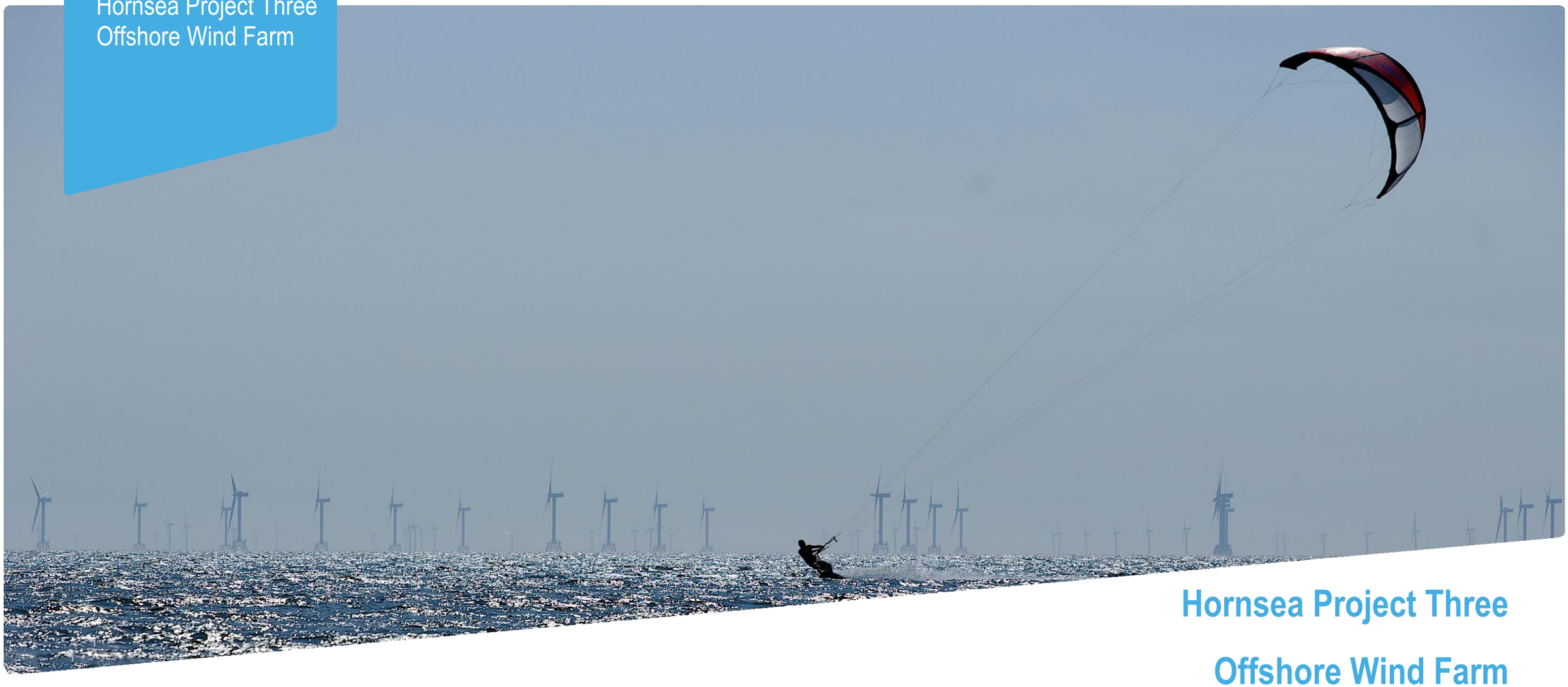
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Environmental Statement:
Volume 5, Annex 2.2 - Water Framework Directive Assessment

PINS Document Reference: A6.5.2.2
APFP Regulation 5(2)(a)

Date: May 2018

Hornsea 3
Offshore Wind Farm

Ørsted

Environmental Impact Assessment

Environmental Statement

Volume 5

Annex 2.2 – Water Framework Directive Assessment

Liability

This report has been prepared by RPS, with all reasonable skill, care and diligence within the terms of their contracts with Orsted Power (UK) Ltd.

Report Number: A6.5.2.2

Version: Final

Date: May 2018

This report is also downloadable from the Hornsea Project Three offshore wind farm website at:

www.hornseaproject3.co.uk

Ørsted

5 Howick Place,

London, SW1P 1WG

Front cover picture: Kite surfer near a UK offshore wind farm © Orsted Hornsea Project Three (UK) Ltd., 2018.

Prepared by: RPS

Checked by: Jennifer Brack

Accepted by: Stuart Livesey

Approved by: Stuart Livesey

Table of Contents

List of Figures

List of Tables

Glossary

Term	Definition
Ballast water	Fresh or salt water, 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 practiced by large numbers of bathers
Entrainment	The entrapment of organisms in a water body (e.g. cooling water)
European site	A Special Area of Conservation (SAC) or candidate SAC, a Special Protection Area (SPA) or potential SPA, a site listed as a Site of Community importance (SCI) or a Ramsar site.
Impingement	The entrapment of organisms on mesh screens used to protect cooling water intakes
Intertidal	An area of a seashore that is covered at high tide and uncovered at low tide.
Mollusc	Invertebrate animal belonging to the phylum Mollusca that includes the snails, clams, chitons, tooth shells, and octopi.
Nitrate vulnerable zones	A conservation designation of the Environment Agency for areas of land that drain into nitrate polluted waters, or waters which could become polluted by nitrates
Polychaete	A class of segmented worms often known as bristleworms.
Shellfish waters	Waters suitable for the farming of shellfish
Subtidal	Area extending from below low tide to the edge of the continental shelf.

Acronyms

Acronym	Description
DCO	Development Consent Order
EMF	Electromagnetic Field
EQSD	Environmental Quality Standards Directive
HDD	Horizontal Directional Drilling
HAT	Highest Astronomical Tide
HMWB	Highly Modified Water Body
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
INNS	Invasive and Non Native Species
MCZ	Marine Conservation Zone
PEIR	Preliminary Environmental Information Report
PEMMP	Project Environmental Management and Monitoring Plan
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
UXO	Unexploded Ordinance
WFD	Water Framework Directive

Units

Unit	Description
%	Percent
km	Kilometre
km^2	Square kilometre
m	Metre
m^2	Square metre
MW	Megawatt
nm	Nautical mile

1. Introduction

1.1.1.1 Orsted Hornsea Project Three (UK) Ltd., on behalf of Orsted Power (UK) Ltd., is promoting the development of the Hornsea Project Three Offshore Wind Farm (hereafter referred to as Hornsea Three). Hornsea Three is a proposed offshore wind farm within the former Hornsea Zone, and includes the associated offshore export cable route (cable) corridor and onshore infrastructure. The proposal is for an offshore wind farm with a capacity of up to 2.4 GW (2,400 MW) which will be situated within the Hornsea Three array area in the east of the former Hornsea Zone. Hornsea Three is located in the North Sea, approximately 121 km to the northeast of Tringham, Norfolk, 140 km to the east of the East Riding of Yorkshire coast and approximately 10.1 km west of the median line between UK and Netherlands waters.

1.1.1.2 RPS was commissioned to undertake a Water Framework Directive (WFD) assessment for Hornsea Three, and specifically the inshore section of the Hornsea Three offshore cable corridor. This Annex of the Environmental Statement provides a WFD Screening, Scoping and Impact Assessment for Hornsea Three. This WFD assessment focuses on those elements of Hornsea Three relevant to the offshore/coastal areas which are required to be assessed against the objectives for each WFD water body (i.e. extending out to 1 nm from MHWS, see Figure 1.1). Assessment of inland WFD water bodies from the 2015 Anglian River Basin Management Plan (RBMP) is covered in volume 3, chapter 2: Hydrology and Flood Risk and therefore not considered further in this assessment.

1.1.1.3 According to guidance provided by the Overarching National Policy Statement for Energy (EN-1) (DECC, 2011) consideration of the WFD (2000/60/EC) is required for any Development Consent Order (DCO) application where a project has the potential to impact on water bodies or protected areas under the Water Framework Directive and has the potential to cause deterioration in the ecological and chemical status of a water body or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. The WFD aims to protect and enhance water bodies within Europe and covers all estuarine and coastal waters out to 1 nm.

1.1.1.4 Under the WFD, coastal waters, estuaries, rivers, man-made docks and canals are divided into a series of water bodies. Within each water body, the WFD sets ecological and chemical objectives. The aim of the WFD was for all water bodies to achieve “good status” by 2015. This aim (“good status” for all water bodies by 2015) was not achieved and therefore the Environment Agency is subsequently aiming to achieve good status in at least 60% of waters by 2021 and in as many waters as possible by 2027. Under all conditions, it requires that there should be no deterioration in status.

1.1.1.5 Using the Environment Agency *Clearing the Waters for All* guidance (Environment Agency, 2016; see also Planning Inspectorate Advice Note Eighteen (Planning Inspectorate, 2017)) and referring to the relevant chapters of the Hornsea Three Environmental Statement, a WFD assessment of the potential for Hornsea Three to have a significant non-temporary effect on WFD parameters at water body level has been carried out. This has been undertaken on the basis of the Hornsea Three information detailed within volume 1 chapter 3: Project Description.

1.1.1.6 This document should be read alongside the following chapters of the Environmental Statement all of which are referred to throughout this document:

- Volume 2, chapter 1: Marine Processes;
- Volume 2, chapter 2: Benthic Ecology;
- Volume 2, chapter 3: Fish and Shellfish Ecology; and
- Report to Inform Appropriate Assessment.

1.2 WFD Assessment Scope

1.2.1.1 Hornsea Three activities of relevance to this WFD Assessment relate to the installation and operation of the offshore export cable within 1 nm of the coast and at the landfall and possible changes to the wave regime due to the presence of operational turbines. The WFD Assessment therefore does not consider any of the offshore elements of the scheme seawards of 1 nm from the coast (other than possible indirect effects on wave regime as described above).

1.2.1.2 Export cables are used for the transfer of power from the offshore substations to the onshore high voltage alternating current (HVAC)/high voltage direct current (HVDC) substation. Up to six export cables will be required for Hornsea Three. The offshore export cables shall be located within the Hornsea Three offshore cable corridor and make landfall near Weybourne Hope on the north Norfolk coast. The maximum design envelope for the Hornsea Three offshore cable corridor and the intertidal area are set out in volume 1, chapter 3: Project Description. The exact location and orientation of the Hornsea Three offshore cable corridor and intertidal shall be determined during an iterative route planning process following the granting of the DCO. The offshore cables will be located wholly within the Hornsea Three offshore cable corridor shown in Figure 1.1.

1.2.1.3 Drawing on the information outlined in volume 1 chapter 3: Project Description, the primary effects associated with laying of the Hornsea Three export cable that are considered to be relevant to the WFD assessment are:

- Offshore cable installation (offshore export cable installation via trenching, dredging, jetting, ploughing or vertical injection and pre-installation activities including boulder and sandwave clearance); and
- Crossing the Hornsea Three intertidal area via trenching or ploughing. Horizontal directional drilling (HDD) may also be used to cross the intertidal, thus minimising or avoiding completely any direct impacts on the intertidal, although for the purposes of this assessment open cut has been assessed as this represents the maximum design scenario.

1.2.1.4 The assessment presented in this document covers the Scoping and Impact Assessment stages of the WFD assessment process; identifying all potential risks to the relevant receptors associated with the proposed activity/activities; identifying those receptors which may require further assessment; receptors that can be scoped out of the WFD assessment and undertaking an Impact Assessment for those receptors where a potential risk is identified. The Impact Assessment focuses on the receptors where risks have been identified and which according to the Environment Agency (2016) guidance should be scoped into the Impact Assessment.

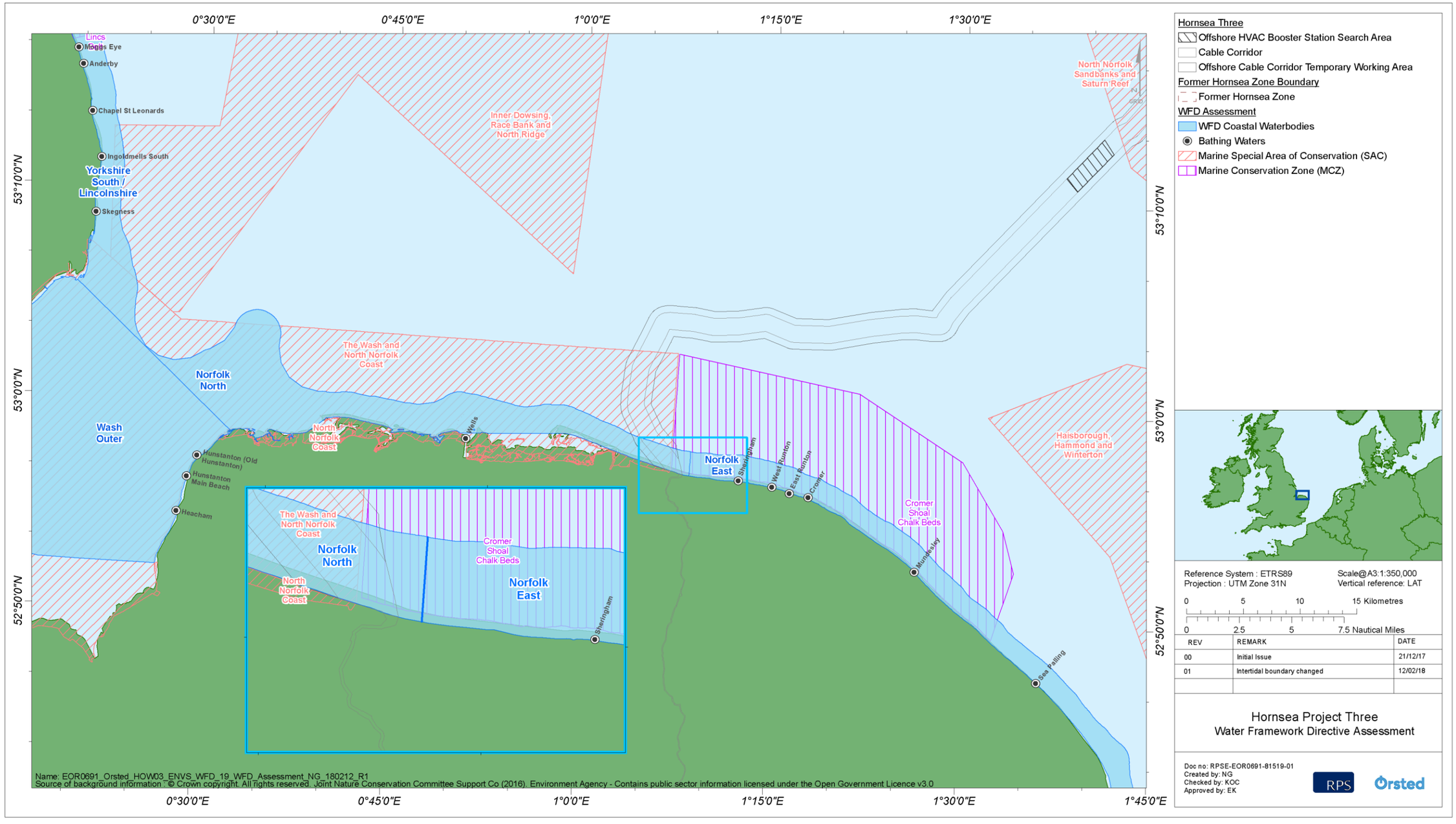


Figure 1.1: Location of Hornsea Three offshore cable corridor and intertidal area (inset) in relation to WFD Coastal Water Bodies, Bathing Waters and Protected Areas.

2. Methodology

2.1.1.1 As stated in paragraph 1.1.1.4, the aim of the WFD was for all water bodies to achieve "good status" by 2015, although this was subsequently updated with the Environment Agency currently aiming to achieve good status in at least 60% of waters by 2021 and in as many waters as possible by 2027.

2.1.1.2 "Good status" comprises two parts. The first is "good ecological status" (or "good ecological potential", for water bodies classed as heavily modified or artificial). The second is "good chemical status". "Good ecological status/potential" includes biological, hydromorphological and physicochemical quality elements and specific pollutants. "Good chemical status" concerns a series of priority substances, including a number of priority hazardous substances. The WFD also requires that relevant protected area objectives (Environment Agency, 2015) are achieved. These are outlined within the Anglian RBMP (Environment Agency, 2015).

2.1.1.3 The current status of water bodies is detailed within River Basin Management Plans (RBMPs) and supporting Appendices. The first RBMPs were published in 2009 and have been superseded by the updated 2015 plans. The 2015 plans included the work undertaken over the preceding last five years and the plans/objectives for the next six years following publication. The Hornsea Three offshore cable corridor is geographically covered by the updated 2015 Anglian RBMP (Environment Agency, 2015). This is applicable to Hornsea Three and information provided within this plan has been drawn upon to provide the characterisation of the environment required for this WFD assessment.

2.1.1.4 The WFD Screening presented within the Hornsea Three Scoping Report (DONG Energy (now Orsted), 2016) was undertaken based on the Environment Agency *Clearing the Waters* guidance (Environment Agency, 2012), which was superseded in late 2016 by the *Clearing the Waters for All* guidance (Environment Agency, 2016). This WFD Assessment has been undertaken following the latest Environment Agency (2016) *Clearing the Waters for All* guidance for assessing impacts in estuarine (transitional) and coastal waters for the WFD. Based on the Environment Agency (2016) 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. The three stages are Screening, Scoping and Impact Assessment and are described in further detail below.

2.1.1.5 Hornsea Three held a meeting with the Environment Agency on the 19 September 2016. The relevant data held by the Environment Agency and the approach to the WFD assessment were discussed at the meeting. In addition, the draft WFD assessment submitted as part of the Preliminary Environmental Information Report (PEIR) was reviewed by the Environment Agency, who were content with the assessment at the PEIR stage; noting that some aspects were to be confirmed for the final WFD assessment to accompany the DCO application (i.e. this document).

2.1.2 Screening

2.1.2.1 According to the Environment Agency *Clearing the Waters for All* guidance (Environment Agency, 2016), screening is required for Hornsea Three as it is not a low risk project, is not a fast-track or accelerated marine licence activity and does not fall into any of the categories of projects where screening is not required (see Environment Agency, 2016). Initial screening information is necessary as part of the Scoping stage and, therefore, this stage is often completed in practice in order to inform the WFD Scoping. Additionally, screening the construction and operational activities of projects enables a high level initial assessment of those activities that could impact on compliance parameters within WFD water bodies.

2.1.2.2 The previous Screening stage presented within the Hornsea Three Scoping Report (DONG Energy (now Orsted), 2016) has informed the scope of the assessment presented in this WFD Assessment.

2.1.3 Scoping

2.1.3.1 The Scoping stage identifies the receptors that are potentially at risk from the proposed activity and therefore may need an Impact Assessment. Scoping is also not required if the activity was carried out during 2009 to 2014 (when evidence was collected for the 2015 RBMPs), where a WFD assessment was already completed and where there are no changes to how the activity is carried out.

2.1.3.2 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;
- Protected areas; and
- Invasive non-native species (INNS).

2.1.3.3 The Environment Agency (2016) guidance provides specific criteria for each of the receptors outlined above to determine if an Impact Assessment is required, and recommends the use of a Scoping template as part of the WFD assessment process. These criteria are considered for each receptor in section 4 of this Annex using the recommended Scoping template.

2.1.4 Impact assessment

2.1.4.1 Following the Scoping stage, if it is determined that the Impact Assessment stage is required, the Environment Agency (2016) 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 water body receptor.

2.1.4.2 Deterioration is when the status of a quality element reduces by one class. For example, biological quality elements move from good to moderate status. If a quality element is already at the lowest status then any reduction in its condition counts as deterioration. According to the Environment Agency (2016) guidelines, temporary effects due to short-duration activities like construction or maintenance are not considered to cause deterioration if the water body would recover in a short time without any restoration measures. Where relevant, mitigation measures should be included to avoid or minimise risks of deterioration.

2.1.4.3 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 water bodies.

2.1.4.4 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.

2.1.4.5 In addition to assessing the potential for deterioration of the current status of a water body, the Impact Assessment must consider the risk of jeopardising good status. Every water body has a target status that it is expected to achieve, with an expected date by when this should be achieved. Where the status of a water body or quality element is less than good, the Impact Assessment should consider whether the activity may jeopardise the water body 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 improvement activities, or measures, can be found in the RBMPs.

2.2 Identification of relevant water bodies

2.2.1.1 With reference to the 2015 Anglian RBMP, the relevant coastal/estuarine water bodies that could be potentially affected by Hornsea Three offshore cable installation activities, due to their locations and associated proximity to the cable installation activities, are the Norfolk East coastal water body (ID GB650503520003) and the Norfolk North coastal water body (ID GB640503300000).

2.2.1.2 Assessment of inland WFD water bodies from the 2015 Anglian RBMP is covered in volume 3, chapter 2: Hydrology and Flood Risk and therefore not considered further in this assessment.

3. Background Information on WFD Water Bodies

3.1 Norfolk East (coastal water body; ID GB650503520003)

3.1.1.1 The Norfolk East coastal water body is designated as a heavily modified water body (HMWB), with flood protection and coastal protection cited as the reasons for this classification. The WFD ecological target for HMWBs is typically good ecological potential, although the target for Norfolk East coastal water body is moderate ecological potential (Environment Agency, 2015) with the justification cited that good ecological potential would be disproportionately expensive. As with all surface water bodies, the default chemical status objective is good chemical status.

3.1.1.2 The Norfolk East WFD coastal water body is at moderate status overall, moderate ecological potential and good chemical potential. The data from the latest 2015 RBMP (Cycle 2) indicates that the water body is currently meeting its WFD objectives in respect of all biological, physico-chemical and supporting elements and specific pollutants. The latest data also indicates that the water body is currently meeting its WFD objectives for chemical quality.

3.1.1.3 In terms of the WFD habitats that are present in the Norfolk East water body, these include chalk reef, polychaete reef, cobbles, gravel and shingle, intertidal soft sediment, subtidal rocky reef and subtidal soft sediments.

3.1.2 Protected areas

3.1.2.1 The 2015 Anglian RBMP provides the status of Protected Areas and only lists the Great Yarmouth North Denes Special Protection Area (SPA), Outer Thames Estuary SPA and Winterton-Horsey Dunes SAC for the Norfolk East WFD water body, none of which are in the vicinity of the Hornsea Three offshore cable corridor. The Hornsea Three offshore cable corridor overlaps with the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ), which is rated as being in favourable condition. Sheringham, which is designated under the Bathing Water Directive, is located approximately 3 km to the east of the Hornsea Three offshore cable corridor (see Figure 1.1) and based on the new Bathing Water Directive standards, was rated as Excellent in 2014 and was not considered to be at risk of failing to comply in 2015.

3.2 Norfolk North (coastal water body; ID GB640503300000)

3.2.1.1 The Norfolk North coastal water body is also designated as a HMWB, with flood protection cited as the reason for this classification. The WFD ecological target is moderate ecological potential (Environment Agency, 2015) with the justification cited that good ecological potential would be disproportionately expensive. As with all surface water bodies, the default chemical status objective is good chemical status.

3.2.1.2 The Norfolk North coastal water body is at moderate status overall, moderate ecological potential and good chemical potential. The data from the latest 2015 RBMP (Cycle 2) indicates that the water body is currently meeting its WFD objectives in respect of its biological quality elements (angiosperms, invertebrates and phytoplankton), physico-chemical (dissolved inorganic nitrogen and dissolved oxygen) and supporting elements. The water body is also meeting its WFD objectives for specific pollutants (arsenic, copper and zinc) as well as its WFD objectives for chemical quality.

3.2.2 Protected areas

3.2.2.1 The nearest Natura 2000 sites of relevance to the Norfolk North coastal water body are the Wash and North Norfolk Coast SAC and the Norfolk Coast SAC/SPA (see Figure 1.1). The Hornsea Three offshore cable corridor is located within both of these Natura 2000 sites at the landfall area. The Hornsea Three offshore cable corridor also overlaps with the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) which is rated as being in favourable condition.

3.2.2.2 The 2015 Anglian RBMP also lists a number of Bathing Waters and designated waters under the Bathing Water Directive, all of which are located outside the Hornsea Three offshore cable corridor. Therefore, only the Wash and North Norfolk Coast SAC and the Norfolk Coast SAC/SPA and the Cromer Shoal Chalk Beds MCZ are proposed for inclusion in the Scoping.

4. Scoping

4.1.1.1 The following details the findings of the Scoping stage of the WFD Assessment for Hornsea Three. This template follows guidance produced by the Environment Agency, i.e. *Clearing the Waters For All* guidance, for assessing impacts on estuarine and coastal WFD water bodies (Environment Agency, 2016).

4.1.1.2 The potential risks of the activity to each of the key receptor groups are considered in the sections below.

4.2 Hydromorphology

4.2.1.1 Table 4.1 provides the specific risk information for hydromorphology receptors.

Table 4.1: Hydromorphology risks.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a high status water body.	-	No – Impact Assessment not required	The activities associated with Hornsea Three will not impact on the hydromorphology of a High status water body. The Norfolk North and Norfolk East water bodies are both of Moderate status.
Could significantly impact the hydromorphology of a water body at less than high status.	-	No – Impact Assessment not required	As per volume 2, chapter 1: Marine processes the potential for any change during construction arises from trenching activities, the installation of cable protection measures and the excavation of HDD exit pits. During the construction phase effects are expected to be of local spatial extent, short term duration and highly reversible, resulting in effects that are of minor adverse significance. Similarly, during operation the presence of cable protection is predicted to result in effects that are of local spatial extent, continuous and reversible and of minor significance. Effects during decommissioning are predicted to be negligible. The operational presence of the Hornsea Three array area has the potential to indirectly affect the shoreline by modifying the sediment transport regime. Wave modelling found that under all scenarios (including cumulatively with other adjacent offshore wind farm projects) there will be no measurable reduction in wave height (>2.5%) at adjacent coastlines and any changes are not predicted to have any indirect impact on hydromorphology or other processes at the coastline (see volume 2, chapter 1: marine processes). Furthermore, as the offshore HVAC booster stations are located in deep water offshore at least 35 km from the coast, they will not affect the wave climate at the shoreline.
Is in a water body that is heavily modified for the same use as your activity	-	No – Impact Assessment not required	The two water bodies are classified as heavily modified for coastal and flood protection.

4.3 Biology

4.3.1 Habitats

4.3.1.1 Table 4.2 provides a summary of the consideration of habitats with higher and lower sensitivity to human pressures for the WFD assessment. Higher sensitivity habitats have a low resistance to, and recovery rate, from human pressures whereas lower sensitivity habitats have a medium to high resistance to, and recovery rate, from human pressures.

4.3.1.2 Table 4.3 provides the specific risk information for biology habitats receptors.

Table 4.2: Habitat sensitivity to human pressures.

Higher Sensitivity Habitats	Lower sensitivity habitats
chalk reef	cobbles, gravel and shingle
clam, cockle and oyster beds	intertidal soft sediments like sand and mud
intertidal seagrass	rocky shore
maerl	subtidal boulder fields
mussel beds, including blue and horse mussel	subtidal rocky reef
polychaete reef	subtidal soft sediments like sand and mud
saltmarsh	
subtidal kelp beds	
subtidal seagrass	

Table 4.3: Biology habitats risks. Note: No direct impacts on habitats within the Norfolk East water body as the Hornsea Three offshore cable corridor is entirely outwith this water body (see Figure 1.1).

Consider if your activity:	Yes	No	Biology habitats risk issue(s)
0.5 km² or larger	Yes	-	***Norfolk North*** Construction phase The maximum length of Hornsea Three offshore cable corridor that crosses the Norfolk North water body is 3,573 m. Based on a 30 m wide seabed disturbance area in the subtidal and six cables the total area affected is 643,140 m². Assuming anchors associated with 3,573 m of cable are placed entirely within the Norfolk North water body, this would equate to a total area of 5,000 m². Assuming intertidal habitat loss/disturbance of up to 12,634 m² (i.e. the entire area of the intertidal cable corridor) through burial of up to 500 m of cable between mean high water springs and mean low water springs, with up to six cable circuits, and due to associated cable construction activities. In total, the area of seabed affected within the North Norfolk water body is 0.661 km². Operational phase Based on 7 m wide cable protection for 10% of the Hornsea Three offshore cable corridor (volume 2, chapter 2: Benthic Ecology) that crosses the North Norfolk water body, the total area of permanent habitat loss is 0.015 km². This is within the area of 0.661 km² of seabed affected by temporary disturbance within the North Norfolk water body.
1% or more of the water body's area	-	No, Impact Assessment not required	***Norfolk North*** The area of seabed affected within the Norfolk North water body (0.661 km²) represents 0.40% of the total area of the water body.
Within 500 m of any higher sensitivity habitat	-	No, Impact Assessment not required	Areas of subtidal chalk reef are present within the Cromer Shoal Chalk Beds MCZ, however site specific sampling indicates there are no such features within 500 m of the Hornsea Three offshore cable corridor. As such, this high sensitivity habitat is not considered to be at risk to a direct impact (i.e. habitat loss) caused by Hornsea Three. This conclusion is reflected in volume 5, annex 2.1: Benthic Ecology Technical Report and volume 5, annex 2.3: MCZ Assessment.
1% or more of any lower sensitivity habitat [a]	-	No, Impact Assessment not required	***Norfolk North*** As per section 2.7 of volume 2, chapter 2: Benthic Ecology, the inshore area within the Norfolk North water body is characterised by subtidal sandy sediments, i.e. the lower sensitivity habitat 'subtidal soft sediments like sand and mud'. Within the Norfolk North water body the area of these habitats is 370.99 km². Therefore the area of disturbance represents 0.18% of the 'subtidal soft sediments like sand and mud'. Due to the small proportions of lower sensitivity habitats predicted to be affected, this impact has been scoped out of the Impact Assessment.

a As defined by the Environment Agency (2016).

4.3.2 Fish

4.3.2.1 Table 4.4 provides the specific risk information for fish receptors.

Table 4.4: Fish risks.

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	-	No, impact assessment not required	The activity will not take place near or within an estuary and is highly unlikely to, or prevent, fish entering or affect fish migrating through any estuary. In addition, in volume 2, chapter 3: Fish and Shellfish Ecology, effects were predicted that would be of negligible to minor adverse significance on populations of fish as a result of Hornsea Three construction, operations and maintenance and decommissioning phases. This included effects from temporary and long term habitat loss, increased suspended sediment concentrations (SSC), underwater noise, electromagnetic fields (EMF), accidental pollution and introduction of hard substrate. No significant impacts on fish populations (including migratory fish populations) were predicted.
Could prevent normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	-	No, Impact Assessment not required	Within volume 2, chapter 3: Fish and Shellfish Ecology effects were predicted that would be of negligible to minor adverse significance on populations of fish as a result of Hornsea Three construction, operation and decommissioning. This included effects from temporary and long term habitat loss, increased SSC, underwater noise, EMF, accidental pollution and introduction of hard substrate. No significant impacts on fish populations were predicted.
Could cause entrainment or impingement of fish	-	No, Impact Assessment not required	No entrainment or impingement will occur as a result of Hornsea Three.

4.4 Water quality

4.4.1.1 Table 4.5 provides the specific risk information for water quality receptors. Table 4.6 provides the specific risk information for water quality receptors in relation to the release of chemicals. Table 4.7 provides the specific risk information for water quality receptors in relation to mixing zones.

Table 4.5: Water quality risks.

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring-neap tidal cycle (about 14 days)?	-	No, Impact Assessment not required	Water clarity is likely to be affected following trenching during cable installation and due to the excavation of HDD exit pits. Sediments are mainly composed of sand, potentially with subcropping chalk. Volume 2 chapter 1: Marine Processes demonstrates that any effects from trenching through chalk and sand are expected to be of local spatial extent, short term duration (i.e. plume effects lasting seconds to minutes in any one location) and highly reversible, resulting in effects that are of minor adverse significance and therefore not significant. Effects during decommissioning are predicted to be negligible.
Is in a water body with a phytoplankton status of moderate, poor or bad	-	No, Impact Assessment not required	The two water bodies are classified as having a phytoplankton status of good.
Is in a water body with a history of significant and persistent algal blooms or toxic algal blooms	-	No, Impact Assessment not required	The two water bodies do not have a history of significant and persistent algal blooms or toxic algal blooms. However, the history of harmful algal blooms is not monitored for both water bodies.

Table 4.6: Water quality risks in relation to the use or release of chemicals

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	-	No, Impact Assessment not required	Bentonite and agar (both natural substances) may be used during HDD activity. Neither agar, nor bentonite and its constituent components are listed on the EQSD list. Any potential risk of accidental release of contaminants will be minimised through the implementation of a Project Environmental Management and Monitoring Plan (PEMMP) during the construction, and operation and maintenance phases.
It disturbs sediment with contaminants above Cefas Action Level 1	-	No, Impact Assessment not required	The sediments present do not contain significant levels of fine material, being composed of coarse sand and gravel. Therefore it is unlikely that significant amounts of contaminants will be present in sediments. Sampling during the site specific environmental surveys (see volume 2, chapter 2: Benthic Ecology) indicated there are no contaminants that exceed the Cefas Action Level 1 in the nearshore environment (both within and adjacent to the WFD water bodies).

Table 4.7: Water quality risks in relation to mixing zones.

If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	Yes	No	Water quality risk issue(s)
It will release Environmental Quality Directive (EQSD) listed chemicals.	-	No, Impact Assessment not required	Hornsea Three does not include a discharge pipeline or outfall.

4.5 WFD protected areas

4.5.1.1 The WFD assessment also considers if WFD protected areas are at risk from the proposed activity. These include:

- Special Areas of Conservation (SAC);
- Special Protection Areas (SPA);
- Shellfish waters;
- Bathing waters;
- Nutrient sensitive areas – polluted or eutrophic; and
- Nitrate vulnerable zones (NVZ) – polluted or sensitive.

4.5.1.2 Marine Conservation Zones (MCZs) are not listed in the Environment Agency (2016) guidance. However, as a protected area at risk from the proposed activities the Cromer Shoal Chalk Beds MCZ has been included in the assessment.

4.5.1.3 The Wash and North Norfolk Coast SAC, North Norfolk Coast SAC/SPA and Cromer Shoal Chalk Beds MCZ coincide with the Hornsea Three offshore cable corridor and intertidal area and are within the MMO 'environmental sensitivity supplement' 2 km Screening trigger, therefore these sites and have been taken forward into the Scoping assessment in Table 4.8. All bathing waters are outside 2 km of the cable corridor (see Figure 1.1). Table 4.8 outlines the protected area risks for Hornsea Three.

Table 4.8: Protected designated area risks.

Consider if your activity:	Yes	No	Protected areas risk issue(s)
Within 2 km of any WFD protected area	-	No, Impact Assessment not required	The activity is within 2 km of the North Norfolk Coast SAC/SPA. The North Norfolk Coast SAC is designated for a number of terrestrial features (e.g. coastal lagoons landward of highest astronomical tide (HAT), dunes etc.) and therefore there is no connectivity between the Hornsea Three activity in the subtidal and intertidal areas and these features. In addition, the North Norfolk Coast SPA is designated for a number of over wintering and breeding bird species. The Hornsea Three Report to Inform Appropriate Assessment (document reference number A5.2) demonstrates no Likely Significant Effects on the SPA from the Hornsea Three cable installation activity in subtidal and intertidal areas.
	Yes	-	The Hornsea Three offshore cable corridor coincides with the Wash and North Norfolk Coast SAC and therefore this is screened in for further consideration in the impact assessment (section 5). Impacts on the SAC and its qualifying features are considered in the Hornsea Three Report to Inform Appropriate Assessment (document reference number A5.2).
	Yes		The Hornsea Three offshore cable corridor coincides with the Cromer Shoal Chalk Bed MCZ and therefore this is screened in for further consideration in the impact assessment (section 5). Impacts on the Cromer Shoal Chalk Beds MCZ and its features of interest are considered in volume 5, annex 2.3: Marine Conservation Zone Assessment.

4.6 Invasive and non-native species

4.6.1.1 Table 4.9 outlines the INNS risks for Hornsea Three.

Table 4.9: Invasive and non-native species risks.

Consider if your activity:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	-	No, impact assessment not required	As discussed, volume 2, chapter 2: Benthic Ecology, new hard substrate habitat (foundations, cable protection and scour protection) will be introduced to the marine environment, the vast majority of which will be located in the Hornsea Three array area, over 100 km to the north of the relevant WFD water bodies considered here. Cable protection may be introduced to the Norfolk North water body, although if this is required, this is likely to be limited to small areas of cable protection (e.g. rock protection). This introduced hard substrate has the potential to provide new habitat for the potential colonisation by INNS. In addition, during the operation and maintenance phase, there will be up to 10,774 vessel return trips during the construction phase and 2,8885 round trips to port by operational and maintenance vessels per year, which will contribute to the risk of introduction or spread of INNS in ballast water. However, the majority of these vessel movements are also likely to be around the Hornsea Three array area, with only a small proportion of these within the boundaries of the Norfolk North water body (and to a lesser extent the Norfolk East water body). Designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the International Maritime Organization (IMO) ballast water management guidelines will 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 will be from within European and / or UK waters. As a result of these measures any impacts are expected to be of minor adverse significance and as a result not significant.

4.7 Scoping Summary

4.7.1.1 The results of the WFD Scoping are summarised in Table 4.10.

Table 4.10: Water Framework Directive Scoping summary.

Receptor	Potential risk to receptor	Notes
Hydromorphology	No	N/A
Biology: habitats	Yes	The area of seabed affected within the North Norfolk water body is 0.661 km^2
Biology: fish	No	N/A
Water quality	No	N/A
Protected areas	Yes	Impacts on the Cromer Shoal Chalk Beds MCZ and its features are considered in volume 5, annex 2.3: Marine Conservation Zones Assessment (see section 5.2). Impacts on the Wash and North Norfolk Coast SAC and its features are considered in the Report to Inform Appropriate Assessment (document reference number A5.2; see also section 5.2 below).
Invasive non-native species	No	N/A

5. Impact Assessment

5.1 Biology: Habitats

5.1.1 Norfolk North water body

5.1.1.1 As detailed in section 4.3.1 above, cable installation may result in temporary habitat loss/disturbance of up to 0.661 km^2 within the Norfolk North water body during the construction phase. All temporary habitat loss/disturbance will occur with subtidal sandy sediments or in intertidal areas. Further detail on sensitivity and recovery potential of this habitat is provided below, allowing for a conclusion to be made with regard to deterioration of this quality element receptor and therefore deterioration of the current status of the water body (section 2.1.4). The Hornsea Three landfall was characterised by barren shingle and sand, with little or no intertidal fauna. As such, volume 2, chapter 2 did not assess the effects of intertidal cable installation as there were no ecological receptors identified and therefore there are no predicted effects on the intertidal ecology at the Hornsea Three landfall.

5.1.1.2 Works associated with subtidal cable installation within the Norfolk North water body will include sandwave clearance which will remove sediments by dredging, abrasion/disturbance of surface substratum through boulder clearance, anchor placement and jack up barge operations and penetration of the substrate during cable installation via trenching, jetting or ploughing (see volume 2, chapter 2: Benthic Ecology for further details).

5.1.1.3 Although the overall offshore construction phase of the Hornsea Three offshore cable corridor may be over up to eight years, construction activities resulting in temporary habitat loss/disturbance will not occur for the entire duration. Within the construction phase, export cable installation will occur over a period of up to three years, with pre-construction activities (e.g. pre-construction geotechnical surveys; pre-lay grapnel runs; sandwave clearance and the deposition of sandwave clearance material; boulder clearance; unexploded ordinance (UXO) clearance; pre-trenching/pre-sweeping; and out of service cable removal) occurring approximately one to two years prior to the start of construction. Following cable installation, it is expected that sediments will recover into affected areas, with cable trenches and jack-up footprints being quickly infilled by mobile sediments transported by wave and tidal action volume 2, chapter 1: Marine Processes).

5.1.1.4 The sensitivity of the communities associated with sandy sediments is discussed in detail in volume 2, chapter 2: Benthic Ecology, with a summary provided here. Two biotopes have been identified in the sandy habitat in this section of the Hornsea Three offshore cable corridor; SS.SSa.IFiSa.NcirBat (*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand; hereafter referred to as NcirBat) and SS.SCS.ICS.MoeVen (*Moerella* spp. with venerid bivalves in infralittoral gravelly sand; hereafter referred to as MoeVen); see volume 2, chapter 2: Benthic Ecology.

5.1.1.5 NcirBat communities are naturally subject to, and tolerant of, high levels of physical disturbance. The predominantly infaunal community are capable of re-burrowing following disturbance (Tillin, 2016a) although construction activities that remove sediment (e.g. seabed preparation) are likely to remove animals that are shallowly buried. Although resistance to abrasion/disturbance of the surface is none to low (for example, this could collapse burrows and damage species through compression), the resilience of these communities is assessed as high. Sediment recovery will be enhanced by wave action and mobility of sand and the characterising species are likely to recover through transport of adults in the water column or migration from adjacent patches. Overall sensitivity to abrasion and disturbance is therefore considered to be low (Tillin, 2016a). Biotope resistance is assessed as low but resilience is assessed as high. The overall sensitivity is therefore low.

5.1.1.6 The MoeVen biotope has a typically low sensitivity to impacts resulting from physical disturbance/abrasion and displacement (Tillin, 2016b). MoeVen, which is characterised by polychaetes and venerid bivalves, is unlikely to experience anything other than minor localised declines in species richness. Most of the infauna will be expected to rebury following displacement with only a small degree of mortality resulting from predation. Although some permanently attached species such as epifaunal hydroids and bryozoans will suffer mortality when removed from the substratum during construction activities, other epifaunal species which remain attached to their substrate will likely survive any physical damage and repair themselves. For example, Silén (1981) demonstrated that damage to the fronds of these species can be repaired within five to ten days. Overall, the high recoverability of the component species of this habitat following removal, displacement and physical disturbance, indicates that damaged or reduced populations will recover numbers and percentage cover within months, with full recovery of polychaete dominated biotopes within five years (Tillin, 2016b; 2016c). This is also supported by some data from the aggregates industry which has shown that following the cessation of dredging activities, sand and gravel communities typically recover in two to three years (Newell *et al.,* 1998).

5.1.1.7 Due to the short term and reversible nature of temporary habitat loss impacts on subtidal sandy habitats, there is no potential for deterioration of the status of this quality element. This is in line with the Environment Agency (2016) guidelines which state, as detailed in paragraph 2.1.4.2, temporary effects due to short-duration activities like construction or maintenance are not considered to cause deterioration if the water body would recover in a short time without any restoration measures. Further, there is also no potential for jeopardising the potential of this quality element achieving good status in the future. Further, there is also no potential for jeopardising the potential of this quality element achieving good status in the future.

5.1.1.8 Cable protection, causing permanent habitat loss, may be installed on up to 10% of the cable length within the Norfolk North water body. This area is within the 0.661 km^2 of seabed affected by temporary disturbance considered in the Impact Assessment in paragraphs 5.1.1.1 to 5.1.1.7, above. However, the area affected (0.015 km^2) is based on a maximum adverse scenario and is within the Scoping threshold of 0.5 km^2 affected seabed. As such, an assessment for permanent loss of habitat is not required.

5.2 Protected areas

5.2.1.1 As detailed in section 4.5, the Hornsea Three offshore cable corridor coincides with the Cromer Shoal Chalk Beds MCZ and the Wash and North Norfolk Coast SAC and therefore has the potential to affect the interest features of these sites. Effects on this site are considered within volume 5, annex 2.3: MCZ Assessment which accompanies the Environmental Statement. The MCZ assessment has concluded no significant effects on the features of the Cromer Shoal Chalk Beds MCZ. Similarly, the Hornsea Three Report to Inform Appropriate Assessment (document reference number A5.2) has concluded no adverse effects on integrity of the Wash and North Norfolk Coast SAC as a result of the proposed works.

5.2.1.2 Due to the conclusions of no significant effects on the Cromer Shoal Chalk Beds MCZ and no adverse effect on integrity of the Wash and North Norfolk Coast SAC (i.e. WFD Protected Areas), there is no potential for deterioration of the status of this quality element of the Norfolk North and Norfolk East coastal water bodies, nor is there potential for jeopardising the potential of this quality element achieving good status in the future.

6. Conclusion

6.1 Conclusion

6.1.1.1 Based on the Scoping presented in section 4 and the Impact Assessment in section 5, there is no potential for deterioration of the status of the Norfolk North and Norfolk East water bodies. In most instances, the relevant activities for the construction and installation of the Hornsea Three offshore cable corridor do not require assessment as they are below the thresholds set by the Environment Agency (2016) guidance. With respect to Biology: Habitats the criteria which determine whether an Impact Assessment is required were met for the total area affected within the Norfolk North water body (i.e. an area greater than 0.5 km^2). This was also the case for protected areas, as the Hornsea Three offshore cable corridor coincides with the Cromer Shoal Chalk Beds MCZ and the Wash and North Norfolk Coast SAC, the features of these protected areas have the potential to be impacted by the activities.

6.1.1.2 Based on the low sensitivity of the habitats affected by cable installation within the Norfolk North water body and the recovery potential of both sediments and associated communities, any effects will be temporary and reversible and therefore do not represent a deterioration of the status of this quality element of the Norfolk North water body, nor is there potential for jeopardising the potential of this quality element achieving good status in the future.

6.1.1.3 However, as outlined in section 5.2, volume 5, annex 2.3: Marine Conservation Zone Assessment concludes no significant effects on the features of the Cromer Shoal Chalk Beds MCZ and the Hornsea Three Report to Inform Appropriate Assessment (document reference number A5.2) concluded no adverse effect on integrity of the Wash and North Norfolk Coast SAC. Therefore, there is no potential for deterioration of the status of this quality element of the Norfolk North or Norfolk East coastal water bodies, nor is there potential for jeopardising the potential of this quality element achieving good status in the future.

7. References

De-Bastos, E. and Marshall, C.E. (2016a) *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available online: http://www.marlin.ac.uk/habitat/detail/374 [Accessed on 4 January 2018].

DONG Energy (2016) Hornsea Project Three Offshore Wind Farm Environmental Impact Assessment Scoping Report. London, DONG Energy.

Environment Agency (2015) Water for life and livelihoods: Anglian river basin district River basin management plan. December 2015. Available online: https://www.gov.uk/government/publications/anglian-river-basin-district-river-basin-management-plan

Environment Agency (2016) Clearing the Waters for All. Water Framework Directive assessment: estuarine and coastal waters guidance. Available at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

Environment Agency (2012). Clearing the waters. Marine dredging and the Water Framework Directive. Available at https://www.gov.uk/government/publications/complying-with-the-water-framework-directive-marine-dredging

Newell, R.C., Seiderer, L.J. and Hitchcock, D.R. (1998) The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources in the sea bed. Oceanography and Marine Biology: Annual Review, 36, 127-178.

Planning Inspectorate (2017) Advice Note Eighteen: The Water Framework Directive. Version 1, June 2017.

Silén, L. (1981) Colony structure in *Flustra foliacea* (Linnaeus) (Bryozoa, Cheilostomata) Acta Zoologica (Stockholm.), 62, 219-232.

Tillin, H.M. & Hill, J.M. (2016) Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-12-2017]. Available online: http://www.marlin.ac.uk/habitat/detail/152http://www.marlin.ac.uk/habitat/detail/152 [Accessed on 4 January 2018].

Tillin, H.M. (2016a) *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available online: http://www.marlin.ac.uk/habitat/detail/154 [Accessed on 4 January 2018].

Tillin, H.M. (2016b) *Moerella* spp. with venerid bivalves in infralittoral gravelly sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available online: http://www.marlin.ac.uk/habitat/detail/1111 [Accessed on 4 January 2018].

Tillin, H.M. (2016c) Polychaete-rich deep Venus community in offshore gravelly muddy sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from online: http://www.marlin.ac.uk/habitat/detail/1117 [Accessed on 4 January 2018].