	56.3	57.8	1.5	Minor
18	Gambling Lane	56.3	57.8	1.5	Minor
19	Out Gates	56.3	57.8	1.5	Minor
20	B1249	67.7	68.2	0.4	Negligible
21	B1249	67.7	68.1	0.4	Negligible
22	B1249	62.5	62.8	0.3	Negligible
23	B1249 - Wansford Road	69.0	69.2	0.2	Negligible
24	B1249 - Wansford Road / Scarborough Road	63.8	64.0	0.2	Negligible
25	Brigham Lane	53.5	54.5	1.0	Negligible
30	Station Road / Main Street	60.1	60.5	0.4	Negligible
32	Maeggison's Turnpike	65.3	65.7	0.4	Negligible
33	Corpslanding Road / Rotsea Lane	58.7	59.9	1.1	Minor
34	Carr Lane / Church Lane	56.2	58.0	1.8	Minor
35	Church Lane	56.2	58.0	1.8	Minor
36	A164 - Beverly Road	70.2	70.5	0.3	Negligible
37	A164 - Beverly Road	70.2	70.5	0.3	Negligible
38	Wilfholme Road	50.3	54.1	3.7	Moderate
39	A164	71.4	71.8	0.4	Negligible
40	Beswick Road / Barfhill Causeway	47.0	53.0	6.0	Major
41	AA164	71.4	71.8	0.4	Negligible

Link ID	Description	2024 Baseline BNL, dBA L10,18hr	2024 Baseline and the proposed Hornsea Project Four BNL, dBA, L10,18hr	Overall Change dBA	Impact Magnitude
42	Station Road	56.3	57.9	1.6	Minor
43	Station Road	59.6	60.6	0.9	Negligible
44	A164	71.4	71.8	0.4	Negligible
45	A164 Main Street	65.4	65.8	0.4	Negligible
47	Unnamed Road west of junction with A164 to Old Road	67.3	67.8	0.6	Negligible
49	Miles Lane	67.3	67.8	0.5	Negligible
51	A1035 - Constitution Hill	70.4	70.8	0.4	Negligible
52	Beverly Northern Bypass	70.4	70.8	0.4	Negligible
53	A1035 - Dog Kennel Lane	71.9	72.2	0.4	Negligible
54	A1174	69.5	69.8	0.3	Negligible
55	A1079	76.4	76.7	0.3	Negligible
56	Newbald Road	60.4	61.0	0.7	Negligible
57	Killingwoldgraves Lane / Coppleflat Lane	66.5	67.1	0.6	Negligible
59	Coppleflat Lane	66.5	67.0	0.5	Negligible
60	A164	75.3	75.7	0.3	Negligible
61	Unnamed Road south of Coppleflat Lane to junction with A164	65.3	66.0	0.7	Negligible
62	A164	75.3	75.7	0.3	Negligible
63	A164	75.2	75.5	0.3	Negligible
64	A165 - Beverly Road / Bridlington Road	65.9	66.4	0.5	Negligible
66	A165	75.6	75.9	0.3	Negligible
67	A165	75.6	75.9	0.3	Negligible
68	A1035	71.4	71.7	0.3	Negligible
70	A1174 - Swinemoor Lane	68.7	69.0	0.3	Negligible
71	A1174 - Hull Road	68.2	68.6	0.3	Negligible
72	Minster Way	70.0	70.4	0.4	Negligible
73	A164	71.9	72.2	0.3	Negligible
76	A164	75.3	75.7	0.3	Negligible
77	A164	73.6	73.9	0.3	Negligible
78	A164	74.2	74.7	0.5	Negligible
79	A164	74.2	74.7	0.5	Negligible
80	A15 - Boothferry Road	72.8	73.1	0.3	Negligible

Sensitivity of the receptor

8.11.1.34 The receptors adjacent to affected links are deemed to be of **medium** sensitivity.

Significance of the effect

8.11.1.35 Overall, it is predicted that the sensitivity of the receptor is medium. Of the 67 roads assessed, 50 are predicted to have a negligible magnitude, 11 minor, 3 moderate and only one of major magnitude. Only where the predicted magnitude is moderate or major (e.g. Beswick Road / Barfhill Causeway) is there a forecast effect of **moderate** (at three links) **to major adverse** (at one link) significance, which is significant in EIA terms. All other locations are forecast to have non-significant noise impacts from construction traffic.

Further mitigation

8.11.1.36 The effect is of moderate adverse significance at Foston Lane, Old How Lane and Wilfholme Road and of major adverse significance at Beswick Road / Barfhill Causeway and requires further mitigation.

8.11.1.37 Mitigation will be identified in a CTMP (secured by Co144), to manage the traffic flows and speeds, where appropriate along the affected link and hence reduce the impact magnitude and the relative noise change along these links. The mitigation measures will be agreed with ERYC between PEIR and DCO and will be presented in an Outline CTMP, within the Outline CoCP (**Volume F2, Chapter 2**). It should be noted that these links are in rural areas and, hence, do not have a large number of receptors in proximity.

8.11.1.38 As identified in **Chapter 7: Traffic and Transport**, the further mitigation may comprise measures such as:

- Travel planning for employees, e.g. promoting car-sharing;
- Use of an escort vehicle; or
- Committing to limiting Hornsea Four's traffic speeds or number of movements to acceptable levels, where appropriate.

8.11.1.39 Following mitigation residual impacts are predicted to be **not significant** to **minor adverse** significance.

Future monitoring

8.11.1.40 Mitigation measures and good practice will ensure that effects due to construction works and traffic are minimised. Future traffic noise monitoring is therefore not proposed.

8.11.2 Operation and Maintenance

8.11.2.1 The impacts of the onshore operation and maintenance of Hornsea Four have been assessed for noise and vibration. The environmental impacts arising from the operation and maintenance of Hornsea Four are listed in **Table 8.18** along with the MDS against which each operation and maintenance phase impact has been assessed.

Noise from the onshore substation (NV-O-8)

Magnitude of impact

8.11.2.2 The impact assessment has been undertaken using the unmitigated MDS for the various potential OnSS components, based on the fixed plant detailed in **Volume 1, Chapter 4: Project Description** and presented in **Table 8.18**.

8.11.2.3 Operations at the OnSS would be 24 hours a day. A detailed SoundPLAN noise model was created to assess noise levels comprising of the plant items set out in the MDS. Ground absorption was incorporated into the SoundPLAN model using a coefficient of 0.6 to represent the mixed ground between the sound sources and receiver for the topographical data.

8.11.2.4 Calculated operational noise levels have been determined at 1st Floor levels (as night time is considered the worst case and bedrooms are specifically targeted) and compared with the background noise levels at each receptor, which have been derived from the measured baseline noise data contained within **Table 8.14**.

8.11.2.5 The impact of the predicted noise levels from the OnSS at surrounding residential receptors are presented in **Table 8.37**. The magnitude of effects has been assessed in accordance with BS 4142:2014 (BSI,2014c). A tonality penalty of +6dB(A) (for highly perceptible tonality) has been added to the predicted noise level at locations SSR1 and SSR3 – SSR7 and +3dB(A) (for perceptible tonality) at location SSR8. At location SSR2 no penalty has been added as the predicted noise level is below the background noise level at this location therefore tonal elements would not be perceptible. Noise from the substation is neither intermittent nor impulsive in character, therefore no penalties for intermittency or impulsivity have been added.

8.11.2.6 The requirement for inclusion of tonality penalties will be developed and reviewed up to DCO throughout the detailed substation design process and may therefore be removed at future stages.

8.11.2.7 **Table 8.37** shows the maximum operational noise impact (i.e. during the night).

Table 8.37: Predicted Onshore Substation Operational Noise Impact – Night time.

Name	Receptor Sensitivity	Measured Background Noise Level (dBA)	Predicted Rating Noise Level Night time	Difference (dBA)	BS4142 Impact magnitude	Reduction to achieve max 5dB above background (dB)
SSR1	Medium	30	39.5	9.5	Moderate	>4.5
SSR2	Medium	34	32.4	-1.6	Negligible	n/a
SSR3	Medium	30	45.7	15.7	Major	>10.7
SSR4	Medium	31	56.6	25.6	Major	>20.6

Name	Receptor Sensitivity	Measured Background Noise Level (dBA)	Predicted Rating Noise Level Night time	Difference (dBA)	BS4142 Impact magnitude	Reduction to achieve max 5dB above background (dB)
SSR5	Medium	34	54.3	20.3	Major	>15.3
SSR6	Medium	29	51.3	22.3	Major	>12.3
SSR7	Medium	34	46.7	12.7	Major	>7.7
SSR8	Medium	34	37.4	3.4	Minor	n/a

8.11.2.8 Analysis of the individual source contributions at each receptor indicates that the dominant OnSS noise sources are the Shunt Reactors (220kV and 400kV), Harmonic Filters and Dynamic Reactive Compensation (DRC) Outdoor, with significant contribution also seen from the EBI Power Converters/33/04kV transformers (due to the large number of these items).

Sensitivity of the receptor

8.11.2.9 The receptors at the OnSS are deemed to be of **medium** sensitivity.

Significance of the effect

8.11.2.10 Overall, it is predicted that the sensitivity of the receptor is medium, and the magnitude, at its highest, is major. The effect is of **major adverse** significance, which is significant in EIA terms.

8.11.2.11 Overall, it is predicted that the sensitivity of the receptor is medium. Of the eight receptors assessed, one is predicted to have a negligible magnitude, one a minor, one a moderate and five a major magnitude. Only where the predicted magnitude is moderate or major (i.e. SSR1 and SSR3 to SSR7) is there a forecast effect of **moderate to major adverse** significance, which is significant in EIA terms. All other locations are forecast to have non-significant noise impacts from operation of the OnSS.

Further mitigation

8.11.2.12 The commitment (Co159) to limit operational noise from the OnSS to a maximum of 5dB above background ($L_{A90,T}$) ensures that impacts are reduced to, at most, **minor adverse**.

8.11.2.13 During detailed design of the OnSS, mitigation strategies, including the use of landscaped bunds, equipment selection to reduce/eliminate tonality and to reduce overall noise level of each contributing item of equipment, will be developed to ensure the operational noise commitment will be met. Further details will be set out in the ES following further design work and associated modelling.

Future monitoring

8.11.2.14 During initial operational activities of the OnSS a commissioning noise survey will be undertaken to establish the noise emissions from the OnSS.

8.11.3 Decommissioning

8.11.3.1 The impacts of the decommissioning of Hornsea Four have been considered on noise and vibration. The environmental impacts arising from the decommissioning of Hornsea Four are expected to be no greater than those for construction.

8.12 Cumulative effect assessment (CEA)

8.12.1.1 Cumulative effects can be defined as effects upon a single receptor from Hornsea Four when considered alongside other proposed and reasonably foreseeable projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment.

8.12.1.2 The overarching method followed in identifying and assessing potential cumulative effects in relation to the onshore environment is set out in **Volume 4, Annex 5.5: Onshore Cumulative Effects**. The approach is based upon the Planning Inspectorate (PINS) Advice Note 17: Cumulative Effects Assessment (PINS, 2017). The approach to the CEA is intended to be specific to Hornsea Four and takes account of the available knowledge of the environment and other activities around the PEIR boundary.

8.12.1.3 The CEA has followed a four stage approach developed from Advice Note 17. Each of the four stages is identified in **Table 8.38** along with commentary specifically relating to noise and vibration.

Table 8.38: Stages and activities involved in the CEA process

CEA stage	Activity
Stage 1 – Establish the project's Zone of influence (ZoI) and establish a long-list of developments	Through consultation it has been identified that potential developments that need considering as part of the onshore CEA are restricted to those within the ERYC area. To determine a 'long-list' of possible projects for inclusion in the CEA the following actions have been carried out: • Interrogation of the ERYC planning portal (latest review is May 2019); and • Discussion of potential projects for specific inclusion in the CEA at the Evidence Plan meetings. To date these processes have identified 17 potential projects which form the 'long-list'. In order to attribute an element of certainty to the assessment each project has been assigned a Tier reflecting their current status within the planning and development process.

CEA stage	Activity
	The full list of projects and relevant tiers assigned can be found in Appendix A of **Volume 4, Annex 5.5: Onshore Cumulative Effects.** The location of projects is shown in **Volume 4, Annex 5.6: Location of Onshore Cumulative Schemes**.
Stage 2 – Screening of long list: Identify a shortlist of other developments for the CEA	Developments within 2km of the Hornsea Four Boundary (OnSS) and 500m of the Hornsea Four Boundary (ECC and Landfall) have been considered within the CEA. It is considered unlikely that any direct significant effects outside of the 2 km buffer would occur given the impacts under assessment and the nature of this topic. Developments within the 2km buffer which show an overlap in terms of construction and/or operational stage with Hornsea Four have been considered.
Stage 3 – Information gathering	Where available information on the other developments within the shortlist generated at Stage 2 has been collated to inform the CEA. At this stage (PEIR) information is of high level unless explicitly discussed with ERYC. The information collected on each project is presented in **Volume 4, Annex 5.5: Onshore Cumulative Effects** with the location shown in **Volume 4, Annex 5.6: Location of Onshore Cumulative Schemes**.
Stage 4 - Assessment	The CEA has been undertaken in two stages: i) Each of the potential effects that are subject to assessment alone have been reviewed against the potential for cumulative effects to occur. ii) A CEA assessment of each of the other developments on the short-list has taken place for those effects where it is considered that potential cumulative impacts could occur. The assessment also includes, where relevant, consideration of any mitigation measures where adverse cumulative effects are identified and signposts to the relevant means of securing mitigation.

8.12.2 CEA Stage 2 Shortlist and Stage 3 Information Gathering

8.12.2.1 A reduced list of projects for CEA has been produced using the screening buffer/criteria set out in **Table 8.38**. Information regarding all projects is provided in **Volume 4, Annex 5.5: Onshore Cumulative Effects**. Summary information on the short-list projects for noise and vibration is provided below.

8.12.2.2 Four projects have been identified for inclusion on the short-list of projects to be assessed cumulatively. The remaining projects have not been considered as resulting in likely cumulative significant effects as they are located in excess of 2 km from the Hornsea Four OnSS boundary or 500m from the Hornsea Four ECC/Landfall Boundary or do not overlap in terms of construction and/or operational stage. The four projects can be summarised as:

- A highway improvement scheme; and

- A number of industrial/commercial projects located within 2 km of the OnSS including: storage and distribution; energy storage projects and onshore components of other offshore wind farm projects.

8.12.3 CEA Stage 3 Assessment

8.12.3.1 As stated in the previous table the assessment is undertaken in two stages:

- **Table 8.39** sets out the potential impacts assessed in this chapter and identifies the potential for cumulative effects to arise, providing a rationale for such determinations; and
- **Table 8.40** sets out the CEA for each of the projects/developments that have been identified on the short-list of projects screened.

8.12.3.2 It should be noted that stage 2 is only undertaken if stage 1 identifies that cumulative effects are possible. This summary assessment is set out in **Table 8.40.**

Table 8.39: Potential Cumulative Effects

Impact		Potential for Cumulative Effect?	Rationale
Construction			
1	Impact of construction noise and vibration on sensitive receptors.	Yes	Potential for cumulative noise and vibration impacts could occur if other developments which generate construction noise and vibration take place concomitantly with the construction phase of Hornsea Four.
Operation			
1	Impact of operational noise on sensitive receptors	Yes	Potential for cumulative noise impacts could occur if other developments which generate operational noise take place concomitantly with the operational phase of Hornsea Four.
Decommissioning			
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage. Additionally, PINS have stated in their Scoping Opinion that cumulative decommissioning effects are scoped out of the EIA.			

8.12.3.3 The second stage of the CEA is a project specific assessment of the potential for any significant cumulative effects to arise due to the construction and/or operation and maintenance of Hornsea Four. To identify whether this may occur each shortlisted project is discussed in **Table 8.40**.

Table 8.40: Project Screening for CEA Noise and Vibration

Project	Description	Location Description (relative to Hornsea Four PEIR Redline Boundary)	Discussion	Likelihood and Significance of Cumulative Effects
Jocks Lodge Highway Improvement Scheme	EIA Screening Opinion - A164 and Jocks Lodge Highway Improvement Scheme	Works occurring on the A1079. 700m northwest of Hornsea Four boundary access track.	The proximity of proposed project boundaries and the potential for construction activities concurrently with Hornsea Four construction may result in direct and / or indirect impacts on the receptors identified within the chapter. However, based on the assumption that appropriate mitigation measures (e.g. CEMP, CoCP)) were incorporated into the design, no cumulative impacts on the receptors identified are predicted.	No potential for cumulative effects during construction or operation.
Lawns Farm Park Battery Storage	Construction of a 49.5MW Battery Storage Facility (17 battery units) with associated infrastructure and landscaping	Works are located east of OnSS within the Hornsea Four boundary.	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified.	There is a potential for a cumulative impact associated with operational phase to occur during operation of the onshore substation in conjunction with other operational noise sources within the vicinity of the onshore substation. Implementation of appropriate mitigation within the detail design will ensure that any impacts will be of negligible significance.
Dogger Bank - Creyke Beck A	The consent application submitted allows for up to 400 wind turbines in total, therefore currently being split across the two phases.	Windfarm located 131km offshore. The converter station would be north of the A1709 between Beverley and Cottingham in the East	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified.	There is a potential for a cumulative impact (associated with operational phase) to occur during operation of the onshore substation in conjunction with other

Project	Description	Location Description (relative to Hornsea Four PEIR Redline Boundary)	Discussion	Likelihood and Significance of Cumulative Effects
	Project Capacity 1,000-1,200MW.			operational noise sources within the vicinity of the onshore substation. Implementation of appropriate mitigation within the detail design will ensure that any impacts will be of negligible significance.
Dogger Bank - Creyke Beck B	The consent application submitted allows for up to 400 wind turbines in total, therefore currently being split across the two phases. Project Capacity 1,000-1,200MW.	Windfarm located 131km offshore. The converter station would be north of the A1709 between Beverley and Cottingham in the East	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified.	There is a potential for a cumulative impact associated with operational phase to occur during operation of the onshore substation in conjunction with other operational noise sources within the vicinity of the onshore substation. Implementation of appropriate mitigation within the detail design will ensure that any impacts will be of negligible significance.

8.12.3.4 Cumulative effects during construction are considered unlikely. The potential for cumulative effects during operation of Hornsea Four from other noise sources in the vicinity of the project has been identified.

8.13 Transboundary effects

8.13.1.1 A screening of transboundary impacts has been carried out and is presented in Appendix K of the Environmental Impact Assessment: Scoping Report (Ørsted, 2018). This screening exercise identified that there was no potential for significant transboundary effects regarding noise and vibration from the onshore components of Hornsea Four upon the interests of other EEA States and this is not discussed further.

8.14 Inter-related effects

8.14.1.1 Inter-related effects consider impacts from the construction, operation or decommissioning of Hornsea Four on the same receptor (or group). The potential inter-related effects that could arise in relation to noise and vibration are presented in **Table 8.41**. Such inter-related effects include both:

- Project lifetime effects: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

8.14.1.2 A description of the process to identify and assess these effects is presented in Section 2 of **Volume 1, Chapter 5: EIA Methodology**. The basis for the identification of receptor led effects is the inter-related effects screening report supplied as Annex J to the Hornsea Four Scoping Report (Ørsted, 2018). Where necessary this has been updated in line with project details now available.

Table 8.41: Inter-related effects assessment for Noise and Vibration.

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Project-lifetime effects			
Construction, Operation and, decommissioning	Increases in noise and vibration as a result of construction, operation and decommissioning	Impacts at human receptors were not predicted to be significant for the construction or operational phase subject to appropriate mitigation. The decommissioning phase is not anticipated to give rise to impacts any greater in magnitude than those considered for construction.	Impacts associated with noise and vibration will only be experienced for the duration of each phase. The phases of the project cannot overlap temporally, therefore there is no potential for inter-related noise and vibration impacts to occur.
Receptor-led effects			
An inter-related effect due to the combination of noise, visual, air quality and traffic effects on human receptors			Due to concurrent multiple activities, the construction phase presents the most likely opportunity for receptor-led effects. A range of effective onshore construction phase mitigation is proposed as part of Hornsea Four, which would be implemented through the CoCP (Co124). An Outline CoCP has been provided as part of the PEIR (**Volume F2, Chapter 2**). Given the effectiveness of the mitigation proposed, many effects during construction would be negligible to minor adverse and not significant. These are detailed in the respective chapters. Construction effects would be temporary. Effects in relation to construction views, noise, traffic and dust are not predicted to be significant. The proposed measures would control construction effects as far as reasonably practicable. The highest level of significance has been assigned to visual effects during construction at the OnSS, which may be up to moderate adverse. The assessment is presented in **Chapter 4: Landscape and Visual**. Overall, whilst inter-related effects on residents may arise from some locations on a temporary basis, they are unlikely to exceed the level reported for visual effects (moderate adverse). On the basis of the assessment undertaken, with mitigation measures, construction noise effects are considered to be not significant. Overall, no inter-related effects across the project phases are anticipated.

8.15 Conclusion and summary

8.15.1.1 Table 8.42 presents a summary of the significant impacts assessed within this PEIR, any mitigation and the residual effects. In accordance with the assessment methodology, this table should only be used in conjunction with the additional narrative explanations provided in Section 8.11. which demonstrate that provided mitigation measures (both embedded and additional) are in place to prevent impacts on receptors from the project, potential impacts are anticipated to be **not significant** to **minor adverse** in relation to noise and vibration.

Table 8.42 Summary of potential impacts assessed for noise and vibration.

Impact and Phase	Receptor and value/sensitivity	Magnitude and significance	Mitigation	Residual impact
Construction				
Indicative temporary works area - temporary noise and vibration from HDD works and other trenchless technologies Landfall, nearshore and intertidal area - temporary noise and vibration from cable installation works. (NV-C-2, NV-C-3)	Landfall receptors, medium sensitivity	Negligible magnitude of impact Not significant	None proposed beyond existing Commitments (Co36, Co41, Co133, Co123, Co124)	Not significant
	Onshore ECC Receptors, medium sensitivity	Major (night) magnitude of impact Major adverse significance	Good practice construction mitigation (secured through Co124) including the use of localised screening (Co123).	Minor adverse
Temporary noise and vibration from constructing the jointing bays. (NV-C-4)	Landfall receptors, medium sensitivity	Negligible magnitude of impact Not significant	None proposed beyond existing Commitments (Co36, Co41, Co133, Co134, Co124)	Not significant
	Onshore ECC receptors, medium sensitivity	Negligible magnitude of impact Not significant		Not significant
Temporary noise and vibration from construction of the onshore substation. (Includes the temporary impacts of tubular steel piling (percussive piling) (NV-C-6)	OnSS receptors, medium sensitivity	Negligible magnitude of impact Not significant	None proposed beyond existing Commitments (Co36, Co124, Co169)	Not significant

Impact and Phase	Receptor and value/sensitivity	Magnitude and significance	Mitigation	Residual impact
Traffic noise (NV-C-7)	Receptors adjacent to traffic routes, medium sensitivity	Not Significant to Major adverse significance. (Of the 67 roads assessed, 50 are predicted to have a negligible magnitude of impact, 11 minor magnitude of impact, three moderate magnitude of impact and only one of major magnitude of impact).	None proposed beyond existing Commitments (Co135, Co144)	Minor adverse
Operation				
Noise from the onshore substation (NV-O-8)	OnSS receptors, medium sensitivity	Negligible to major magnitude of impact Not significant to major adverse significance	Equipment selection, screening, commitment to restrict noise to no more than 5dB above background (Co159)	Minor adverse

8.16 References

BSI (2003). British Standards Institution [BS] 7445-1:2003 - Description and measurement of environmental noise. Guide to quantities and procedures. BSI, London.

BSI (2003). British Standards Institution [BS] EN 61672-1:2003 Electroacoustics. Sound level meters. Specifications. BSI, London.

BSI (2008). British Standards Institution [BS] 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting, BSI, London.

BSI (2014a). British Standards Institution [BS] 5228-1:2009+A1:2014 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise".

BSI (2014b). British Standards Institution [BS] 5228-2:2009+A1:2014 "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration".

BSI (2014c). British Standards Institution [BS] 4142:2014 Methods for rating and assessing industrial and commercial sound, BSI, London.

BSI (2014d). British Standards Institution [BS] 8233: Sound Insulation and Noise Reduction for Buildings. BSI, London.

Department of Transport, Welsh Office (1988). Calculation of Road Traffic Noise. HMSO, London.

Environmental Protection Act (1990). HMSO, London.

Environment Agency (2004). Integrated Pollution Prevention and Control [IPPC] Version 3 Horizontal Guidance for Noise Part 2 – Noise Assessment and Control. Environment Agency, Bristol.

Highways Agency (2011). Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7: Noise and Vibration. The Highways Agency.

Hiller. DM and Crabb GI (2000). Ground borne vibrations caused by mechanised construction works. Highways Agency, Transport Research Laboratory, TRL report 429.

International Organization for Standardization (1996). ISO9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. ISO, Switzerland.

International Organization for Standardization (2010). ISO 3744:2010 Acoustics –Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for an essentially free field over a reflecting plane. ISO, Switzerland.

Ministry of Housing, Communities & Local Government (2018). National Planning Policy Framework. OGL, London.

Ørsted (2018). Hornsea Four Environmental Impact Assessment Scoping Report; available at: https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library

Rockhill D.J, Bolton M.D and White D.J (2014). Ground-borne vibrations due to press-in piling operations. Cambridge University Engineering Department.

Transport Research Laboratory (2000). Hiller D.M and Crabb G.I Groundborne vibration caused by mechanised construction works. TRL Report 429. Wokingham: TRL,2000.

Watts, GR (1990). Traffic induced vibrations in building. Department for Transport, Transport and Road Research Laboratory Research Report (TRRL), Research Report 246.

World Health Organization (2009). Night Noise Guidelines for Europe; available at URL: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf