Hornsea Project Four: Environmental Statement (ES)

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Volume A5, Annex 2.2: Water Framework Directive Assessment

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Glossary

Term	Definition
Commitment	A term used interchangeably with mitigation and enhancement measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or Environmental Statement (ES)). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
Ballast Water	Fresh or saltwater, sometimes containing sediments, held in tanks and cargo holds of ships to increase stability and manoeuvrability during transit.
Bathing Water	Fresh or sea waters in which bathing is either explicitly authorised or is not prohibited and is traditionally practised by a large number of bathers.
Entrainment	The entrapment of organisms in a waterbody.
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.
Intertidal	An area of seashore that is covered at high tide and uncovered at low tide.
Nutrient Sensitive Water	A designation of the Environment Agency for waters that are sensitive to pollution from macronutrients (i.e. nitrates and phosphates).
Order Limits	The limits within which Hornsea Four (the 'authorised project) may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Shellfish Water	Waters suitable for the cultivation of shellfish (e.g. cockles or oysters).
Subtidal	Area extending from below the low tide mark.

Acronyms

Acronym	Definition
AA	Annual Average
AEoI	Adverse Effect on Integrity
AfL	Agreement for Lease
BW	Bathing Water
BWD	Bathing Water Directive
cBWD	Current Bathing Water Directive
CFE	Controlled Flow Excavation
CPEMMP	Construction Project Environmental Management and Monitoring Plan
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EQSD	Environmental Quality Standards Directive

Acronym	Definition
ES	Environmental Statement
EU	European Union
HDD	Horizontal Directional Drilling
HMWB	Heavily Modified Waterbody
HRA	Habitats Regulation Assessment
IE	Intestinal *enterococci*
IMO	International Maritime Organisation
INNS	Invasive and Non-Native Species
LSE	Likely Significant Effect
MAC	Maximum Allowable Concentration
MAGIC	Multi-Agency Geographic Information for the Countryside
MDS	Maximum Design Scenario
MHWS	Mean High-Water Springs
MLWS	Mean Low Water Springs
MPCP	Marine Pollution Contingency Plan
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NSW	Nutrient Sensitive Water
O&M	Operation and Maintenance
OCNS	Offshore Chemical Notification Scheme
PAHs	Polycyclic Aromatic Hydrocarbons
PEIR	Preliminary Environmental Information Report
PINS	The Planning Inspectorate
PLONOR	Pose Little or No Risk to the Environment
RBMP	River Basin Management Plan
rBWD	Revised Bathing Water Directive
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SFW	Shellfish Water
SoS	Secretary of State
SPA	Special Protection Area
SPM	Suspended Particulate Matter
SSC	Suspended Sediment Concentration
WFD	Water Framework Directive
WTG	Wind Turbine Generator

Units

Unit	Definition
km	Kilometre
m	Metre
ml	Millilitre
nm	Nautical Mile
pH	Acidity

1 Introduction

1.1 Project Background

1.1.1.1 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop the Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four') which will be located approximately 69 km offshore from the East Riding of Yorkshire in the southern North Sea and will be the fourth project to be developed in the former Hornsea Zone (please see **Volume A1, Chapter 1: Introduction** for further details on the Hornsea Zone). Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to the landfall, and connection to the electricity transmission network (see **Volume A1, Chapter 4: Project Description** for full details on the Project Design). The location of Hornsea Four is illustrated in **Figure 1**.

1.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 846 km^2 at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project has due consideration to the size and location (within the existing AfL area) of the final project that is being taken forward to Development Consent Order (DCO) application. This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction.

1.1.1.3 The combination of Hornsea Four's Proportionality in EIA and Developable Area process has resulted in a marked reduction in the array area taken forward at the point of DCO application. Hornsea Four adopted a major site reduction from the array area presented at Scoping (846 km^2) to the Preliminary Environmental Information Report (PEIR) boundary (600 km^2), with a further reduction adopted for the Environmental Statement (ES) and DCO application (468 km^2) due to the results of the PEIR, technical considerations and stakeholder feedback. The evolution of the Hornsea Four Order Limits is detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**.

1.2 Aims and Objectives

1.2.1.1 This document has been prepared by GoBe Consultants Ltd to present the findings of the Water Framework Directive (WFD) Assessment for the potential impacts of the marine activities associated with Hornsea Four. This document details the assessment for the transitional and coastal WFD bodies. The Hornsea Four offshore Export Cable Corridor (ECC) crosses the Yorkshire South waterbody (GB640402491000) (see **Figure 1**). A separate WFD assessment has been prepared for onshore waterbodies and groundwater and is presented in **Volume A6, Annex 2.3: Water Framework Directive Compliance Assessment**.

1.2.1.2 This WFD assessment has drawn information from the Hornsea Four EIA and should be read in conjunction with:

- **Volume A1, Chapter 4: Project Description**;
- **Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes**;
- **Volume A2, Chapter 2: Benthic and Intertidal Ecology**;
- **Volume A2, Chapter 3: Fish and Shellfish Ecology**;

- **Volume A5, Annex 1.1: Marine Processes Technical Report**[1];
- **Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report**;
- **Volume A6, Annex 2.3: Water Framework Directive Compliance Assessment**; and
- **B2.2: Report to Inform Appropriate Assessment**.

1.3 Project Need and Objectives

1.3.1.1 Climate change is the defining challenge of our time. The impacts of climate change are global in scope and unprecedented in human existence. By definition, an emergency demands an immediate response.

1.3.1.2 Hornsea Four is a major renewable energy infrastructure project which responds to that imperative. It enacts fundamental and urgent national objectives articulated at the highest level in legislation and policy documents. That includes but is not limited to the Climate Change Act 2008, the Overarching National Policy Statement (NPS) for Energy (EN-1) and the NPS for Renewable Energy Infrastructure (EN-3) amongst others.

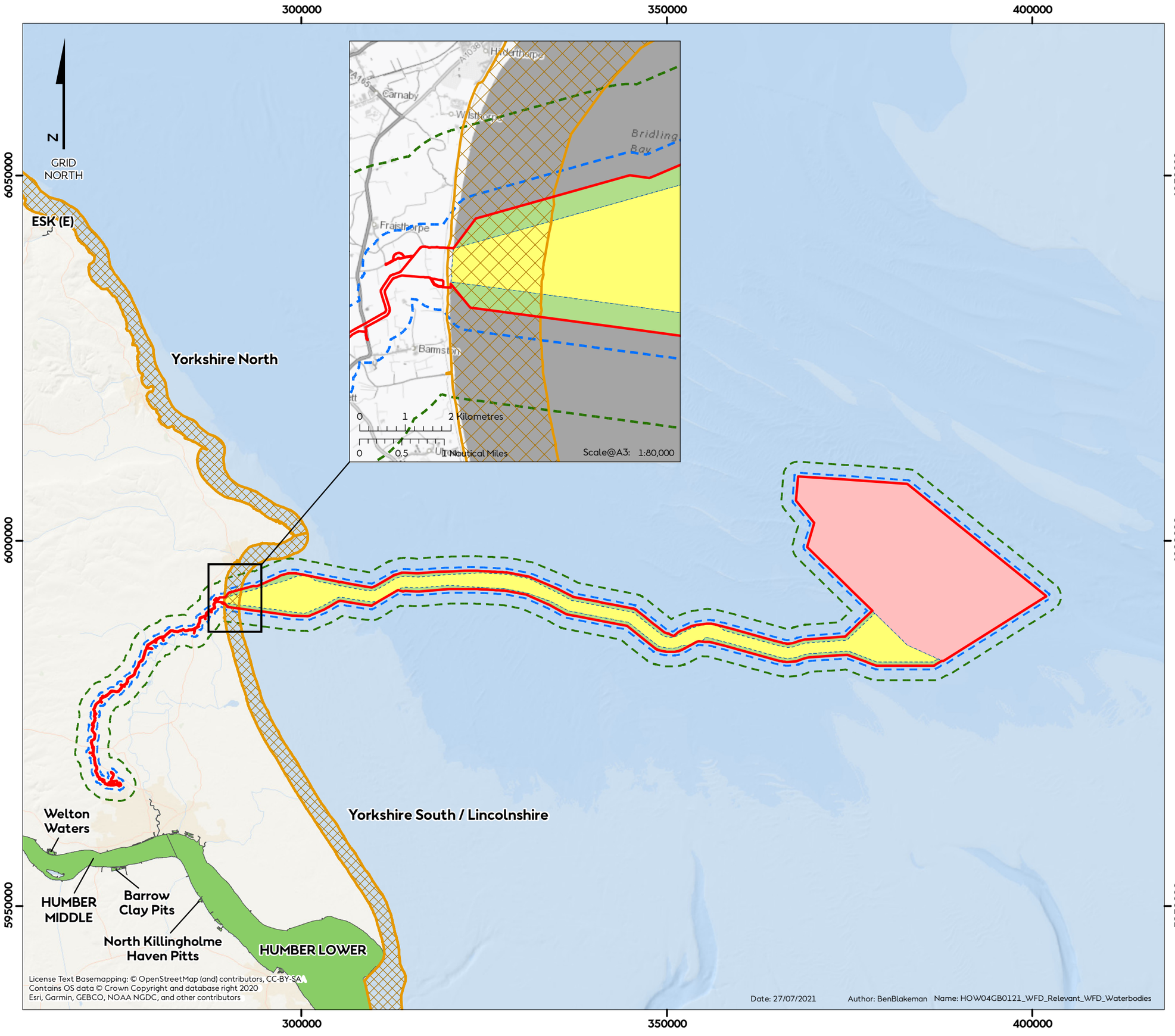
[1] This annex details the project-specific modelling undertaken to determine the fate of sediment plumes which has informed the findings of the EIA and this assessment.

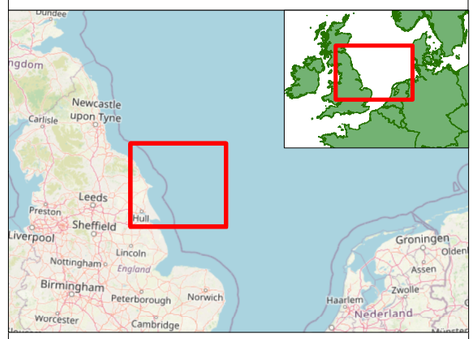
Hornsea Four

Figure 1

Relevant WFD waterbodies in relation to Hornsea Four and the assessment buffers

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area
- 500m Buffer from Order Limits
- 2km Buffer from Order Limits
- Water Framework Directive Coastal Waterbody
- Water Framework Directive Transitional Waterbody





Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:500,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
...	First Issue	26/06/2019
A	Updated following PEIR consultation, for DCO	27/07/2021

Relevant WFD Waterbodies in relation to Hornsea Four
Document no: HOW04GB0121
Created by: BPHB
Checked by: RM
Approved by: LK

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2 Policy and Legislative Context

2.1 Introduction

2.1.1.1 The following section provides information regarding the legislative context surrounding the assessment of potential effects in relation to the WFD.

2.2 Water Framework Directive

2.2.1.1 The European Union (EU) WFD (2000/60/EC) (hereafter referred to as the Directive) was established in 2000 in order to provide a single framework for the protection of surface waterbodies (including rivers, lakes, coastal waterbodies and estuaries) and groundwater. Each waterbody has an assigned ecological status which is assigned by considering the biological, hydromorphological and chemical environment of the waterbody. The different ecological statuses are:

- High;
- Good;
- Moderate;
- Poor; and
- Bad.

2.2.1.2 The Environment Agency is currently aiming to achieve 'good status' in as many waters as possible by 2027. 'Good status' comprises of two parts – the first is 'good ecological status' (or 'good ecological potential', for waterbodies classed as heavily modified or artificial), and the second is 'good chemical status'. 'Good ecological status/potential' includes biological, hydromorphological and physicochemical quality elements and specific pollutants, whereas 'good chemical status' concerns a series of priority substances (including priority hazardous substances). The Directive also requires that relevant protected area objectives are achieved (Environment Agency 2017).

2.2.1.3 The current WFD status, the pressures affecting the water environment, the objectives for protecting and improving it, and the programme of measures needed to achieve the statutory environmental objectives of the WFD for each waterbody were set out in the 2015 River Basin Management Plans (RBMPs). There are eight RBMPs which cover watercourses and coastal waterbodies in England and Wales. Hornsea Four is located within the Humber River Basin District RBMP (Environment Agency 2015) which has been reviewed to inform this assessment. This assessment aims to ensure that Hornsea Four complies with the requirements under the WFD which seeks to ensure there is no deterioration in quality (as presented in the Humber RBMP) of the protected areas and waterbodies.

2.2.1.4 The RBMPs are reviewed and updated every six years in England. It is understood at the time of writing that the RBMPs are currently being reviewed and updated. At the time of writing, it is anticipated that the draft River Basin Management Plans for consultation are anticipated in autumn 2021 (Environment Agency 2021).

2.2.1.5 Monitoring of the aquatic environment in relation to physical, chemical, and biological parameters started in 2006 with a view to ensuring a 'good ecological status' of all surface waterbodies. Chemical and biological environmental quality indicators are used, and a programme of measures is implemented in order to improve surface waters that do not meet the required status.

2.2.1.6 The Directives' objective of 'good chemical status' is defined in terms of compliance with all the quality standards, within the waterbody, as established for chemical substances at a European level. The Directive also provides a process for renewing these standards and establishing new ones by means of a prioritisation mechanism for hazardous chemicals. This will ensure at least a minimum chemical quality, particularly in relation to very toxic substances.

2.2.1.7 The Directives' objective of 'good ecological status' also requires certain chemical conditions. The chemical requirements include the achievement of environmental quality objectives for discharged priority substances. It also identifies any other substances liable to cause pollution or being discharged in significant quantities.

2.2.1.8 The Environmental Quality Standards Directive (EQSD) list[2] identifies priority substances and polluting chemical which should be considered in WFD assessments for transitional and coastal waterbodies. The Directive and EQSD seek to reduce these substances entering into the marine environment, primarily from discharges and outfalls. Priority substances include, but are not limited to benzene, nickel, and lead.

2.2.1.9 A WFD assessment of the potential for Hornsea Four to result in deterioration of status or prevent achievement of Good status has been undertaken using the Environment Agency's 'Clearing the Waters for All' guidance (Environment Agency 2017). This has been carried out based on the Hornsea Four information detailed in **Volume A1, Chapter 4: Project Description**.

2.2.1.10 This assessment is reliant upon identifying those effects that are non-temporary which, for the purposes of this assessment is defined as:

'A period of time that is greater than the recommended monitoring period interval as stated by the WFD (2000/60/EC).'

2.2.1.11 Different monitoring periods are defined for different parameters under the WFD. In this assessment, the monitoring period interval is aligned with that of the RBMP, which is understood to be six years.

2.3 WFD Regulations

2.3.1 Introduction

2.3.1.1 The UK left the European Union (EU) on 31 January 2020 and entered a period of transition that ended on 31 December 2020. The transition period is defined in the UK EU Withdrawal Act 2018 and the UK EU (Withdrawal Agreement) Act 2020 which transposed EU law into UK domestic law. References to Directives mean the Directive as applied in UK law by the Withdrawal Acts.

2.3.1.2 At the time of writing, the Environment Bill has not reached Royal Assent, having reached the committee stage in the House of Lords (as of 6th July 2021). The Environment Bill sets a new environmental governance framework as the UK leaves the European Union's environmental policy and legislative structures. The Bill is substantial, and when Royal Assent is granted it is anticipated to set in law significant new governance structures for

[2] https://www.gov.uk/government/publications/list-of-chemicals-for-water-framework-directive-assessments/environmental-quality-standards-directive-eqsd-list-for-wfd-assessments

managing and improving the environment together with more specific measures on waste and resources, air quality, water, and nature and biodiversity. With regards water quality, it is anticipated that the Environment Bill will provide powers to enable the Secretary of State (SoS) to maintain the list of priority substances used to assess the chemical status of water bodies in line with the latest scientific and technical knowledge, as has previously been carried out under the WFD.

2.3.1.3 As the Bill may come into force during the pre-application phase of Hornsea Four, a summary of the current policy and legislation is provided in the sub-sections below. At the time of the Development Consent Order (DCO) Application, the Applicant will ensure that the WFD assessment adheres to the relevant UK legislation.

2.3.2 Overview

2.3.2.1 The Directive was transposed into English and Welsh law by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 2017 Regulations). The 2017 Regulations assign responsibility to the Secretary of State (SoS) and the Environment Agency to secure compliance with the WFD in England by exercising their 'relevant functions'. As Hornsea Four is a Nationally Significant Infrastructure Project (NSIP), the Examining Authority will need to report to the SoS on the effects of Hornsea Four on the relevant RBMP (Humber) and ensure that the sufficient information is available for the SoS to determine whether the proposed development will have implications on the obligations of the UK under the WFD.

2.4 Requirement to Consider the WFD in the Context of the Planning Act 2008

2.4.1.1 Consideration of the Directive is required for any DCO application. Consideration is specifically required for NSIPs, under various NPSs including EN-1, to assess and provide sufficient information on any potential impacts arising from the proposed development on the waterbodies or protected areas under the Directive (and daughter directives). The SoS, the Environment Agency and other public bodies have a specific duty to have regard to the relevant RBMPs in exercising their functions, including the determinations of applications under the Planning Act 2008. This assessment has been prepared to provide information on the potential for Hornsea Four to cause deterioration within transitional and coastal waterbodies (including the ecological and chemical status of a waterbodies) or the potential to compromise improvements which might otherwise lead to a waterbody meeting its Directive objectives.

2.5 Protected areas

2.5.1.1 Under the WFD, member states are required to establish a register of protected areas. Protected areas for the purposes of WFD include:

- Bathing Waters;
- Shellfish Waters;
- Nutrient-sensitive areas, including areas identified as Nitrate Vulnerable Zones (NVZs) under the Nitrates Directive or areas designated as sensitive under Urban Waste Water Treatment Directive (UWWTD); and
- Relevant National Site Network sites; and
- Drinking Water Protected Areas.

2.5.2 Shellfish Waters Directive (SWD)

2.5.2.1 The Directive incorporates the requirements of the Shellfish Waters Directive which aims to protect and improve water quality, support the growth of healthy shellfish, and contribute to good quality edible shellfish. The original Directive 'Council Directive 79/923/EEC of 30th October 1979 on the quality required of Shellfish Waters (SFWs) as amended by Council Directive 91/692/EEC (further amended by Council Regulation 1882/2003/EC)', known as the Shellfish Waters Directive, was designed to protect the aquatic habitats of bivalve and gastropod molluscan species of shellfish. It sets out standards for various parameters that should be monitored in designated shellfish areas. It has since been superseded by 'Directive 2006/113/EC of the European Parliament and of the Council of 12th December 2006 on the quality required of shellfish waters'.

2.5.2.2 The identification of SFWs within 2 km of Hornsea Four is presented in **Section 6.2** of this annex.

2.5.3 Bathing Water Directive (BWD)

2.5.3.1 The EU's revised Bathing Water Directive (rBWD) came into force in March 2006 and replaced the 'current Bathing Water Directive (cBWD)' (76/1160/EEC). The rBWD provides more stringent standards than the cBWD and places an emphasis on providing information to the public.

2.5.3.2 The rBWD has four different classifications of performance, these are:

- Excellent – the highest, cleanest class;
- Good – generally good water quality;
- Sufficient – the water meets minimum standards; and
- Poor – the water has not met the minimum required standards.

2.5.3.3 The Environment Agency measures, monitors, and reports the number of certain types of bacteria which may indicate the presence of pollution, mainly from sewage or animal faeces, these are *Escherchia coli* (*E. coli*) and intestinal *enterococci* (IE). An increase in the concentrations of these bacteria indicates a decrease in water quality. **Table 1** presents the microbiological standards for the different types of bacteria under the rBWD.

Table 1: rBWD classifications.

Classification	E. Coli		IE	
	No. per 100 ml	Percentile*	No. per 100 ml	Percentile*
Excellent	250	95	100	95
Good	500	95	200	95
Sufficient	500	90	185	90
Poor	>500	90	>185	90

2.5.3.4 The Environment Agency collects approximately 20 samples from each Bathing Water (BW) each year during the bathing season (15th May to 30th September in England). An overall classification for the BW is then determined by creating a distribution from the monitoring

data for the last four years (4 years x 20 samples = distribution of 80 samples)[3]. A separate distribution is calculated for both *E. coli* and IE. The 95th and 90th percentile values[4] from each distribution are calculated. This then enables the determination of the classification for each bacterium for the BW. Therefore, activities from Hornsea Four have the potential to affect the BW classifications for up to four bathing seasons after the proposed activities commence.

2.5.3.5 If the classification for both types of bacteria is different, then the overall compliance of the BW is the lowest classification achieved by either type. For example, if E. coli were performing at 'Good' but IE was performing at 'Sufficient', then the BW would be classified as performing at 'Sufficient'.

2.5.3.6 The status of the BWs within 2 km of Hornsea Four are presented in **Section 6.2.2** of this annex.

3 Consultation

3.1.1.1 Consultation is a key part of the DCO application process. Consultation regarding the Water Framework Directive has been conducted through the EIA scoping process (Orsted 2018) and formal consultation on the Preliminary Environmental Impact Report (PEIR) under section 42 of the 2008 Act. An overview of the project consultation process is presented within **Volume A1, Chapter 6: Consultation**.

3.1.1.2 A WFD Screening Assessment was submitted as Annex E to the Hornsea Four Scoping Report (Orsted 2018). A formal Scoping Opinion was sought from the Planning Inspectorate (PINS) following the submission of the Scoping Report (Orsted 2018). No comments were received as part of the Scoping process in relation to the offshore elements of the WFD Assessment. Comments relating to the onshore elements are addressed in **Volume A6, Annex 2.3: Water Framework Directive Compliance Assessment**.

3.1.1.3 A WFD Assessment was prepared and submitted as part of the PEIR to be reviewed as part of the Section 42 consultation process. Following the Section 42 consultation, the Applicant corresponded with the Environment Agency who confirmed (via email on 03 October 2019) that they had reviewed the Marine WFD Assessment submitted with the PEIR and were satisfied that the relevant mitigation was in place for intertidal habitats (**B2.2: Consultation Report**). This annex is a revised version of the document submitted as part of Section 42.

3.1.1.4 No further consultation responses have been provided in relation to this WFD assessment.

4 Assessment Methodology

4.1 Guidance

4.1.1.1 This WFD assessment has been undertaken following the Environment Agency's (2017) 'Clearing the Waters for All' guidance for assessing the potential deterioration of transitional and coastal waterbodies. This WFD assessment has also been undertaken in line the guidance within PINS Advice Note 18 (PINS, 2017).

[3] It is noted that no classifications are available for 2020 due to COVID-19 related sampling difficulties.
[4] A percentile is a measure used in statistics indicating the value below which a given percentage of observations in a group of observations fall.

4.2 Assessment Process

4.2.1.1 Based on the Environment Agency (2017) guidelines, a WFD Assessment can have up to three stages, with the need to undertake later stages of the assessment dependent on the outcomes of the preceding stages. These three stages are:

- **Stage 1** – WFD screening – to determine if there are any activities associated with the proposed development that do not require further consideration. For example, activities which have been ongoing since before the current RBMP plan cycle and therefore, have formed part of the baseline;
- **Stage 2** – WFD scoping – to identify risks of the proposed development activities to receptors based on the relevant waterbodies and their water quality elements (including information on status, objectives, and the parameters for each waterbody); and
- **Stage 3** – WFD impact assessment – a detailed assessment of waterbodies and their quality elements that are considered likely to be affected by the proposed development; and identification of any areas of non-compliance, consideration of mitigation measures, enhancements, and contributions to the RBMP objectives.

4.2.1.2 Where the potential for deterioration of waterbodies is identified in the impact assessment, and it is not possible to mitigate the impacts to a level where deterioration can be avoided, the proposed development would need to be assessed in the context of Article 4.7 of the Directive.

4.3 Screening

4.3.1.1 According to the Environment Agency 'Clearing the Waters for All' guidance (Environment Agency 2017), Hornsea Four is categorised as a new project (i.e. one which has been proposed after January 2009 and not included in the relevant RBMP). As a result, Hornsea Four is not required to complete a screening stage and therefore is required to commence at the scoping stage. However, initial screening information is necessary as part of the scoping stage and therefore this stage is still often completed in practice in order to inform the WFD scoping. Additionally, screening the construction, and operation and maintenance (O&M) activities of projects enables a high-level initial assessment of those activities that could impact on compliance parameters within WFD waterbodies.

4.3.1.2 Screening has been undertaken in this assessment to inform the scoping phase and is presented in **Section 5**. Proposed activities for Hornsea Four are presented in **Section 5.1**.

4.4 Scoping

4.4.1.1 The scoping stage identifies the receptors that are potentially at risk from the proposed activities and therefore may need to be subject to an impact assessment. At the scoping stage, it is necessary to identify all potential risks to each receptor associated with the proposed activity/activities. The receptors are:

- Hydromorphology;
- Biology – habitats;
- Biology – fish;
- Water quality; and
- Protected areas.

4.4.1.2 Invasive and Non-Native Species (INNS) must also be considered during the scoping stage.

4.4.1.3 The WFD assessment considers each stage of activity at Hornsea Four as relevant. Those proposed activities to be considered in terms of their potential impacts on each receptor are defined in **Section 5.1**.

4.4.1.4 Hydromorphology in this assessment is defined as the physical characteristics of the waterbody including the size, shape, structure and (for marine bodies) the flow and quantity of water and sediment.

4.4.1.5 Biological habitats (both those designated as higher or lower sensitivity habitats) will be scoped in if the footprint (including sediment plumes and dredging areas) of activities is:

- 0.5 km^2 or greater;
- 1% of more of the waterbody's area;
- Within 500 m of any higher sensitivity habitat; or
- 1% or more of any lower sensitivity habitat.

4.4.1.6 The following impacts on fish will be considered for scoping:

- The activity is in an estuary and could affect the fish in the estuary;
- The activity could delay or prevent fish from entering the estuary; or
- The activity could affect fish migrating through the estuary to freshwater.

4.4.1.7 The impacts resulting from the proposed activities on water quality will be assessed in terms of:

- Whether it could affect water clarity, temperature, salinity, oxygen levels, nutrients, or microbial patterns continuously for longer than a spring/neap tidal cycle;
- Whether it is in a waterbody / waterbodies with a phytoplankton status of moderate, poor or bad; and
- Whether the waterbody/waterbodies have a history of harmful algae.

4.4.1.8 The water quality assessment will assess the potential for the release of chemicals (on the EQSD list) and sediment bound contaminants (above Cefas Action Level 1[5]) as a result of the proposed activities.

4.4.1.9 Any identified protected areas with 2 km of the offshore ECC will be identified and scoped in for further assessment.

4.5 Impact Assessment

4.5.1.1 Following the scoping stage, if it is determined that the impact assessment stage is required, i.e. a receptor cannot be scoped out, the Environment Agency (2017) guidance sets out that an impact assessment should be undertaken for each receptor identified as being at risk from the activity. The impact assessment should consider what (if any) pressures the activity may create on the marine environment and specifically the receptors identified. The key aim of the impact assessment is to determine whether there is potential for deterioration in the status of the waterbody receptor.

[5] https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#suitability-of-material

4.5.1.2 Deterioration is defined as when the status (ecological or chemical) of a quality element reduces by one class, for example, ecological quality elements move from 'good' to 'moderate' status. If a quality element is already at the lowest status (Bad), then any reduction in its condition also counts as deterioration. According to the Environment Agency (2017) guidance, temporary effects due to short-duration activities like construction and maintenance are not considered to cause deterioration if the waterbody would recover in a short time without any restoration measures. Where relevant, mitigation measures should be included to avoid or minimise risks of deterioration (if predicted).

4.5.1.3 If the activity may cause deterioration, either of the quality element or supporting habitat, an explanation must be provided of how this deterioration could occur, including consideration of whether the impact is:

- Direct and immediate – it will happen at the same time and place as the activity; or
- Indirect – it will happen later or further away, including in other linked waterbodies.

4.5.1.4 Where the activity may cause deterioration, alternatives should be considered to minimise the impact, including changes to the materials or substances used, the size, scale or timing of the activity or methods of working and/or how equipment or services are used.

4.5.1.5 In addition to assessing the potential for deterioration of the current status of a waterbody, the impact assessment must consider the risk of jeopardising 'Good status'. Every waterbody has a target status that it is expected to achieve, with an expected date by when this should be achieved as set out in the RBMPs. Where the status of a waterbody or quality element is less than 'Good', the impact assessment should consider whether the activity may jeopardise the waterbody achieving 'Good status' in the future. These may include activities which reduce the effectiveness of improvement activities taking place or prevent improvement activities taking place in the future. Details of these activities or measures are set out in the RBMPs.

4.6 Data Sources

4.6.1.1 The following data sources have been collated and used to inform the assessment:

- Site-specific data including particle size and contaminant analysis of sediment samples acquired within the ECC;
- Environment Agency BW Classifications[6]; and
- Multi-Agency Geographic Information for the Countryside (MAGIC) interactive mapping tool[7].

5 Screening

5.1 Proposed Activities for Consideration

5.1.1.1 This WFD assessment focuses on those elements of Hornsea Four of relevance to the offshore/coastal areas designated for WFD consideration. As such, the construction, O&M and decommissioning[8] activities of relevance relate to the proposed activities below Mean High Water Springs (MHWS). An assessment of inland WFD waterbodies (i.e. above MHWS) is

[6] https://www.gov.uk/government/statistics/bathing-water-quality-statistics
[7] https://magic.defra.gov.uk/magicmap.aspx
[8] Decommissioning activities are considered to be less than those for the construction phase and as such are not considered further within this assessment.

presented in **Volume A6, Annex 2.3: Water Framework Directive Compliance Assessment**. Full details of the proposed offshore activities are presented in **Volume A1, Chapter 4: Project Description**. Hornsea Four will comprise of Wind Turbine Generators (WTGs) and the associated infrastructure required to transmit the power generated by the WTGs to the National Grid network via the grid connection. The minimum distance between the Hornsea Four array area and the coastline is 69 km (approximately 37 nm). The array will be sufficiently distanced from the areas protected under the WFD (1 nm for ecological status and 12 nm for chemical status) and therefore activities within this site are not considered in this assessment. Therefore, the components and activities relevant to this WFD Assessment are limited to the offshore export cables which will transfer power from the offshore substations to shore (**Figure 1**). Up to six export cables will be required for Hornsea Four, located within the Offshore ECC which will make landfall on the Yorkshire Coast, south of Bridlington. The exact location and orientation of the offshore export cables, within the Order Limits, will be determined during an iterative route planning process, following the granting of the DCO.

5.1.1.2 The Applicant has made a commitment (Co188 in **Volume A4, Annex 5.2: Commitment Register** and secured in the DCO (Schedule 12, Part 2, Condition 3(3))) that no cable protection will be employed within 350 m seawards of Mean Low Water Springs (MLWS).

5.1.1.3 There is no intention to knowingly release any chemicals listed in the EQSD into the environment during construction, operation or decommissioning of Hornsea Four.

5.1.1.4 The earliest onshore construction start date would be in 2024, with a single phase of offshore construction over, approximately, three years. Of note is that, currently, the operational lifetime is anticipated to be 35 years. Further detail on the construction programme and other project information is provided in Section 4.7 of **Volume A1, Chapter 4: Project Description**.

5.1.1.5 Drawing on the information presented in **Volume A1, Chapter 4: Project Description**, the primary activities associated with the installation of the Hornsea Four offshore export cables that are considered to be relevant to the WFD assessment are:

- Preparatory works including boulder clearance and sandwave clearance;
- Offshore cable installation via jetting, vertical injection, cutting, ploughing or controlled flow excavation (CFE);
- The installation of the export cables at the cable landfall under the intertidal area via Horizontal Directional Drilling (HDD); and
- Cable rock-berm protection for cable crossings and where cable burial is not achieved.

6 Scoping

6.1 Relevant waterbodies

6.1.1.1 As required under the Environment Agency (2017) guidance, coastal and transitional waterbodies were identified based on whether there are any coastal or transitional WFD waterbody within 2 km of the Order Limits.

6.1.1.2 The Hornsea Four offshore ECC crosses the Yorkshire South waterbody (GB640402491000) (**Figure 1**). The current status of the screened-in WFD waterbody (Yorkshire South) is

presented in Table 2. No other coastal or transitional waterbodies are within 2 km of the offshore ECC.

Table 2: Current status of the identified waterbodies (Yorkshire South).

ID	GB640402491000
Type	Coastal
Distance from Hornsea Four Order Limits (km)	0 (Order Limits overlap with waterbody)
Waterbody area (ha)	15,836.87
Overall current status	Moderate
Current status (ecological)	Moderate
Current status (chemical)	Good
Target status by 2027	Good
Is the waterbody heavily modified (HMWB)?	Yes
Reasons for HMWB	Coastal protection; flood protection; and navigation, ports and harbours
Hydromorphology status	Supports good
WFD phytoplankton classification	High
History of harmful algae?	Not monitored

6.2 Protected areas

6.2.1.1 As required under the Environment Agency (2017) guidance, the following WFD protected areas have been considered:

- Special Areas of Conservation (SACs);
- Special Protection Areas (SPAs);
- BWs;
- SFWs; and
- Nutrient Sensitive Waters (NSWs).

6.2.1.2 At Scoping, the Bridlington South Beach and Skipsea BWs were identified in WFD Screening. For the PEIR, the Hornsea Four offshore ECC boundary was further refined from that presented at Scoping such that these BWs were at a distance of greater than 2 km from the boundary of the Order Limits and therefore were scoped out for further consideration in this WFD assessment. The offshore ECC element of the Order Limits remains largely consistent with that presented at PEIR with very minor refinements made at the landfall funnel (see **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure** for further details on the refinements). As such, there is no change to the list of protected areas of relevance to this assessment within 2 km of the Order Limits (between PEIR and DCO Application). The following sites (as illustrated in **Figure 2**) described below are within 2 km of the Order Limits and are therefore included in this assessment:

- Flamborough Head SAC;;
- Flamborough Head and Bempton Cliffs SPA;
- Greater Wash SPA;
- Wilsthorpe BW; and
- Fraisthorpe BW.

6.2.1.3 There are no SFWs or NSWs within 2 km of the Hornsea Four Order Limits. Therefore, these areas have been scoped out of this assessment.

Hornsea Four

Figure 2

Relevant protected areas in relation to Hornsea Four

290000 300000 310000

6000000 5990000 5980000

N

GRID NORTH

Wilsthorpe

Fraisthorpe

Bridlington

Hornsea

- Order Limits
- Offshore Export Cable Corridor
- Offshore Temporary Works Area
- 500m Buffer from Order Limits
- 2km Buffer from Order Limits
- Bathing Water Monitoring Locations
- Bathing Waters Designated Areas
- Flamborough & Filey Coast Special Protection Area
- Flamborough Head Special Area of Conservation
- Greater Wash Special Protection Area

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:120,000

0 3 6 Kilometres

0 1 2 Nautical Miles

REV	REMARK	DATE
....	First Issue	26/06/2019
A	Updated following PEIR consultation, for DCO	27/07/2021

Relevant Protected Areas in Relation to Hornsea Four
Document no: HOW04GB0120
Created by: BPHB
Checked by: RM
Approved by: LK

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Date: 27/07/2021

Author: BenBlakeman Name: HOW04GB0120_WFD_Relevant_Protected_Areas

6.2.2 Status of Relevant Protected Areas

6.2.2.1 The current status of the two of the screened-in BWs are presented in **Table 3**. **Table 4** presents the designated features of the screened-in SACs and SPAs. The named SACs and SPAs are further considered in **B2.2: Report to Inform Appropriate Assessment** (RIAA) and their current conditions and conservation status are provided in Appendix D of **B2.2: Report to Inform Appropriate Assessment**.

Table 3: Current status of the identified BWs.

Bathing Water Name	Wilsthorpe	Fraisthorpe
ID	uke1200-08200	uke1200-08300
Type	BW	BW
Distance from Hornsea Four Order Limits (km)	1.19	0.38
Classification (2019)	Good	Good
Classification (2018)	Good	Good
Classification (2017)	Good	Good
Classification (2016)	Good	Good

Table 4: Designated feature(s) of the identified SACs and SPAs.

Site	Designated feature(s)
Flamborough Head SAC	• Reefs; • Submerged and partially submerged caves; and • Vegetated sea cliffs of the Atlantic and Baltic Coasts
Flamborough and Filey Coast SPA[9]	• Gannet; • Herring gull; • Kittiwake; • Guillemot; • Razorbill; • Puffin; and • Seabird assemblage[10]
Greater Wash SPA[11]	• Red-throated diver; • Common scoter; • Little gull; • Sandwich tern; • Common tern; and • Little tern.

6.2.2.2 As part of the DCO Application for Hornsea Four, a Habitats Regulation Assessment (HRA) has been undertaken. **B2.2: Report to Inform Appropriate Assessment** has been prepared which assesses the potential impacts on National Site Network sites (SACs, SPAs and Ramsar

[9] Features as per Natural England Citation for FFC SPA (dated August 2019).
[10] Seabird assemblage consisting of 216,730 average number of individuals (2008-12); including interest features listed above, additional named assemblage species (data from 2017); fulmar (1,257 pairs), shag (25 pairs), cormorant (27 pairs), herring gull (466 pairs) and puffin (approx. 2,879-4,079 individuals) as well as other non-named species.
[11] Features as per Annex II SPA Citation (2018)

sites) and their associated features. The RIAA provides a detailed assessment for the potential effects on SAC, SPA and Ramsar[12] sites.

6.3 Biological habitats

6.3.1.1 There are two higher sensitivity habitats present (Figure 3) within the Yorkshire South waterbody as a whole. These higher sensitivity habitats are "Mussel beds, including blue and horse mussel" and "Subtidal kelp beds" (Table 5). However, analysis of the area using the MAGIC[13] mapping tool has indicated that none are present within 500 m of the Hornsea Four Order Limits (see Figure 3 and Table 5). As such, further consideration of these habitats is screened out. Figure 4 presents the Lower Sensitivity habitats in the Yorkshire South waterbody within the vicinity of the Hornsea Four Order Limits; principally intertidal soft sediment, subtidal soft sediments, and subtidal rocky reef.

6.3.1.2 The maximum footprint of the proposed activities, from boulder clearance and seabed preparation in the section of the offshore ECC that lies within the Yorkshire South waterbody is approximately 0.45 km^2 (45 ha). When a 1.5 multiplier[14] is applied to the footprint to account for dredging activities, the footprint is 0.67 km^2 (67 ha) within the Yorkshire South waterbody. This is the equivalent of 0.004% of the Yorkshire South waterbody's total area. Table 5 presents the higher and lower sensitivity habitats within the waterbody.

Table 5: Higher and lower sensitivity habitats assessment within the Yorkshire South waterbody

Characterisation	Habitat	Within 500 m of Order Limits?	Area in Waterbody (ha)	Area potentially affected (%)
Higher sensitivity	Mussel beds, including blue and horse mussel	No	0.29	N/A to higher sensitivity habitats
Higher sensitivity	Subtidal kelp beds	No	349.12	
Lower sensitivity	Cobbles, gravel, and shingle	N/A to lower sensitivity habitats	299.38	0.22%
Lower sensitivity	Intertidal soft sediment		680.83	0.10%
Lower sensitivity	Rocky shore		7.59	8.78%
Lower sensitivity	Subtidal rocky reef		860.94	0.08%
Lower sensitivity	Subtidal soft sediments		20,779.33	0.00%

6.4 Scoping conclusions

6.4.1.1 Table 6 details the scoping assessment, whilst Table 7 provides a summary of the results of scoping for consideration in the impact assessment.

[12] Note: The guidance (environment Agency, 2017) does not require an assessment of Ramsar sites as part of the WFD assessment
[13] https://magic.defra.gov.uk/magicmap.aspx
[14] As required under the 'Clearing the Waters' Guidance.

290000
300000
310000
6000000
5990000
N
GRID NORTH
Bridlington
Flamborough
Hilderthorpe
Burton Agnes
Driffield
Barmston
Skipsea
Dunnington
A165
A166
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Date: 27/07/2021
Author: BenBlakeman
Name: HOW04GB0250_WFD_Higher_Sensitivity_Habitats

Hornsea Four

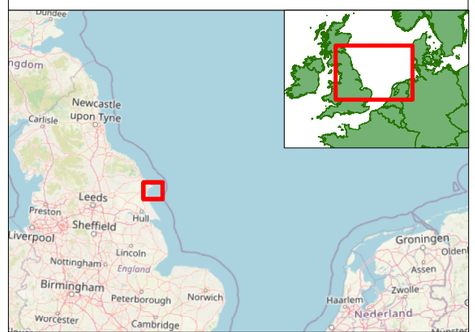
Figure 3

Higher sensitivity habitats

- Order Limits
- Offshore Export Cable Corridor

WFD Habitats: Higher Sensitivity

- Subtidal Kelp Beds (A3.11, A3.21. A3.22, A3.31, A3.32, A5.52)



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:100,000

0 2 4 Kilometres

0 1 2 Nautical Miles

REV	REMARK	DATE
....	First Issue	27/07/2021

Higher Sensitivity Habitats
WFD Habitats
Document no: HOW04GB0250
Created by: BPHB
Checked by: SM
Approved by: LK

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Hornsea Four

Figure 4

Lower sensitivity habitats

290000 300000 310000

6000000

5990000

N

GRID NORTH

Reighton Sands
Reighton
Speeton
Crab Rocks
Buckton
Bempton
Holiday
Grindale
Flamborough
FLAMBOROUGH HEAD
Boynton
Sewerby
BRIDLINGTON
Carnaby
Haisthorpe
Hilderthorpe
Holiday Village
BRIDLINGTON BAY
Burton Agnes
Fraisthorpe
Lissett
Barmston
Ulrome
Dringhoe
Beeford
Skipsea
Skipsea Brough
Dunnington
Arwick
A165
A1035
B1253
B1255
B1259
B1254
B1249

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Date: 27/07/2021 Author: BenBlakeman Name: HOW04GB0249_WFD_Lower_Sensitivity_Habitats

290000 300000 310000

Order Limits

Offshore Export Cable Corridor

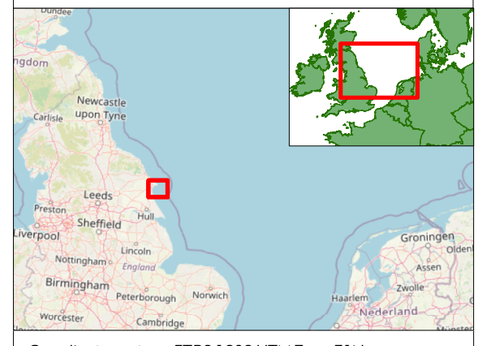
Water Framework Directive Coastal Waterbody

WFD Habitats: Lower Sensitivity

Subtidal Soft Sediment (Sand, Mud & Mixed A5.2, A5.3, A5.4)

Gravel & Cobbles (intertidal & subtidal coarse sediment A2.1, A5.1)

Subtidal Rocky Reef (Infralittoral and Circalittoral rock A3, A4)



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:100,000

0 2 4 Kilometres

0 1 2 Nautical Miles

REV	REMARK	DATE
....	First Issue	27/07/2021

Lower Sensitivity Habitats
WFD Habitats
Document no: HOW04GB0249
Created by: BPHB
Checked by: SM
Approved by: LK

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Table 6: Scoping assessment.

Consideration of the Activity	Key Risk Issues and Justification	Scoped into assessment?
Hydromorphology		
Could impact on the Hydromorphology (for example morphology or tidal patterns) of a waterbody at high status	The activities associated with Hornsea Four will not impact the hydromorphology of a High status waterbody. The Yorkshire South waterbody is of Moderate status.	No – Impact assessment not required
Could significantly impact the Hydromorphology of any waterbody	There will be no physical barrier placed within the Yorkshire South waterbody as a result of the activities from Hornsea Four. The presence of the export cables buried in the seabed will not affect current speeds and will, as a worst-case, result in a minor depth reduction at cable crossings and where cable protection is used, noting that they will not be installed within 350 m of MLWS. Therefore, changes to water depth and currents are not considered to be significant.	No – Impact assessment not required
Waterbody is heavily modified for the same use as the proposed activity	The Yorkshire South waterbody is classed as heavily modified in terms of coastal protection, flood protection, navigation and ports and harbours. It is not modified for the purpose of renewable energy and therefore no further consideration of the potential impacts associated with Hornsea Four is required.	No – Impact assessment not required
Biology - Habitats		
0.5 km^2 or greater	The footprint of the works within the Yorkshire South waterbody, including a factor of 1.5 times the footprint in terms of dredging is approximately 0.67 km^2 and is therefore above the 0.5 km^2 threshold.	Yes
1% or more of the waterbody's area	The footprint of the works, including a factor of 1.5 times the footprint of the dredged area, totals approximately 0.04 % of the waterbody area and therefore falls below the 1% threshold.	No – Impact assessment not required
Within 500 m of any higher sensitivity habitat	The Hornsea Four Order Limits are located greater than 500 m from any higher sensitivity habitat – see **Figure 3**.	No – Impact assessment not required
1% or more of any lower sensitivity habitat	The Hornsea Four offshore export cables will cross areas of subtidal soft sediment and intertidal soft sediment and may cross areas of subtidal rocky reef – see **Figure 4**. As presented in **Table 5** the footprint of the development within the Yorkshire South waterbody is greater than 1% of rocky shore habitat, however, as presented in **Figure 4**, there is no direct overlap with the Hornsea Four Order Limits and this type of habitat.	Yes
Biology - Fish		
Is in an estuary and could affect fish in the estuary but could delay or prevent fish entering it or could	The activities associated with the offshore export cables for Hornsea Four will not take place near or within an estuary and it is highly unlikely to, or prevent, fish entering or affect fish migrating through an estuary. This is	No – Impact assessment not required

Consideration of the Activity	Key Risk Issues and Justification	Scoped into assessment?
affect fish migrating through the estuary	further supported by **Volume A2, Chapter 3: Fish and Shellfish Ecology** which concluded that no significant impacts on fish populations (including migratory populations) were predicted as a result of Hornsea Four.	
Could impact on normal fish behaviour like movement, migration or spawning (for example by creating a physical barrier, noise, chemical change or a change in depth or flow)	The proposed activities for Hornsea Four will not cause a physical barrier to prevent fish from entering the estuaries or their migration patterns. The presence of the export cable buried in the seabed will not affect current speeds and will, as a worst-case result in a minor reduction in terms of total water depth at cable crossings (beyond 350 m below MLWS). Therefore, changes to water depth and changes in currents (both tidal and non-tidal) are not considered to be significant and are not considered to impact on normal fish behaviour, such as, movement, migration or spawning. **Volume A2, Chapter 3: Fish and Shellfish Ecology** presents full details of the noise modelling undertaken to determine the potential impacts of noise and vibration on fish receptors as a result of the proposed activities for Hornsea Four. No significant impacts were predicted on fish species and given the distance from the array to the Yorkshire South waterbody, nor are measurable impacts on fish species anticipated within this waterbody. There will not be any outfalls or discharges associated with Hornsea Four and so the proposed activities are not expected to cause a reduction in the dissolved oxygen in the water column. Therefore, the potential for chemical changes and its implication on fish species will not be taken forward as a consideration of the impact assessment. No significant impacts are predicted on fish and shellfish ecology resources (**Volume A2, Chapter 3: Fish and Shellfish Ecology**).	No – Impact assessment not required
Could cause entrainment or impingement of fish	No entrainment or impingement will occur as a result of Hornsea Four.	No – Impact assessment not required
Water Quality		
Could affect water clarity, temperature, salinity, oxygen levels nutrients or microbial patterns continuously for longer than a spring-neap tidal cycle (approximately 14 days).	It is not anticipated that the temperature or salinity would be affected as a result of export cable installation activities and therefore these parameters have not been taken forward to the impact assessment. The resuspension of sediments into the water column would result in short-term increases in SSC as a result of construction activities such as seabed preparation and cable installation. The methods used for installation would affect the amount of sediment displaced, but it is considered that the impacts would be localised, and high levels of SSC would not disperse to a significant level outside the footprint of the Order Limits. During these periods of increased SSC, there would be a reduction in water clarity (i.e. an increase in turbidity) which could result in the greater longevity of microbiology in the water column. In addition, sediment-bound nutrients could	No – Impact assessment not required

Consideration of the Activity	Key Risk Issues and Justification	Scoped into assessment?
	be released as a result of the activities. However, as noted in **Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes**, the silt fractions of the SSC, which will persist for the longest duration, are predicted to fully dissipate within 65 hours of the proposed activities. Therefore, the direct and indirect effects of the resuspension of sediment are not anticipated to occur continuously for longer than 14 days.	
Is in a waterbody with a phytoplankton status of moderate, poor or bad	The Yorkshire South waterbody is currently classified as being of high phytoplankton status, and therefore this has not been taken forward for the impact assessment.	No – Impact assessment not required
Is in a waterbody with a history of harmful algae	This has not been monitored for the Yorkshire South waterbody and has therefore not been taken forward for impact assessment.	No – Impact assessment not required
Release or use of chemicals which are on the EQSD list	The proposed activities do not include the use of direct discharge of any chemicals listed under the EQSD list. A Construction Project Environment Management and Monitoring Plan (CPEMP) (commitment Co111 in **Volume A4, Annex 5.2: Commitment Register)** will be produced post-consent and implemented to cover the construction and O&M phases of Hornsea Four which will be secured through a Condition in the Marine Licence. The CPEMMP will include a Marine Pollution Contingency Plan (MPCP) to provide protocols to cover accidental spills and potential contaminant release, and include key emergency contact details (e.g. EA, Maritime Coastguard Agency and the project site co-ordinator). The only substance which may be released into the environment from Hornsea Four would be bentonite from HDD at the landfall export cable installation. Bentonite is a non-toxic, inert, natural clay mineral (<63 µm particle diameter) and is *not* on the EQSD list. It is included in the List of Notified Chemicals approved for use and discharge into the marine environment and is classified as a group E substance under the Offshore Chemical Notification Scheme (OCNS)[15]. Substances in group E are defined as the group least likely to cause environmental harm and are "readily biodegradable and is non-bioaccumulative". This is further supported by bentonite being included on the OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR)[16]. Any release will be relatively short-lived and of low volume (see **Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes Report**). Therefore, no deterioration of the status of any sites designated under the WFD is anticipated from the release of bentonite.	No – Impact assessment not required

[15] Offshore Chemical Notification Scheme operated by Cefas - https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment/
[16] OSPAR (2019) 'OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment' Available from: https://www.ospar.org/work-areas/oic/chemicals

Consideration of the Activity	Key Risk Issues and Justification	Scoped into assessment?
Disturbance of sediment with contaminants above Cefas Action Level 1	The composition and grain size present within the ECC is predominantly sand with limited fine fractions. No known sources of contamination have been identified within 2 km of the proposed activities within the waterbody or have been raised by stakeholders. Therefore, it is considered highly unlikely that any sediments disturbed in the WFD waterbody would have contamination levels greater than Cefas Action Level 1 (CAL1). This is supported by the Hornsea Four site specific survey, in particular the sample (ECC_27), which is the closest sample to the Yorkshire South waterbody and did not exceed CAL1 for any of the contaminants tested for – see **Annex 2.1: Benthic and Intertidal Ecology Technical Report** for further details. A project specific grab sample was undertaken for Hornsea Four, in the Yorkshire South waterbody, but due to the ground conditions encountered it was not possible to collect sediment for analysis. Given the absence of data within the waterbody the potential for disturbance of this has been scoped in to ensure precaution within this assessment.	Yes
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the EQSD list.	The proposed development does not have a discharge pipe or outfall, nor does the project intend to release substances on the EQSD list. Therefore, the project will not have a mixing zone for these chemicals.	Not applicable
WFD Protected Areas		
Within 2 km of any WFD protected area	Sites within the National Site Network: - Flamborough Head SAC; - Flamborough and Filey Coast SPA; and - Greater Wash SPA. Bathing Waters: - Fraisthorpe BW; and - Wilsthorpe BW.	Yes
INNS		
Potential to introduce or spread INNS	It is likely that any man-made structures placed on the seabed will be colonised by a range of marine species. These structures have the potential to act as artificial reefs and may also facilitate the spread of non-native species if these species are already present (i.e. they will not act as a vector for INNS in and of themselves).The vast majority of these structures will be located within the Hornsea Four array area and so are not relevant to this assessment; however cable protection may be installed within the Yorkshire South waterbody (noting Co188). If required, it is likely to be limited to small areas of the offshore cable route. Both construction and O&M vessels have the potential to introduce or spread INNS through the discharge of ballast water within the Yorkshire South waterbody. This potential impact will be mitigated through designed-in measures such as the marine biosecurity plan as part of the CPEMMP (commitment Co111 in **Volume A4, Annex**	Yes

Consideration of the Activity	Key Risk Issues and Justification	Scoped into assessment?
	5.2: Commitment Register), as well as vessels complying with International Maritime Organisation (IMO) ballast water management guidelines, ensuring that risks associated with INNS are minimised. In addition, the materials and vessels are highly likely to be from within European and/or UK waters. There is currently little evidence from other offshore wind farms in the North Sea to suggest adverse effects on key species and habitats from INNS.	

Table 7: Summary of receptors and impacts scoped into the impact assessment.

Receptor	Potential risk to receptor?	Waterbodies/protected areas	Risk issues for impact assessment
Hydromorphology	No	N/A	N/A
Biology – habitats	Yes	Yorkshire South waterbody	Cable installation will result in direct and indirect effects upon the features identified.
Biology – fish	No	N/A	N/A
Water quality	Yes	Yorkshire South waterbody	The potential for disturbance of sediment with contaminants above Cefas Action Level 1
Protected areas	Yes	Sites within the National Site Network: - Flamborough Head SAC; - Flamborough and Filey Coast SPA; and - Greater Wash SPA. Bathing Waters: - Fraisthorpe BW; and - Wilsthorpe BW.	All within 2 km of the proposed development.
INNS	Yes	Yorkshire South waterbody	Potential to introduce or increase the spread of INNS.

7 Impact Assessment

7.1 Biological habitats

7.1.1.1 As identified in Section 6.3, cable installation may result in temporary habitat loss/disturbance of up to 0.67 km^2 within the Yorkshire South waterbody during the construction phase. In addition, the footprint of the activities is equivalent to 8.78% of the rocky shore in the waterbody, however, no direct interaction with this habitat type is anticipated. Works associated with cable installation within the Yorkshire South waterbody include seabed preparation, cable installation into the seabed and the use of HDD at the landfall. Further details are provided in Section 5 (and Volume A1, Chapter 4: Project Description).

7.1.1.2 A characterisation of the benthic and subtidal habitats which may be directly or indirectly impacted by Hornsea Four is provided in Volume A2, Chapter 2: Benthic and Intertidal Ecology. The EIA assessment concluded that there would be no adverse significant effects on benthic receptors from the habitat disturbance from the proposed activities in the offshore ECC.

7.1.1.3 Given that the benthic habitats that characterise the Hornsea Four Order Limits are common and widespread throughout the wider southern North Sea region (as described in Section 2.7 of Volume A2, Chapter 2: Benthic and Intertidal Ecology and in Annex 2.1: Benthic and Intertidal Ecology Technical Report), the temporary habitat disturbance during construction activities would have an impact on a very limited footprint compared to their overall extent.

7.1.1.4 The sensitivity of all biotopes that are known to characterise the Hornsea Four Order Limits and that have been modelled across the Order Limits (Section 2.7.1 of Volume A2, Chapter 2: Benthic and Intertidal Ecology) have been assessed according to the detailed MarESA sensitivity assessments (Table 2.13 of Volume A2, Chapter 2: Benthic and Intertidal Ecology). This assessment determined that all biotopes have a low to medium sensitivity to a disturbance of this nature. None of the biotopes likely to be affected are rare or geographically restricted. As detailed within the baseline characterisation, comparable habitats are distributed within the wider region and southern North Sea. Therefore, given the relatively small spatial scales for the total temporary habitat disturbance outlined above, this loss is not expected to undermine regional ecosystem functions or diminish biodiversity.

7.1.1.5 The impact on benthic habitats is predicted to be of local spatial extent (i.e. restricted to discrete areas within Hornsea Four), short term duration (as it is limited to the duration of construction activities), intermittent and with high reversibility.

7.1.1.6 Since the loss of subtidal habitat is only temporary and recovery will occur, deterioration is only predicted to be on a small scale and only for a limited period of time. As such there is not predicted to be a deterioration in the ecological status of this waterbody receptor. The proposed development therefore considered to be compliant with the WFD requirements and there would not be a deterioration in the status of the Yorkshire South waterbody.

7.2 Water quality

7.2.1.1 Activities which disturb the seabed have the potential to remobilise contaminants bound in the sediment back into the water environment. The total area that is likely to be disturbed

by construction activities, and therefore the potential volume of material disturbed, resulting in the potential release of sediment bound contaminants, is small (0.67 km^2) and localised in extent. In addition, the nature of the subtidal sediments is predominantly coarse, typically with low levels of fines adhering to them. Following disturbance as a result of construction activities, the majority of resuspended sediments are expected to be deposited in the immediate vicinity of the works. The release of contaminants such as arsenic and Polycyclic Aromatic Hydrocarbons (PAHs) from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects is not expected.

7.2.1.2 The use of the Cefas Guideline Action Levels is undertaken as part of a 'weight of evidence' approach to assessing material suitability for disposal at sea. Cefas guidance indicates that, in general, contaminant levels below Cefas Action Level 1 (CAL1) are typically of no concern and are unlikely to influence the licensing decision. Whilst there is no site specific data within the offshore ECC within the Yorkshire South waterbody, the nearest site (ECC-27) did not have any substances above CAL1. **Annex 2.1: Benthic and Intertidal Ecology Technical Report** provides further detail. This site is considered to be representative of the levels of contamination within the Yorkshire South waterbody. The levels of contaminants within the length of the offshore ECC are all comparable to the wider regional background and not considered to be of a low quality that may result in a significant effect-receptor pathway if made bioavailable.

7.2.1.3 Project specific modelling was undertaken to understand the SSC plume dynamics including lateral and vertical dilution as well as temporal nature of the plumes. The key findings of the modelling are presented in **Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes** and are summarised in **Table 8**. The results from the project specific modelling can be used to infer the number and rate of dilutions which would be achieved by any released contaminants as a result of the proposed activities. Therefore, given the high number of dilutions and the short timescales (in the order of days) of these plumes, it is considered highly unlikely that the proposed works would result in a breach of the WFD waterbody's Annual Average (AA) concentration of the EQSD substances detected.

7.2.1.4 In addition, under normal circumstances, very small concentrations of contaminants enter to the dissolved phase, with the vast majority adhering to the sediment particles when temporarily entering suspension in the water column. Partition coefficients may be applied to estimate the concentration of the contaminants entering the dissolves phase which typically result in a reduction of several orders of magnitude than the concentrations associated with suspended sediments. As such, it is considered highly unlikely that the Maximum Allowable Concentration (MAC) EQSD's threshold will be exceeded for any of the substances as a result of disturbing sediment in the waterbody from the proposed activities, given the fates of the plumes.

7.2.1.5 Moreover, given the short-term nature of the works and the short term nature of the sediment plumes, any small uplift in the water concentrations of ESQD substances would be anticipated to return to background levels very quickly. Therefore, given the temporal nature of the works, the chemical status of the waterbody, both locally to the works and at sampling points, would remain unaffected as a result of the proposed works. The proposed development therefore is considered to be compliant with the WFD requirements and there would not be a deterioration in the status of the Yorkshire South waterbody.

Table 8: Temporary increases in SSC and sediment deposition as a result of construction activities at Hornsea Four.

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
Sandwave clearance	Nearshore ECC / cable crossing	10 km (springs) and 6 km (neaps)/ 14 km (springs) and 6 km (neaps)	• SSCs within sediment plumes associated with overspill can be in the order of hundreds of mg/l in the vicinity of the dredger, reducing to tens of mg/l with distance, but also quickly dissipating in time after release; • The deposition of fine sediment under low flow conditions is predicted to be less than 2 mm from overspill; • Dredge spoil disposal plume concentrations remain less than 10 mg/l for all locations 2 km beyond the point of release and are not detectable after about 20 hours; and • The depth of spoil deposition (for all sediments) is typically very small (around 0.1 mm) but reaches 5.9 cm for the spring tide in a confined area and 10 cm for a neap release. These depths of deposition cover a very small area and are due to coarser grained sediments (gravels).
Offshore trenching for cables	Offshore ECC	4 km along the axis of the tide	• Within 5 m of trenching very high plume concentrations are expected. SSC could be millions of mg/l. This is only expected to occur while the CFE is active; • At 2 km from the source, the silt content will be approximately 100 mg/l during the trenching period and will fully dissipate and will fully dissipate after around 65 hours; and • The maximum depth of deposition is 0.1 m to 0.12 m within the cable crossing area and 0.13 m to 0.14 m within the inshore cable route. The maximum settlement depth reduces exponentially in range from the trench reaching 0.12 m at 50 m and 0.06 m at 100 m, for a 6 m^2 trench.

7.3 Protected Areas

7.3.1.1 The Hornsea Four Order Limits coincide with, or is within 2 km of, the following sites and therefore has the potential to affect the interest features of these sites:

- Flamborough Head SAC;
- Flamborough Head and Filey Coast SPA;
- Greater Wash SPA;
- Fraisthorpe BW; and
- Wilsthorpe BW.

7.3.1 Sites within the National Site Network

7.3.1.1 The identified protected areas (Flamborough Head SAC; Flamborough Head and Filey Coast SPA; and Greater Wash SPA) have been subjected to the HRA process (**B2.2: Report to Inform Appropriate Assessment**). **Table 9** presents the conclusions of the RIAA on those protected sites within 2 km of the project boundary. The RIAA applies the conclusions on the potential for a Likely Significant Effect (LSE), as drawn in the Screening Report, with respect to the conservation objectives of the screened in European sites, to determine the potential for an Adverse Effect on Integrity (AEoI). No potential for AEoI has been identified for the three National Site Network sites of relevance to this WFD assessment.

Table 9: Conclusions of the HRA on designated sites within 2 km of the Hornsea Four Order Limits (offshore ECC).

Designated Site	Relevant Features with potential for LSE	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Temporary increases in SSC/ smothering	No potential for AEoI	No potential for AEoI	No potential for AEoI
		Invasive non-native species (introduction of hard substrate)	No potential for AEoI	No potential for AEoI	No potential for AEoI
		Accidental pollution	No potential for AEoI	No potential for AEoI	No potential for AEoI
	Reefs	Changes to physical processes	N/A	No potential for AEoI	N/A
Flamborough and Filey Coast SPA	Gannet	Disturbance and displacement	-	No potential for AEoI	-
	Guillemot Razorbill Puffin	Disturbance and displacement	No potential for AEoI	No potential for AEoI	No potential for AEoI
	Guillemot Razorbill Puffin	Barrier effect	-	No potential for AEoI	-
	Avocet Golden plover Black-tailed godwit Bar-tailed godwit Ruff Shelduck Dunlin Redshank Knot	Risk of Collision	-	No potential for AEoI	-
Greater Wash SPA	Little gull	Collision Risk	-	No LSE	-

Designated Site	Relevant Features with potential for LSE	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Red-throated diver Common scoter	Disturbance and displacement	No potential for AEoI	No potential for AEoI	No potential for AEoI
	Gannet Kittiwake	Collision Risk	-	No potential for AEoI	-

7.3.2 Bathing Waters

7.3.2.1 Resuspension of sediment as result of activities within the Hornsea Four offshore ECC could mobilise bacteria within the sediments into the water column and be advected to the BWs. This could theoretically affect the performance of the local BWs. In addition, during periods of increased turbidity (i.e. high SSC concentrations) a reduction in the amount of ultra-violet light within the water column could occur and indirectly reduce the mortality rate of bacteria in the water.

7.3.2.2 Sediment plumes are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source). Any fine material being dispersed by construction works is likely to be widely distributed and will quickly form part of the background concentration of Suspended Particulate Matter (SPM) in the nearshore and therefore is unlikely to settle in measurable thickness locally. The impact of increased SSC and deposition from construction activities is expected to be short-term, intermittent and of localised extent (within one tidal excursion) and reversible.

7.3.2.3 Given the Good performance of the BWs, this indicates that the levels of bacteria within the sediments, in close proximity to these BWs, do not result in a reduction in water quality when mobilised during storm events. This suggests that there are not elevated bacterial concentrations in the seabed sediments in the vicinity of the BWs or the Hornsea Four Order Limits. Furthermore, given the short-term nature of the sediment plumes the relative increases in bacteria are considered to be negligible in terms of BW compliance. No deterioration or non-compliances at the two identified bathing waters are anticipated to occur as a result of the proposed activities.

7.4 Invasive non-native species

7.4.1.1 An assessment of the increased risk of introduction or spread of marine INNS due to presence of infrastructure and vessel movements associated with Hornsea Four is provided in **Volume A2, Chapter 2: Benthic and Intertidal Ecology**.

7.4.1.2 There is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by invasive/ non-indigenous species that might otherwise not have had a suitable habitat for colonisation, thereby enabling their spread. This along with the movement of vessels in and out of the Hornsea Four Order Limits has the potential to impact upon benthic ecology and biodiversity locally and in the broader region.

7.4.1.3 Colonisation in general may result in an overall increased biodiversity; however, it represents a change from the baseline that occurs in the area. Whether this is considered a positive or negative can be subjective, and both are possible. Positive effects could include an increase in abundance of commercially important invertebrate species, which would benefit commercial fisheries. Negative effects could include providing habitat that may allow the establishment of non-native species. Rock outcroppings are known to occur throughout the region; therefore, the introduction of hard substrate will not fundamentally change the type of available habitats available within the wider study area. The existing rocky outcrops may already act as a vector for the spread of INNS. Therefore, the addition of cable protection within the offshore ECC is not considered to provide a significant risk in the spread of INNS.

7.4.1.4 In addition to this, there will be up to 249,756 round trips to port during the construction phase and up to 1,693 round trips to port by operational and maintenance vessels, which will contribute to the risk of introduction or spread of INNS through ballast water discharge. Designed-in measures including a CPEMMP with a marine biosecurity plan (see Co111 of **Volume A4, Annex 5.2: Commitment Register**, see **Table 6**) will, however, ensure that the risk of potential introduction and spread of INNS will be minimised. There is little evidence from other offshore wind farm developments within the North Sea of non-indigenous species having any adverse effects on key species and habitats. Materials and vessels are likely be from within European and/ or UK waters. As a result of these measures, any impacts are expected to be minor.

7.4.1.5 Therefore, taking into the existing hard substrate within the waterbody and the proposed management of INNS, there is not predicted to be a deterioration in the status of the waterbody receptor.

8 Conclusions

8.1.1.1 This WFD Assessment has considered the potential effects of Hornsea Four to ensure that the proposed activities would not cause or contribute to deterioration of status or jeopardise any waterbodies from achieving Good status. The conclusions of the different elements of the WFD assessment are summarised in **Table 10**.

Table 10: Conclusions of the WFD assessment.

Receptor	Conclusion
Hydromorphology	No deterioration of in the status of the waterbody receptor is predicted.
Biology – habitats	No deterioration of in the status of the waterbody receptor is predicted.
Biology – fish	No deterioration of in the status of the waterbody receptor is predicted.
Water quality	No deterioration of in the status of the waterbody receptor is predicted.
Protected areas	No AEoI
Bathing waters	No deterioration of in the status of BWs are predicted.
INNS	No deterioration of in the status of the waterbody receptor is predicted.

9 References

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