Hornsea 4

Ørsted

Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 5, Annex 2.3: Marine Conservation Zone Assessment

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Glossary

Term	Definition
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from a number of different projects, on the same single receptor/resource.
Cumulative impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Four.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI).
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Four	The proposed Hornsea Project Four offshore wind farm project; the term covers all elements within the DCO (i.e. both the offshore and onshore components).

Acronyms

Acronym	Definition
AC	Alternating Current
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
DC	Direct Current
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EP	Evidence Plan
ES	Environmental Statement
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IROPI	Imperative Reasons Of Over-Riding Public Interest
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MFE	Mass Flow Excavation
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
SAC	Special Area of Conservation
SNCB	Statutory Nature Conservation Bodies
SoS	Secretary of State
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SSSI	Sites of Special Scientific Interest
WTG	Wind Turbine Generator

Units

Unit	Definition
kV	Kilovolt
m	Metre
km	Kilometre
ms^{-1}	Metres per second
mg/l	Milligrams per litre

1 Introduction

1.1 Project background

1.1.1.1 Ørsted Hornsea Project Four Ltd (hereafter the Applicant) is proposing to develop the Hornsea Project Four offshore wind farm (hereafter Hornsea Four). Hornsea Four will be located approximately 65 km offshore from the East Riding of Yorkshire coast in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone (please see **Volume 1, Chapter 1: Introduction** for further details on the Hornsea Zone). Hornsea Four will include both offshore and onshore infrastructure including offshore generating stations (within the wind farm), export cables to the landfall, and connection to the electricity transmission network (please see **Volume 1, Chapter 4: Project Description** for full details on the Project Design).

1.2 Aims and objectives

1.2.1.1 Specific consideration of Marine Conservation Zones (MCZs) is required for any Marine Licence or Development Consent Order (DCO) application containing deemed Marine Licences (dMLs). The Marine Management Organisation (MMO) has specific duties for MCZs and Marine Licence decision making under section 126 of the Marine and Coastal Access Act (MCAA) 2009. Section 126 applies where:

- A public authority has the function of determining an application (whenever made) for authorisation of the doing of an act; and
- The act is capable of affecting (other than insignificantly):
    - The protected features of an MCZ; and/ or
    - Any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependent.

1.2.1.2 This document has been produced as an annex to the Hornsea Four Preliminary Environmental Information Report (PEIR) to provide evidence on whether the potential impacts of Hornsea Four give rise to a significant risk of hindering the conservation objectives of the following two MCZs that have been identified within one tidal excursion (up to 15 km) of Hornsea Four are shown in **Figure 1**:

- Holderness Inshore MCZ; and
- Holderness Offshore MCZ.

1.2.1.3 This document follows guidance published by the MMO (2013) on how these assessments should be undertaken. The MCZ assessment has been undertaken on the basis of Hornsea Four project information as detailed within **Volume 1, Chapter 4: Project Description**.

1.2.1.4 This MCZ assessment should be read alongside the following chapters of the PEIR, which are referred to and drawn upon throughout this document:

- **Volume 1, Chapter 4: Project Description**;
- **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**;
- **Volume 2, Chapter 2: Benthic and Intertidal Ecology**;
- **Volume 5, Annex 1.1: Marine Geology, Oceanography and Physical Processes Technical Report**; and
- **Volume 5, Annex 2.1: Benthic and Intertidal Ecology Technical Report**.

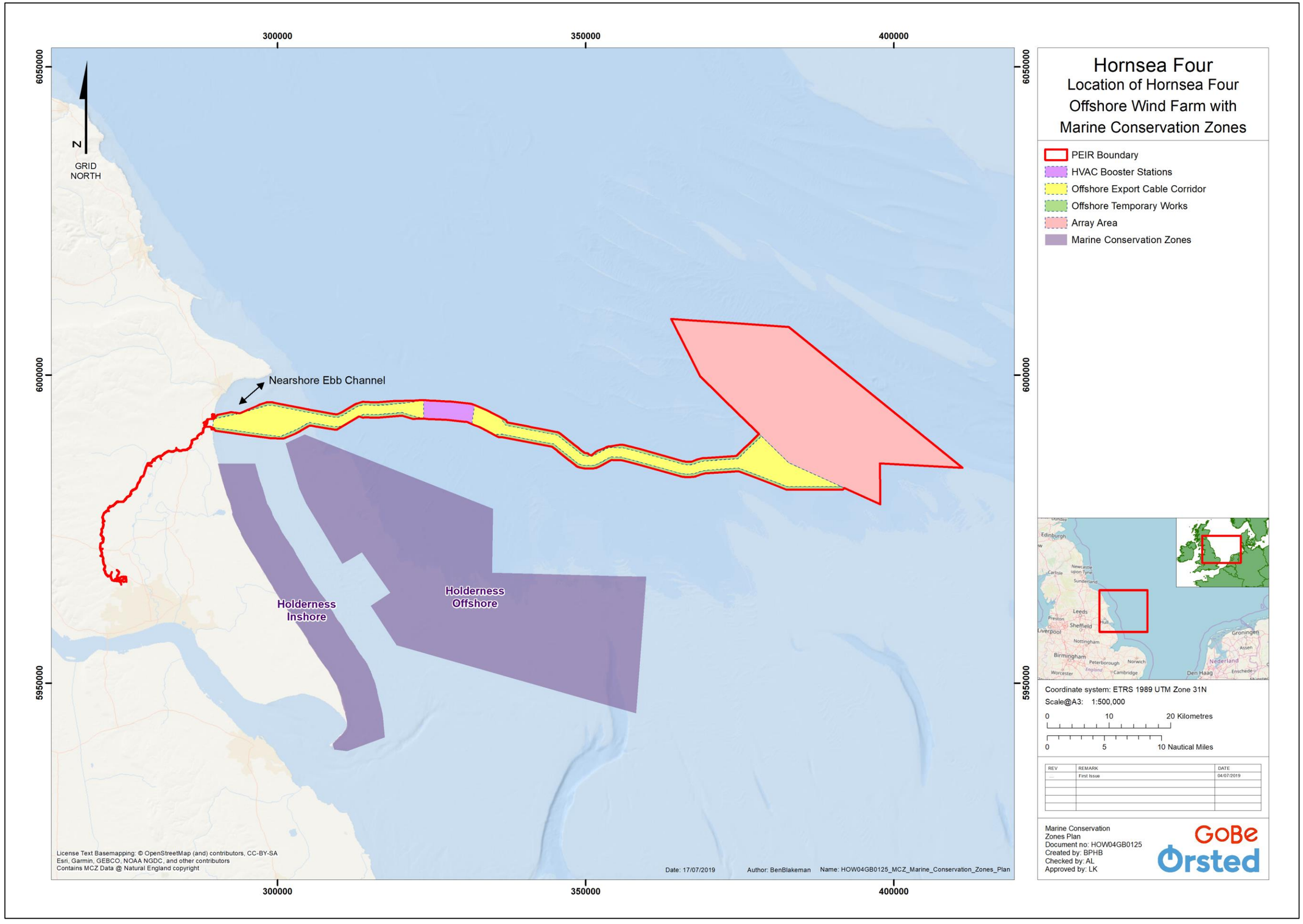

Figure 1: Marine Conservation Zones (MCZs) within one tidal excursion of Hornsea Four (not to scale).

1.3 Project overview

1.3.1.1 This section provides a brief overview of the key components of Hornsea Four (**Figure 1**). A full description of the project is described in **Volume 1, Chapter 4: Project Description.**

1.3.1.2 In order to inform the Environmental Impact Assessment (EIA), Hornsea Four has created an indicative layout of 190 positions, containing 180 potential wind turbine generator (WTG) positions and the 10 potential platform positions (offshore substations, accommodation platform and High Voltage Alternating Current (HVAC) booster stations). The Hornsea Four array area covers 600 km^2 and will be approximately 65 km due east of Flamborough Head at its closest point and adjacent to Hornsea Project Two Offshore Wind Farm (hereafter Hornsea Project Two) on the eastern boundary.

1.3.1.3 The export cable corridor (ECC) that links the Hornsea Four array area to the export cable landfall location has been refined since scoping (from 3 km to 1.5 km wide). A major consideration on the landfall for the ECC was an early project decision to commit to the avoidance of both the Holderness Inshore MCZ and the Holderness Offshore MCZ (see Commitments 44 and 45 in **Volume 4, Annex 5.2: Commitments Register**, and **Table 2** below).

1.3.1.4 Hornsea Four will include up to a maximum of six offshore electrical export cables (HVDC or HVAC) within a 1,500 m. Where possible, the cable will be buried below the seabed (1-3 m) to landfall, through one or a combination of trenching, dredging, jetting, ploughing, vertical injection, mass flow excavation (MFE) and rock cutting. For detailed cable installation techniques see **Volume 1, Chapter 4: Project Description**.

1.3.1.5 The Hornsea Four offshore boundaries were selected following a consideration of both engineering and environmental matters. For further details regarding the site selection of Hornsea Four see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives**.

2 Consultation

2.1.1.1 In order to determine whether an MCZ assessment was required for Hornsea Four, an initial screening exercise was undertaken as part of the Hornsea Four EIA Scoping Report, Annex F (Ørsted, 2018). Comments received as part of the Scoping process in relation to MCZs are summarised in **Table 1.**

2.1.1.2 Ongoing consultation post-scoping has been important in the evolution of the project and the parameters for assessment. As part of the EIA process, ongoing consultation has been undertaken with various statutory and non-statutory authorities, under the auspices of the Evidence Plan (EP). EP discussions in relation to MCZs have also been summarised in **Table 1.**

Table 1: Summary of consultation relating to the MCZ Assessment.

Consultee, Forum and Date	Comment	Where addressed in the PEIR
Natural England, Scoping Response, November 2018	In relation to the screening criteria proposed by Hornsea Four (suspended sediment dispersal ranges from other Hornsea projects)	**Appendix A** of **Volume 5, Annex 1.1: Marine Processes Technical Report** compares the environmental conditions between Hornsea Project One, Hornsea Project Two and Hornsea Three with Hornsea Four. In

Consultee, Forum and Date	Comment	Where addressed in the PEIR
	it needs to be clearly demonstrated why the assumptions made in relation to other projects are appropriate in the context of Hornsea Four.	addition, the final options for Hornsea Project One and Hornsea Project Two are now based on a fewer number of smaller foundations which would further lessen their potential environmental impact.
Natural England, Scoping Response, November 2018	Direct impacts should not be scoped out of the MCZ assessment until it can be clearly demonstrated that the cable route and working area does not directly interact with the features of the MCZ. Concerns raised about how Commitment to avoid MCZs will be secured.	Hornsea Four has made Commitments (Co44, and Co45 – see **Volume 4, Annex 5.2: Commitments Register**) to avoid any spatial overlap with the Holderness Inshore MCZ and the Holderness Offshore MCZ, so that the offshore ECC, will not interact directly with either site. As a result, the ECC boundary is approximately 4,450 m from the boundary of the Holderness Inshore MCZ and approximately 753 m from the boundary of the Holderness Offshore MCZ (**Figure 1**). This avoidance will be secured by means of the Hornsea Four Order limits that will be defined in the final DCO application DCO and dMLs. As such, any direct impacts are scoped out.
Natural England, EP Marine Ecology & Processes Technical Panel Meeting 3, April 2019	Concerns raised about the Scoping boundary apparent overlap with the Holderness Inshore MCZ and Holderness Offshore MCZ.	

3 Commitments

3.1.1.1 Hornsea Four has made several Commitments (primary design principles inherent as part of the project, installation techniques and engineering designs/modifications as part of its pre-application phase, to eliminate a number of impacts or reduce impacts as far as possible). Further commitments (adoption of best practice guidance) are embedded as an inherent aspect of the EIA process.

3.1.1.2 The Commitments adopted by Hornsea Four in relation to the MCZ assessment are presented in **Table 2**, for a full list of the Commitments made by Hornsea Four see **Volume 4, Annex 5.2: Commitments Register**.

Table 2: Relevant MCZ Commitments.

Commitment ID	Measure proposed	How the measure will be secured
Co44	The Holderness Inshore Marine Conservation Zone (MCZ) will not be crossed by the offshore export cable corridor including the associated temporary works area.	Secured in DCO Schedule 1, Part 1 Authorised Development.
Co45	The Holderness Offshore MCZ will not be crossed by the offshore export cable corridor including the associated temporary works area.	Secured in DCO Schedule 1, Part 1 Authorised Development.
Co48	Annex I habitats will be avoided where possible, informed through the undertaking of geophysical survey works pre-construction. This excludes features of Smithic Sands which at the time of application is not designated.	DCO Schedule 11, Part 2 - Condition 12(1) and; DCO Schedule 12, Part 2 - Condition 12(1)
Co83	Where possible, cable burial will be the preferred option for cable protection.	DCO Schedule 11, Part 2 - Condition 12(h) and; DCO Schedule 12, Part 2 - Condition 19(h)
Co84	Presence of sensitive habitats will be identified through a review of the latest available benthic datasets and pre-construction surveys. Wind turbine foundations and the offshore export cable will be micro-sited around Annex I habitats wherever reasonably practicable (subject to agreement with the MMO) to an extent not resulting in a hazard for marine traffic and Search & Rescue capability.	DCO Schedule 11, Part 2 - Condition 12(1) and; DCO Schedule 12, Part 2 - Condition 12(1) (Pre-construction plans and documentation)

4 Methodology

4.1 Introduction

4.1.1.1 Guidance published by the MMO (2013) describes how MCZ Assessments could be undertaken in the context of marine licensing decisions (Note: there is no published PINS guidance or advice on MCZ Assessments for DCO applications). These MMO guidelines recommend a staged approach to the assessment, with three sequential stages: Screening, Stage One Assessment and Stage Two Assessment (see **Figure 2**). Full details of each of these stages of the approach have been provided in the following sections.

4.1.1.2 If certain activities, sites or impacts are screened into the MCZ assessment process, these are then considered within the Stage One Assessment, followed by Stage Two Assessment if significant risks to the achievement of the MCZ conservation objectives have been identified in the Stage One Assessment.

4.1.1.3 This assessment has considered MCZs that have been designated during the first three tranches of MCZ designations (Tranche One in 2013, Tranche Two in 2016, and Tranche Three in 2019). The Holderness Offshore MCZ became fully designated on 31 May 2019, and therefore the site's Conservation Objectives have been taken into consideration in completing this assessment.

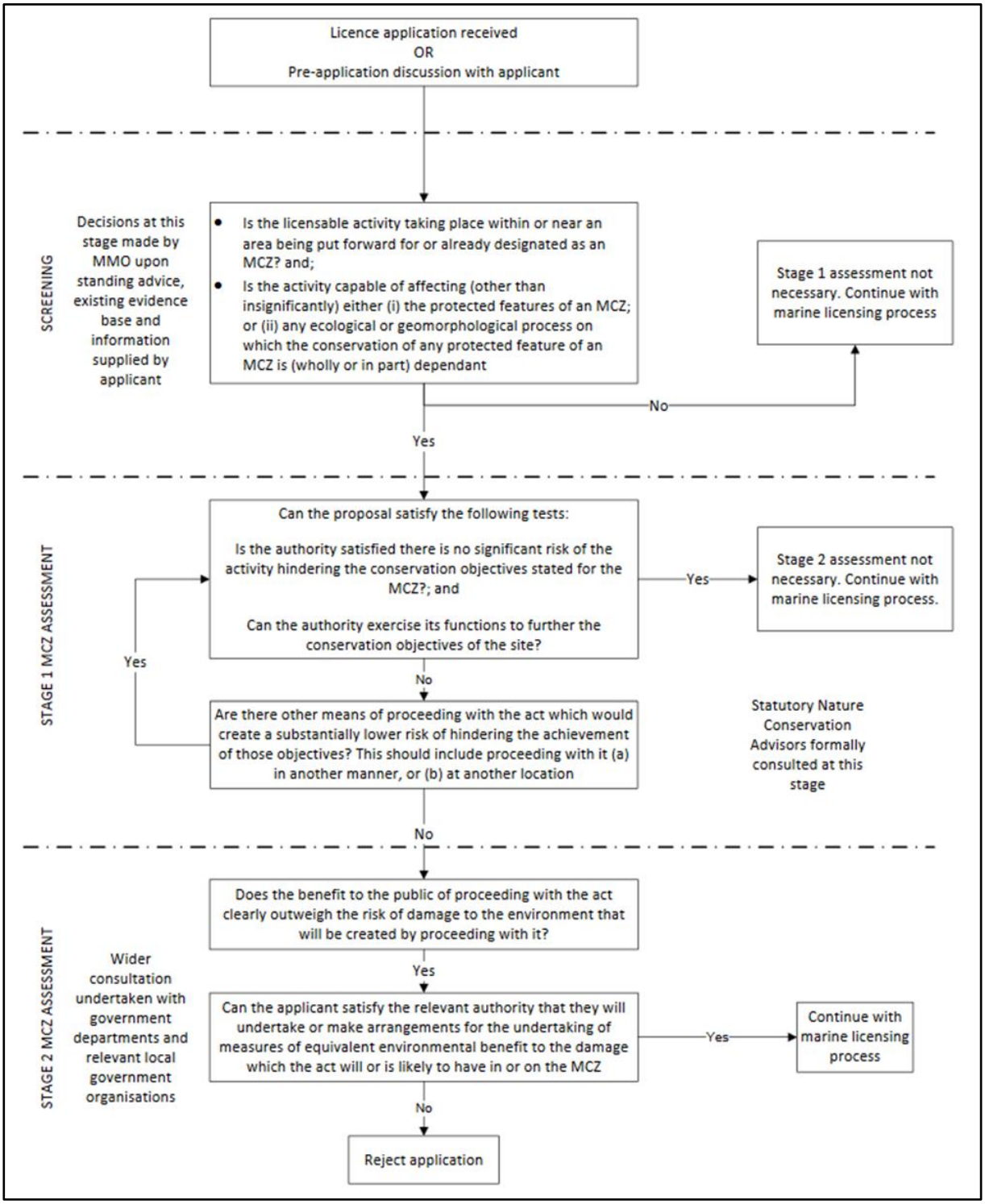

Figure 2: Summary of the MCZ assessment process used by the MMO (MMO, 2013).

4.2 Screening

4.2.1.1 According to the MMO (2013) guidance, all marine licence applications need to be screened to determine whether section 126 should apply to the application. It would apply if it is determined through the course of screening that:

- *The licensable activity is taking place within or near an area being put forward or already designated as an MCZ; and*
- *The activity is capable of affecting (othering than insignificantly) either (i) the protected features of an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant.*

4.2.1.2 In undertaking the screening, the following guidance is applied:

- The MMO recommends the use of a risk-based approach when determining the *'nearness'* of an activity to MCZs, including applying an appropriate buffer zone to the MCZ features under consideration as well as a consideration of risks for activities at greater distances from features of the MCZ(s); and
- In determining *'insignificance'*, the likelihood of an activity causing an effect, the magnitude of the effect (should it occur), and the potential risk any such effect may cause on either the protected features of an MCZ or any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant should be considered.

4.2.1.3 For the purposes of undertaking the Hornsea Four MCZ screening, MCZs that have considered within this assessment are those that were identified through the Hornsea Four EIA Scoping Report, Marine Conservation Zone Screening (Hornsea Four EIA Scoping Report, Annex F).

4.3 Stage One Assessment

4.3.1.1 The Stage One Assessment (if/ as required) should consider whether the conditions in section 126(6) of the MCAA can be met, namely can the decision-maker be satisfied there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ. In doing so, the MMO uses the information supplied by the Applicant, together with advice provided by the Statutory Nature Conservation Bodies (SNCBs) and any other relevant information, to determine whether *'there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ'* (MCAA, Section 126(6) 2009).

4.3.1.2 If the condition in Section 126(6) cannot be met, the Stage One assessment should consider whether the condition in Section 126(7)(a) of the MCAA can be met; this states that if *'there is no other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of those objectives' (MCAA, Section 126(7)(a) 2009).* In doing so the MMO should determine whether there are no other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of the conservation objectives stated for the MCZ. This should include proceeding with it (a) in another manner, or (b) at another location.

4.3.1.3 In undertaking a Stage One assessment, the MMO formally consults with SNCBs for a period of 28 days unless the SNCB notifies the MMO that it need not wait for the full period or the MMO determine that there is an urgent need to grant authorisation (in accordance with Section 126(4).

4.3.1.4 The MMO (2013) guidance states that within this stage of assessment, *'hinder'* (in the context of the conservation objectives) would be any act that could, either alone or in-combination:

- *In the case of a conservation objective of 'maintain', increase the likelihood that the current status of a protect feature would go downwards (e.g. from favourable to degraded) either immediately or in the future (i.e. these protected features would be placed on a downward trend); or*
- *In the case of a conservation objective of 'recover', decrease the likelihood that the current status of a protected feature could move upwards (e.g. from degraded to favourable) either immediately or in the future (i.e. these protected features would be placed on a flat or downward trend).*

4.3.1.5 When considering whether an activity can hinder the conservation objectives of a site, consideration should be given to the direct impact of an activity upon a protected feature as well as any applicable indirect impacts. Such an indirect impact could include changing the effectiveness of a management measure put in place to further the conservation objectives.

4.3.1.6 The MMO advise that the Applicant should be able to demonstrate for the purposes of the condition in section 126(7)(a) that *'other means'* reduces the risk such that the act no longer has a significant risk of hindering the conservation objectives of the site.

4.3.1.7 In determining *'insignificance'*, the MMO (2013) guidance states that *'this should take into account the likelihood of an activity causing an effect, the magnitude of the effect should it occur, and the potential risk any such effect may cause on either the protected feature of an MCZ or any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant'*.

4.3.2 Significance of Effects

4.3.2.1 **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** and **Volume 2, Chapter 2: Benthic and Intertidal Ecology** of the PEIR present assessments of the impacts of Hornsea Four on the physical and ecological marine environment respectively, with definitions of the magnitude of impacts, sensitivity of receptors, and the significance of effects on those receptors. These definitions, adopted from the Design Manual for Roads and Bridges (DMRB) (Highways England, 2009) are set out in **Volume 1, Chapter 5: Environmental Impact Assessment Methodology**, have also been adopted for the purposes of this MCZ assessment, with the term *'effect'* used to express the consequence of an impact. This is expressed as the *'significance of effect'* and is determined by considering the magnitude of the impact alongside the sensitivity of the receptor or resource, in accordance with defined significance criteria as defined in the respective chapters and bringing forward the conclusions of the assessments from the relevant PEIR chapters.

5 Screening

5.1 Is the licensable activity taking place within or near an area being put forward or already designated as an MCZ?

5.1.1.1 The MCZs identified in the Marine Conservation Zone Screening, provided for consultation as part of the scoping exercise (Annex F of the Scoping Report), as having the potential to be

affected by Hornsea Four were the Holderness Inshore MCZ and the Holderness Offshore MCZ. The location of the MCZs to Hornsea Four are shown in **Figure 1**.

5.1.1.2 The Hornsea Four ECC is located approximately 4,450 m from the Holderness Inshore MCZ is and approximately 753 m from the Holderness Offshore MCZ.

5.2 Is this activity capable of affecting (other than insignificantly) either (i) the protected features of an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ (wholly or in part) is dependent?

5.2.1.1 Since the offshore ECC does not overlap with both the Holderness Inshore MCZ or the Holderness Offshore MCZ, no direct impacts on either site will occur. All direct impacts (for example temporary or permanent habitat loss due to cable installation, sandwave clearance, placement of cable protection material etc) will occur within the Hornsea Four offshore cable corridor or temporary working areas (although cables will only be installed within the Hornsea Four offshore cable corridor), and are therefore scoped out of any further assessment in this MCZ assessment. It should be noted that a 'temporary works area' has been incorporated around the ECC boundary, represented by a 500 m buffer from the offshore ECC in areas of closest proximity to the MCZ boundaries. There is no overlap with this temporary works area and either MCZ. This area will have no permanent infrastructure (i.e. cables or HVAC booster stations) installed within it, however it may be used for temporary works such as vessel anchor placement.

5.2.1.2 Indirect effects from Hornsea Four are considered further given the proximity of the ECC to the boundary of each site and the potential for indirect effects.

5.2.1.3 In order to determine *the 'nearness'* of the activities that could result in indirect effects associated with the construction and operational phases of Hornsea Four, the same screening criteria are used for the MCZ assessment as are applied for the Habitats Regulations Assessment (HRA). The criteria used for the Hornsea Four assessment are based on the evidence from **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**, which predicts a precautionary, potential suspended sediment dispersal of up to 15 km from the construction works within the ECC, scaled to represent the equivalent distance over which suspended sediments could theoretically be transported over a single tidal cycle under mean spring tide conditions. This distance criteria were therefore used during the screening of MCZs around the Hornsea Four ECC.

5.2.2 Holderness Inshore MCZ

5.2.2.1 The Holderness Inshore MCZ has been included due to the proximity of the site boundary to the ECC boundary (approximately 4,450 m) (**Figure 1**).

5.2.2.2 **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** predicts that export cable installation activity (including sandwave clearance, seabed levelling and cable trenching) and HVAC booster stations installation in the ECC will result in increased levels of Suspended Sediment Concentrations (SSC) with subsequent deposition of disturbed sediment. Sediment plumes are expected to be restricted to a single mean spring tidal excursion (15 km from the ECC) from slack water to peak flows.

5.2.2.3 The assessment predicts that the majority of the coarser grained sediments will settle back to the seabed and close to the point of disturbance. The content of fine sediments (silts and muds) within the ECC boundary is generally expected to be low (< 1% to < 7% of the seabed sediment particle size distribution), limiting the potential for large sediment plumes to be formed with very high concentrations (i.e. a relatively small amount of the sediment disturbed during construction works in the ECC is available to form a persistent sediment plume). The main potential exception is for works that disturb sediment in the nearshore ebb channel (shown in **Figure 1**) where areas of exposed glacial tills are likely to have a higher content of fine sediments (< 48%) (but also being located in the nearshore area where levels of background SSC are at their highest). Finer sediments disturbed by cable installation or works during the operational and maintenance phase (or arising as overspill during the dredging of sandwaves or for seabed preparation at the HVAC booster stations) will tend to persist over a greater period as sediment plumes with these finer sediments advected away from the location of the sediment disturbance; the trajectory of any sediment plume will be governed by the tidal conditions at the point of release, with concentrations reducing around this tidal axis due to dispersion and diffusion mixing processes spreading the plume (as well as sediment deposition).

5.2.2.4 Deposition of coarse sand and fine gravel falling out of suspension are unlikely to be subsequently remobilised by the local tidal flows, whereas the medium sands are only likely to be remobilised when flows exceed the velocities experienced during mean neap tidal conditions and for material that is not covered and armoured by the immobile coarser sediment sizes. Any fine sediments would become highly dispersed and are predicted to become part of the background suspended sediment concentration.

5.2.2.5 It is predicted that the majority of the sediment disturbed by cable installation or other works in the ECC will fall out of suspension in relatively close proximity to the location of the disturbance and will not impinge on the Holderness Inshore MCZ; however there is the potential for suspended sediment plumes to extend over a greater distance and therefore have the capacity to affect the MCZ (i.e. there is a theoretical receptor-impact pathway to the Holderness Inshore MCZ as a result of suspended sediment plumes resulting from the works). Sediment plume modelling completed for Hornsea Project One and Hornsea Project Two provides an indication of the likely spread and concentrations of such plumes; the modelling completed predicted that the maximum excursion of the sediment plume could extend up to a full spring tidal excursion from the location of disturbance, but at distance the concentration of the plume would be low (> 2 mg/l above background SSC levels).

5.2.2.6 The receptor-impact pathway is expected to occur during the construction phase (and specifically for the installation of the export cables or other associated works occurring in the nearshore region closest to the MCZ and tidally aligned with it). It is noted, by reference to Figure 1, that for works within the majority of the ECC that lies seaward of Flamborough Head, including the HVAC booster station area, the tidal axis means that there is no such receptor-impact-pathway to the Holderness Inshore MCZ.

5.2.2.7 Impacts from the operation and maintenance phase could arise from cable maintenance activities. The effects from these operational impacts are expected to be similar in magnitude to those arising during the construction phase as described above, with impacts localised to site of maintenance works but are predicted to be much more limited in extent (by merit of the more limited nature of the works) and unlikely to significantly impinge on the MCZ. During the decommissioning phase, cables are likely to be left in situ, and therefore

impacts from this phase are also likely to be limited; however, even if removed impacts would be no greater (and likely less than) those arising from the construction works. It is noted that the decommissioning methodology will be confirmed through the development of a decommissioning plan during the post-consent phase.

5.2.2.8 Given the theoretical potential for sediment plumes arising from works within the ECC during the construction, operation and maintenance and decommissioning phases it is concluded that the works are capable of affecting the features of the Holderness Inshore MCZ, and therefore the impact from increases in SSC and subsequent sediment deposition from the plume are screened into the Stage One Assessment.

5.2.3 Holderness Offshore MCZ

5.2.3.1 The Holderness Offshore MCZ has been included due to the proximity of the site boundary to the ECC boundary (approximately 753 m) (**Figure 1**).

5.2.3.2 The potential impacts on the Holderness Offshore MCZ are expected to be similar in nature to those described for the Holderness Inshore MCZ, with indirect impacts arising from the disturbance and subsequent deposition of sediment arising from the construction (and decommissioning) process during cable installation process (and also potentially from the HVAC booster station installation) in the ECC. The closer proximity of the Holderness Offshore MCZ to the ECC means that there is the potential for somewhat greater quantities of sediment arriving at or in the vicinity of the MCZ as plumes and subsequently a greater potential level of deposition when compared to levels likely to impact the Holderness Inshore MCZ. It is noted, by reference to **Figure 1**, that this potential exists for works in the ECC landward of the HVAC booster station search area (and including the HVAC booster area), with works seaward of this being either at a distance beyond a single tidal excursion or not aligned with the MCZ on the tidal axis.

5.2.3.3 Therefore, given the theoretical potential for sediment plumes arising from works within the ECC during the construction, operation and maintenance and decommissioning phases it is concluded that there is the potential for interaction with the Holderness Offshore MCZ, and therefore the impact from increases in SSC and subsequent sediment deposition from the plume are screened into the Stage One Assessment.

5.2.4 Screening Conclusions

5.2.4.1 The scoped in indirect effect on the Holderness Inshore MCZ and the Holderness Offshore MCZ are those arising from the temporary increase in SSC and subsequent sediment deposition in the Hornsea Four offshore ECC arising from export cable (and for the Holderness Offshore MCZ also the HVAC booster station) installation, maintenance and removal.

5.2.4.2 In accordance with the MMO guidelines (MMO, 2013), any impacts that are concluded to have a negligible impact on benthic ecology receptors (including features of an MCZ) can be screened out and are therefore not taken through to the Stage One Assessment.

5.2.4.3 Impacts which can be concluded as having a negligible impact on features of an MCZ are considered to present a sufficiently low risk, to its protected features or the ecological or

geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependent, to allow these impacts to be screened out at this stage.

5.2.4.4 The impacts arising from SSC and deposition on benthic ecology receptors arising from the construction (or decommissioning) phase and for installation of the export cables and HVAC booster stations in the ECC are predicted to be of **minor** significance (**Volume 2, Chapter 2: Benthic and Intertidal Ecology**). The impacts therefore remain screened into the Stage One assessment process.

6 Background information on MCZs

6.1.1.1 This section provides a summary of the baseline information for the MCZs which are considered within the Stage One Assessment.

6.2 Holderness Inshore MCZ

6.2.1.1 The Holderness Inshore MCZ is located to the south of the landward end of the offshore ECC (**Figure 1**). The site begins in Skipsea and extends along the coast south to the mouth of the Humber estuary. The MCZ has an area of approximately 309 km^2, and is designated for, amongst other features, the geological feature, Spurn Head, located at the southern end of the MCZ. The sediment composition of the site is variable, consisting of cobble habitats, mixed sediments, sand, and mud. The features of the MCZ, along with feature types, general management approaches and conservation objectives are summarised in **Table 3**.

6.2.1.2 Broadscale marine habitat mapping of the MCZ revealed the habitats with the closest proximity to the cable boundary are intertidal sand and subtidal coarse sediment (**Figure 3**), both of which are designated features of the MCZ **Table 3**). Sediment chemistry analysis of the site (within the coastal section of the ECC, where there is an overlap with the Creyke Beck cable corridor) showed contaminant levels below the threshold to cause significant effects to benthic organisms (Forewind, 2013).

6.2.1.3 The conservation objectives of an MCZ establish whether a feature of the MCZ meets the required state (quality) and should be 'maintained' or falls below the required state and should be 'recovered to favourable condition'. The Holderness Inshore MCZ has a conservation objective of 'maintain in favourable condition'.

6.2.1.4 Natural England's Advice on Operations for the Holderness Inshore MCZ, outlines the sensitivities of each protected feature to various pressures. These are summarised in **Appendix A**.

6.3 Holderness Offshore MCZ

6.3.1.1 The Holderness Offshore MCZ is located approximately 11 km offshore from the Holderness coast and covers an area of approximately 1,176 km^2. The MCZ lies approximately 753 m to the south of the nearshore section of the ECC at its closest point (**Figure 1**).

6.3.1.2 The site is designated for, amongst other features, part of a glacial tunnel valley, and for the Ocean Quahog (*Arctica islandica*).

6.3.1.3 The MCZ seabed is predominantly composed of sediment habitats ranging from subtidal sand to subtidal coarse sediments (**Table 3**). Broadscale marine habitat mapping of the MCZ

revealed the habitats with the closest proximity to the cable boundary are circalittoral coarse sediment, circalittoral mixed sediment and offshore circalittoral coarse sediment (**Figure 3**), all of which are designated features of the MCZ (**Table 3**). Sediment chemistry analysis of the site (within the coastal section of the ECC, where there is an overlap with the Creyke Beck Cable corridor) showed contaminant levels below the threshold to cause significant effects to benthic organisms (Forewind, 2013).

6.3.1.4 The benthic features have a general management approach to 'recover to a favourable condition' (**Table 3**), whilst the geological feature 'North Sea glacial tunnel valleys' is to be 'maintained in a favourable condition'.

6.3.1.1 This site was fully designated on 31st May 2019, and as yet there are no Conservation Objectives assigned to the site. The Holderness Offshore MCZ also has no published 'Advice on Operations' document in order to aid the assessment of the sensitivity of the sites' features to various pressures. To account for this, the Advice on Operations for the Holderness Inshore MCZ has been used as proxy in the assessment process where the sites' features are shared. The shared features include subtidal coarse sediment, subtidal mixed sediment and subtidal sand (**Table 3**). Advice on Operations from the Runswick Bay MCZ has been used as a proxy for the Ocean Quahog benthic feature. No alternative Advice on Operations is available for the North Sea Glacial Tunnel Valley, and therefore the feature was assessed in the context of the features' broadscale habitat, 'subtidal mixed sediments'.

Table 3: Sites screened into the Hornsea Four MCZ assessment, their designated features and conservation objectives.

Site Name	Protected Features	Type of Features	General Management Approach	Conservation Objective
Holderness Inshore MCZ	Intertidal sand and muddy sand	Broadscale marine habitat	Maintain in favourable condition	1. Are maintained in favourable condition if they are already in favourable condition 2. Be brought into favourable condition if they are not already in favourable condition
	Moderate energy circalittoral rock			
	High energy circalittoral rock			
	Subtidal coarse sediment			
	Subtidal mixed sediments			
	Subtidal sand			
	Subtidal mud			
	Spurn head (subtidal)	Geological feature		
Holderness Offshore MCZ	North Sea Glacial Tunnel valleys	Geological/Geomorphological feature	Maintain in a favourable condition	No conservation objectives assigned to this site
	Subtidal coarse sediment	Broadscale marine habitat	Recover to favourable condition	
	Subtidal sand			
	Subtidal mixed sediments			
	Ocean Quahog (*Artica islandica*)	Marine Species		

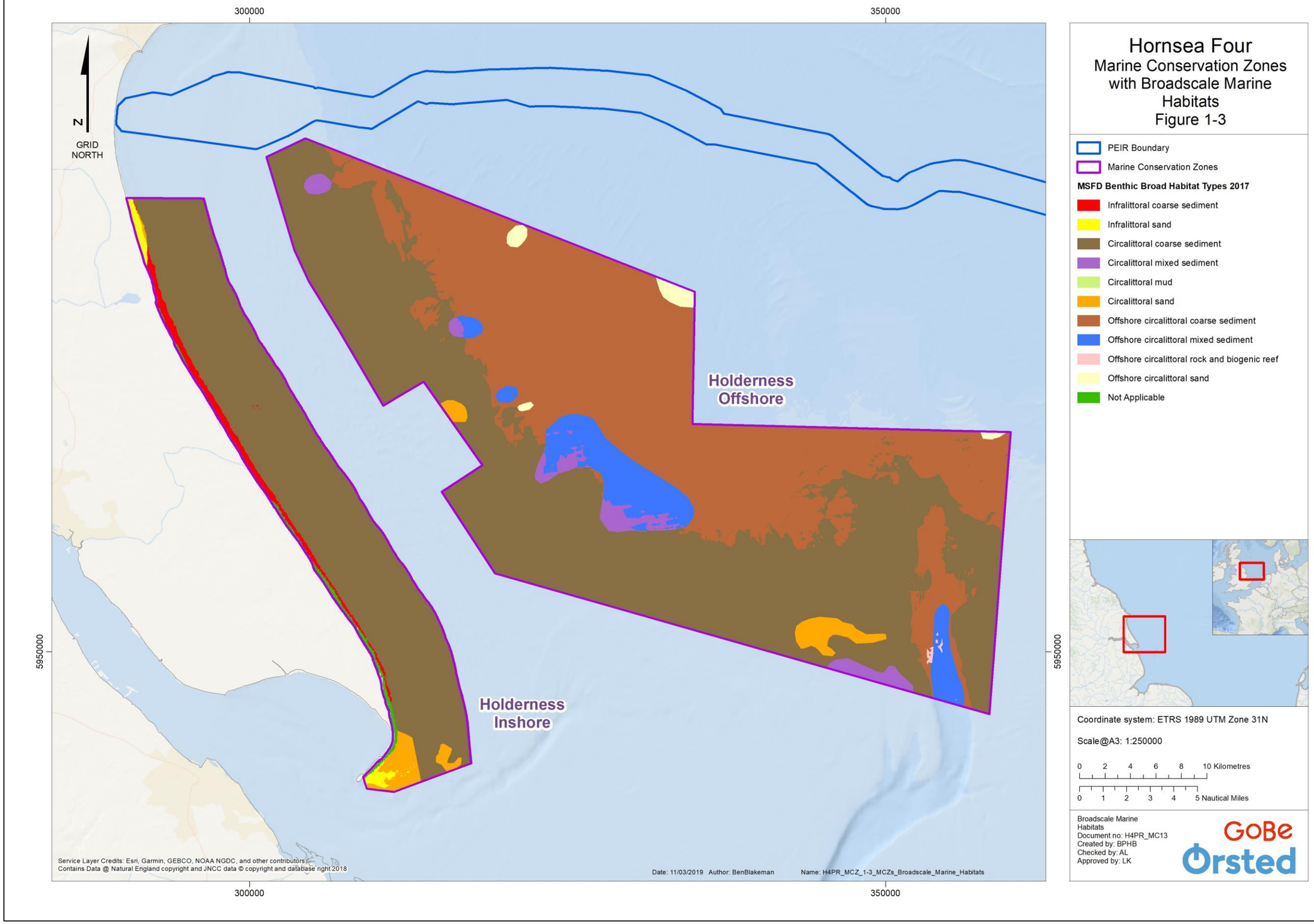

Figure 3: Broadscale Habitats of the Holderness Inshore and Offshore MCZs (not to scale).

7 Stage One Assessment

7.1 Holderness Inshore MCZ

7.1.1.1 This MCZ assessment on the features of the Holderness Inshore MCZ has been undertaken with reference to Natural England's Advice on Operations, and Supplementary Advice on Conservation Objectives (**Appendix A**).

7.1.2 Construction Phase

Temporary increase in SSC and sediment deposition in the offshore ECC area

7.1.2.1 Increases in SSC and associated sediment deposition are predicted to occur during the construction phase as a result of cable route pre-sweeping (sandwave clearance and seabed levelling) and cable and HVAC booster station installation. **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** and **Volume 2, Chapter 2: Benthic and Intertidal Ecology** provide a full description of the assessment of these potential impacts arising from the construction phase on marine processes and indirect impacts on the benthos respectively (with the maximum design scenarios (MDSs) associated with this impact presented in these PEIR chapters).

Sandwave clearance along the ECC

7.1.2.2 Increased SSC and plume formation from sandwave clearance will result from overspill of finer sediment fractions; the overspill is considered to occur local to the sandwave clearance operation along the ECC. As detailed in **Volume 5, Annex 1.1: Marine Processes Technical Report**, modelling for sandwave clearance was undertaken for Hornsea Project One and Hornsea Project Two (close comparable projects to Hornsea Four). The modelling estimated the sandwave to have a 1.5% fine sediment content, with the results indicating a plume footprint of fine sediments aligned to the main tidal flow direction. A depth-averaged suspended sediment concentration of up to 40 mg/l was predicted 200 m from the cable route (source) but with concentrations reducing rapidly with distance and time from release. The peak predicted (depth-averaged) increase above background concentration was 37 mg/l along the dredge track, with the deposition of fine sediment under low flow conditions predicted to be less than 2 mm. Based on a minimum thickness of 0.5 mm, the area of deposition extended 60 m to the northwest and 250 m to the southeast of the cable route, however, under higher flow conditions this material was dispersed away. The settling and re-suspension of fine sediments were predicted to occur over a full maximum tidal excursion distance (for Hornsea Four this equates to a distance of 15 km).

7.1.2.3 Discharge from the dredger is likely to consist of coarser sediment fractions, as a result of most of the finer sediment being lost to overspill (see **paragraph 7.1.2.2**), and as a result there is less concern for the formation of a sediment plume. In contrast, the majority of the spoil will fall more quickly to the seabed with limited opportunity to disperse (but correspondingly leading to a greater depth of accumulation at the seabed). Modelling of spoil disposal from Hornsea Project One and Hornsea Project Two estimated that coarser

sands and gravels are not considered to disperse with tidal currents, settling rapidly within 200 m of the source, and up to 1 m in depth (based on a single placement from a hopper with a volume of 11,650 m^3).

Export Cable installation

7.1.2.4 The export cable installation scenario that represents the worst-case for increases in SSC and associated sediment deposition is the use of mass flow excavation (MFE) for cable trenching. The majority of the excavated material from this process is expected to be coarse sediments (sands and gravels) which will drop back to the seabed relatively quickly and close to the point of disturbance as previously described in **paragraph 5.2.2.3**. The percentage of fines (fine sands, silts and muds) which can be dispersed away from the point of disturbance is considered here to be no more than 15% of the total release for the majority of the offshore ECC, which infers a sediment plume would form with a source rate of no more than 140 kg/s of fines.

7.1.2.5 The exception to this assumption is the ebb channel area (shown in **Figure 1**) where mud content is reported as 48%. The stiffer soils expected here will reduce trenching rates to 125 m/hr, or less, and this equates to a release rate of up to 221 kg/s for fines (assuming 50% content) in this section of the trench.

7.1.2.6 The main axis of any plume trajectory will be governed by tidal advection at the point of release with reduced concentrations around this axis due to dispersion and diffusion mixing processes spreading the plume.

7.1.2.7 Plume modelling undertaken for Hornsea Project One and Hornsea Project Two (assuming jetting into till) suggested a typical plume width of 100 m for concentrations above 20 mg/l and 40 m for concentrations above 30 mg/l, but with these peak values reached over only a short period and extending only a very short distance from the site of the cable installation works (estimated for Hornsea Project One as 40 m). Initial deposition occurred during periods of low flow and was around 2 mm thick for locations at around 60 m from the release, and based on a sediment with a settling velocity of 1 mm/s.

7.1.2.8 The magnitude of the impact SSC and associated deposition on the features of the Holderness Inshore MCZ is determined to be **minor**, (as described in **Volume 2, Chapter 2: Benthic and Intertidal Ecology**), and taking account of the local spatial extent, short-term and intermittent and reversible nature of these impacts.

Sensitivity

7.1.2.9 The effects from increases in SSC and associated deposition on the benthic ecology were assessed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology**; the subtidal habitats were deemed to be a maximum of medium vulnerability, a worst-case of medium recoverability and of regional to national value. The broadscale habitat features of the Holderness Inshore MCZ were deemed to be not vulnerable, with high recoverability and national importance.

The habitats in the region, including those of the Holderness Inshore MCZ, being considered tolerant to periodic increases in SSC and associated deposition.

7.1.2.10 The Advice on Operations provides information on the sensitivities of the MCZ features in relation to a variety of pressures; of relevance to the cable installation works the pressures 'changes in suspended solids (water clarity)' and 'light smothering and siltation rate changes' are provided and are both assigned a medium to high risk profile, with all features identified as sensitive to the pressures, with the exception of the geological feature Spurn Head (which isn't assessed), and subtidal mixed sediments and high energy circalittoral rock which are not considered sensitive to increases in SSC.

7.1.2.11 The habitats identified as being closest to the ECC boundary (4,450 m) in **paragraph 6.2.1.2** (**Figure 3**) are intertidal sand and subtidal coarse sediment; these are both identified as being sensitive to these pressures (**Appendix B**).

7.1.2.12 The geological feature, Spurn Head is located 250 m from the Holderness Inshore MCZ. Supplementary Advice on Conservation Objectives was consulted to provide additional information on the Spurn Head feature; Spurn Head is referred to as a dynamic spit system, with a consistent supply of sediment from erosion of the Holderness coast, which results in the spit continuously shifting its position. Any barrier to longshore drift within the Holderness Inshore MCZ would be likely to decrease sediment supply to Spurn Head, leading to a net increase in erosive activity around along both sides of the spit (May and Hansom, 2003). Taking the above into consideration, it is considered that the feature Spurn Head would not be considered sensitive to increases in SSC and deposition, due to its distance from the point source activity (cable installation activities) and that Hornsea Four is not introducing any barrier to nearshore sediment transport.

7.1.2.13 Taking the above into account, it is concluded that the features of the Holderness Inshore MCZ have a maximum sensitivity of **medium**.

Significance of effect

7.1.2.14 The features of the Holderness Inshore MCZ are predicted to have a maximum sensitivity of medium and the magnitude of effects are assessed as low, resulting in a worst case significance of **minor** (in EIA terms) for impacts arising from increases in SSC and sediment deposition during the construction phase (noting that much of the MCZ will not be subject to indirect effects given the distance from the ECC) and noting also that construction activity in much of the ECC seaward of Flamborough Head will have not potential to affect the MCZ given the alignment of the prevailing tidal axis.

7.1.2.15 With respect to the conservation objectives of the Holderness Inshore MCZ, as outlined in **Table 3**, it can be concluded that there is no significant risk to the site achieving its conservation objectives, as:

- Increases in SSC and associated deposition will not affect the maintenance of the extent of the designated features remaining stable; and

- The structure and function, quality and composition of characteristic biological communities will remain in a stable condition and will not deteriorate.

7.1.3 Operation and Maintenance Phase

Temporary increase in SSC and sediment deposition in offshore ECC area

7.1.3.1 Increases in SSC and associated sediment deposition are predicted to occur during the operation and maintenance phase as a result of, for example, cable remedial burial, repairs, and cable protection replenishment. **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes and Volume 2, Chapter 2: Benthic and Intertidal Ecology** provide a full description of the assessment of these potential impacts arising from the operation and maintenance phase on marine processes and indirect impacts on the benthos respectively (with the maximum design scenarios associated with this impact presented in these PEIR chapters).

7.1.3.2 Sediment plumes are expected to be restricted to well-within the tidal excursion from slack water to peak flows, with plumes expected to occur over a theoretical maximum distance of 2 km. An increase in SSC of 2 mg/l above background levels is predicted local to the source; these concentrations are expected to reduce with dispersion, with sediments remaining in suspension for up to three hours. It should be noted that any sediment released from cable protection replenishment will be of a substantially smaller scale than that for cable reburial works as the only sediment released from this activity will be that which arises when the cable protection is placed on the seabed. This is in comparison with sediment released from cable burial works for which it is assumed that the full volume of sediment from the trench is suspended and entrained in the water column.

7.1.3.3 Sediment deposition from the plume is predicted to occur up to 2 km from the source, with maximum depth of 2 mm from the deposition of finer sediments (silts and muds). Coarser sediments are predicted to be deposited local to the source.

Magnitude

7.1.3.4 The magnitude of the maximum potential increase in SSC resulting from operation and maintenance activities is within the natural range of SSC (2 to 14 mg/l closer inshore, reducing offshore to around 2 to 3 mg/l), within the region, with each event being discrete, short term, and of localised extent (within one tidal excursion).

7.1.3.5 The impacts of increases in SSC and associated deposition on features of the Holderness Inshore MCZ during the operation and maintenance phase are predicted to be of local spatial extent, short-term and intermittent and reversible to the baseline conditions following the cessation of activities. It is predicted that this impact would be of **minor** magnitude.

Sensitivity

7.1.3.6 The sensitivities of the MCZs features to this pressure are expected to be the same as those described in **Section 7.1.2**, which assessed the features to have a maximum sensitivity of **medium** to temporary increases in SSC and deposition.

Significance of effect

7.1.3.7 Increases in SSC and associated sediment deposition from cable maintenance activities are expected to be discrete events, representing a temporary and short-term impact, affecting a relatively small and localised portion of Holderness Inshore MCZ. Most receptors are predicted to have some tolerance to this impact. The features of the Holderness Inshore MCZ are predicted to have a maximum sensitivity of medium, and the magnitude of effects are assessed as low, resulting in a significance of **minor** (in EIA terms) for impacts arising from increases in SSC and sediment deposition during the operation and maintenance phase, and noting also that activity during the operational phase in much of the ECC seaward of Flamborough Head will have not potential to affect the MCZ given the alignment of the prevailing tidal axis.

7.1.3.8 With respect to the conservation objectives of the Holderness Inshore MCZ, as outlined in **Table 3**, it can be concluded that there is no significant risk to the site achieving its conservation objectives, as:

- Increases in SSC and associated deposition will not affect the maintenance of the extent of the designated features remaining stable; and
- The structure and function, quality and composition of characteristic biological communities will remain in a stable condition and will not deteriorate.

7.1.4 Decommissioning phase

Increased SSC and sediment deposition from removal of cables

7.1.4.1 Increases in SSC and associated sediment deposition are predicted to occur during the decommissioning phase as a result of the decommissioning of the export cables (for a detailed methodology for cable removal see **Volume 1, Chapter 4: Project Description**). For the purposes of this assessment full removal of the export cables although the final extent of cable decommissioning will be determined through the development of a Decommissioning Plan.

7.1.4.2 The effects of increases in SSC and associated deposition due to the decommissioning of the export cables in the Holderness Inshore MCZ are expected to be equal or less than those described for the construction phase affecting the same MCZ features and their relevant attributes as outlined for the construction phase. For the purposes of this assessment, it is assumed that cable removal will lead to increases in SSC and subsequent deposition to

levels similar to those experienced during the construction phase (i.e. due to the similarity in some of the methods used to install and remove cables, e.g. jetting).

Significance of effect

7.1.4.3 As a result, and as for the construction phase, the features of the Holderness Inshore MCZ are predicted to have a maximum sensitivity of medium and the magnitude of effects were assessed as low, resulting in a significance of **minor** (in EIA terms) for impacts arising from increases in SSC and sediment deposition during the decommissioning phase.

7.1.4.4 With respect to the conservation objectives of the Holderness Inshore MCZ, as outlined in **Table 3**, it can be concluded that there is no significant risk to the site achieving its conservation objectives, as:

- Increases in SSC and associated deposition will not affect the maintenance of the extent of the designated features remaining stable; and
- The structure and function, quality and composition of characteristic biological communities will remain in a stable condition and will not deteriorate.

7.1.5 Cumulative Effects

7.1.5.1 The MCAA does not provide any explicit legislative requirement for cumulative effects on features of MCZs to be considered during the assessment process. However, the MMO guidelines (MMO, 2013) state that the MMO considers that in order for the MMO to fully discharge its duties under section 69 (1) of the MCAA, cumulative effects must be considered.

7.1.5.2 As outlined in **Volume 1, Chapter 5: Environmental Impact Assessment Methodology**, for the purposes of the Hornsea Four cumulative effects assessment (CEA), all projects, plans and activities that were built and operational at the time of Hornsea Four data collection (field surveys etc.) were screened out of the CEA. This is because the effects of these projects have already been captured within the Hornsea Four surveys and desktop study, and hence their effects have already been accounted for within the baseline assessment. The exclusion of built and operational projects that were in place at the time of data collection/survey in this way avoids the double counting that would occur if projects were to be included within both the baseline and the CEA.

7.1.5.3 A buffer of 15 km from the boundary of the Holderness Inshore MCZ has been used to identify any operational projects that may have a cumulative effect on the MCZ. A buffer of 15 km represents a precautionary maximum distance sediment will travel, as sediment plumes, from the construction, operation and maintenance, or decommissioning activity in one tidal excursion (**Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**).

7.1.5.4 With respect to the Holderness Inshore MCZ, other plans or projects that lie within this buffer consist of operational disposal sites and a singular offshore wind farm, Westermost Rough (see **Table 4** and **Figure 4**). None of the disposal sites directly overlap the Holderness Inshore MCZ: The Bull Sand Fort and the Bull Sand Fort Extension disposal sites are located in closest

proximity to the MCZ (approximately 2.8 km, 2.4 km respectively). All disposal sites are used intermittently, and no information is available on the frequency of deposition. One of the key impacts associated with the disposal of spoil at these sites is a resulting increase in SSC and sediment deposition.

Table 4: Distances of operational sites to Holderness Inshore MCZ within a 15 km buffer.

Site	Distance to Holderness Inshore MCZ (km)
Westermost Rough (offshore wind farm)	0
Bridlington A (disposal site)	11
Bull Sand Fort (disposal site)	2.8
Bill Sand Fort Extension (disposal site)	2.4
Conoco Pipeline Trench (disposal site)	2.9
Hedon Haven (disposal site)	14
Humber 1a (disposal site)	8
Humber 2 (disposal site)	12.3
Pyewipe channel (disposal site)	12.7
Stone Creek (disposal site)	13.9
Sunk Dredge Channel A (disposal site)	9.7
Sunk Dredge Channel Window C (disposal site)	10.6

7.1.5.5 Although dependent on the nature of the sediment deposited at each disposal site, it is expected that the sediment released will behave in a similar manner as that described for the Hornsea Four cable installation process above (and set out in more detail in **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**). Levels of SSC at the point of release will be high for all sediment types but with material rapidly descending to seabed during the dynamic plume phase. Coarser sediments in the plume will settle relatively quickly with finer grained material persisting in suspension during the passive plume phase. The plume will be dispersed over greater distances but with SSC reducing to near background levels with time due to natural dispersion and deposition. The maximum extent of this plume will initially be limited to the tidal excursion distance but at concentrations at background levels.

7.1.5.6 The ECC of the Westermost Rough offshore wind farm is located within the Holderness Inshore MCZ (see **Figure 4**); the site is currently in the operational phase, and therefore any impacts from increased SSC and deposition are likely to result from cable maintenance activities. These events are expected to be indirect, temporary, of short-term duration and comprising of a single event in each location. It should be noted that beyond surveys and monitoring, cable maintenance is not anticipated as a regular occurrence during the operation and maintenance phase. Therefore, cumulative impacts from this site and Hornsea Four on the MCZ are considered to be minimal.

7.1.5.7 Therefore, taking this into consideration, it is expected that the greatest levels of SSC and the majority of the deposition will occur in close proximity to the source with only low concentrations and levels of deposition extending further and potentially interacting with the MCZ; therefore it is concluded that there will be no cumulative impacts from these sites

on the Holderness Inshore MCZ, and therefore no hinderance to the conservation objectives, as:

- The extent of the designated features will be maintained, despite increased SSC or associated deposition, and will remain stable during the construction phase; and
- The structure and function, quality and composition of characteristic biological communities will remain in a stable and healthy condition which will not deteriorate from impacts of the pressure.

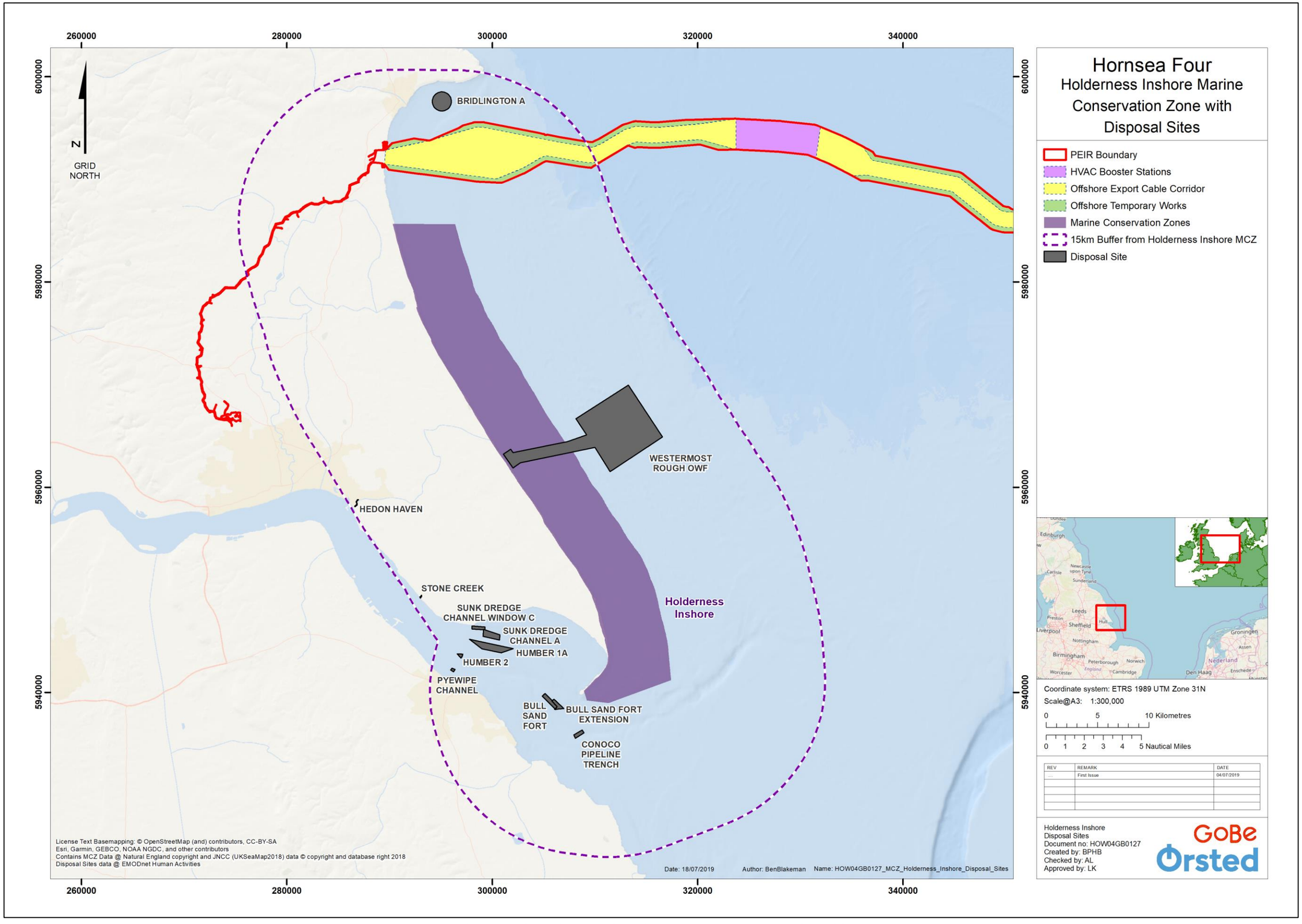

Figure 4: Disposal sites in the vicinity of the Holderness Inshore MCZ (not to scale).

7.2 Holderness Offshore MCZ

7.2.1.1 As noted in **Section 6.3** there is currently no Advice on Operations published for the Holderness Offshore MCZ; the approach to considering the sensitivity of the features of the site to relevant pressures is set out under **Section 6.3** and in **Appendix A.** Consideration has also been given in the benthic ecology assessment to the MarESA assessments, and the MarLIN sensitivity reviews.

7.2.2 Construction Phase

Temporary increase in SSC and sediment deposition in offshore ECC area

7.2.2.1 Increases in SSC and associated sediment deposition are predicted to occur during the construction phase as a result of cable route pre-sweeping and export cable installation and during HVAC booster station construction. **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** provides a full description of the impacts on the physical environment, including the specific assessment with respect to increases in SSC and subsequent sediment deposition, with a summary of the maximum design scenario with this impact presented in the PEIR chapter.

Magnitude

7.2.2.2 The magnitude of impact of increased SSC and deposition from the Hornsea Four construction phase (export cable installation and HVAC booster station construction) will be similar in nature to that detailed in **paragraph 7.1.2.1** *et seq.* above, which concluded that the impacts of increased SSC and associated deposition arising from sandwave clearance and export cable installation on features of the MCZ are predicted to localised, short-term and intermittent and reversible. It is predicted that this impact would be of **minor** magnitude. Similar levels of magnitude would arise from HVAC booster station seabed preparation.

Sensitivity

7.2.2.3 The available Advice on Operations (as outlined in **Section 6.3** and in **Appendix A**) for subtidal coarse sediment, subtidal mixed sediment and subtidal sand indicates that the pressures 'changes in suspended solids (water clarity)', and 'smothering and siltation changes (light)' are considered a medium to high risk profile, with all habitats listed as sensitive to the pressures (with the exception of subtidal mixed sediment which is assessed as not sensitive to changes in suspended solids, and associated deposition). Proxy Advice on Operations for the MCZ feature of North Sea Glacial Tunnel Valley is not available; the feature has, therefore, been assessed in terms of its broadscale habitat type, subtidal mixed sediment (**Figure 3**), which is assessed as not sensitive to increased SSC and deposition.

7.2.2.4 *Artica islandica* is listed as a protected species under the MCZ designation; the species is listed as not sensitive in the MarLIN sensitivity review to changes in suspended solids (water clarity) and light and heavy smothering and siltation rate changes. This conclusion is supported by the Advice on Operations from the Runswick Bay MCZ, which lists the species as not sensitive to increased SSC and deposition. Runswick Bay MCZ is deemed appropriate

as a proxy site, as both sites are broadly comparable, being located on the Yorkshire coast and sharing comparable environmental conditions.

7.2.2.5 Taking the above into consideration, the features of the MCZ are assigned a maximum sensitivity of **medium** to increased SSC and deposition.

7.2.2.6 The magnitude of impact has been defined as **minor**, and the features of the MCZ have been assigned a maximum sensitivity of **medium**. Therefore, the significance of the effect of is assessed as being of **minor** (not significant in EIA terms). It is noted that for works in the ECC seaward of the HVAC booster station search area, will be at a distance beyond a single tidal excursion or not aligned with the MCZ on the tidal axis.

7.2.2.7 Using the proxy conservation advice documents noted above, it is considered appropriate to conclude that it is very likely that there will be no significant risk to the site achieving the sort of conservation objectives that are likely to be set out for the Holderness Offshore MCZ site.

7.2.3 Operation and Maintenance Phase

Temporary increase in SSC and sediment deposition in offshore ECC area

7.2.3.1 Increases in SSC and associated sediment deposition are predicted to occur during the operation and maintenance phase as a result of Cable remedial burial, repairs, and cable protection replenishment. **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** and **Volume 2, Chapter 2: Benthic and Intertidal Ecology** provide a full description of the assessment of these potential impacts arising from the operation and maintenance phase on marine processes and indirect impacts on the benthos respectively (with the maximum design scenarios associated with this impact presented in these PEIR chapters).

Magnitude

7.2.3.2 The magnitude of impact of increased SSC and deposition from the Hornsea Four operation and maintenance phase will be the same as that detailed in **Section 7.1.3**, which concluded that the impacts of increased SSC and associated deposition on features of the MCZ are predicted to localised, short-term and intermittent and reversible. It is predicted that this impact would be of **minor** magnitude.

Sensitivity

7.2.3.3 The sensitivities of the MCZs features to this pressure are expected to be the same as those described in **Section 7.2.2**, which assessed the features to have a maximum sensitivity of **medium** to temporary increases in SSC and deposition.

Significance of effect

7.2.3.4 Increases in SSC and associated sediment deposition from cable maintenance activities are expected to be discrete events, representing a temporary and short-term impact, affecting a relatively small and localised portion of Holderness Offshore MCZ. Most receptors are

predicted to have some tolerance to this impact. The features of the Holderness Inshore MCZ are predicted to have a maximum sensitivity of **medium**, and the magnitude of effects are assessed as **minor**, resulting in a significance of **minor** (in EIA terms) for impacts arising from increases in SSC and sediment deposition during the operation and maintenance phase. It is noted that for works in the ECC seaward of the HVAC booster station search area, will be at a distance beyond a single tidal excursion or not aligned with the MCZ on the tidal axis.

7.2.3.5 Using the proxy conservation advice documents noted above, it is considered appropriate to conclude that it is very likely that there will be no significant risk to the site achieving the sort of conservation objectives that are likely to be set out for the Holderness Offshore MCZ site.

7.2.4 Decommissioning Phase

Increased SSC and sediment deposition from removal of cables

7.2.4.1 Increases in SSC and associated sediment deposition are predicted to occur during the decommissioning phase as a result of cable removal.

7.2.4.2 Currently there is no statutory requirement for the removal of decommissioned cables, and the removal of buried cables is difficult. Exposed cables are more likely to be removed to ensure they don't become hazards to other users of the seabed, although it is expected that most export cables will be left in situ. For the for the purposes of this application for Development Consent it has been assumed that all cables will be removed during decommissioning (for a detailed breakdown of the proposed methodology for decommissioning see **Volume 1, Chapter 4: Project Description**).

7.2.4.3 **Volume 2, Chapter 2: Benthic and Intertidal Ecology** provides a full description of the physical assessment, including the specific assessment with respect to increases in SSC and subsequent sediment deposition, with a summary of maximum design scenario associated with this impact presented in the PEIR chapter.

7.2.4.4 The offshore ECC does not overlap with the MCZ, so any impacts on the habitats will be indirect, furthermore any impacts to subtidal benthic receptors from cable removal are likely to be of regional spatial extent, and of medium term. Only a number of activities will be undertaken at one time and will be intermittent in duration and reversible to baseline conditions, reducing the magnitude of impact.

7.2.4.5 To assess the sensitivity of the features to this pressure Natural England's Advice on Operations is consulted; the Holderness Offshore MCZ was fully designated in May 2019, and as such currently has no Advice on Operations available. To account for this, when features are shared the Holderness Inshore MCZ is used as proxy (**Appendix B**).

7.2.4.6 Under Natural England's Advice on Operations, increased SSC and sediment deposition are considered to be low risk pressures, indicating that the pressure generally does not occur at a level of concern. The site's protected habitats are all assigned a sensitivity of being sensitive to the pressures, with an exception of subtidal mixed sediments which is listed as not sensitive to increased SSC. The protected species *Arctica islandica* is assessed as 'not sensitive' to the pressure increased SSC and sediment deposition due to its burrowing nature.

The sensitivity of the feature North Sea Glacial Tunnel Valley is assessed in the context of the benthic and intertidal ecology assessments and physical processes assessments for the site (**Volume 2, Chapter 2: Benthic and Intertidal Ecology** and **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** respectively).

Significance of Effect

7.2.4.7 As for the construction phase, the features of the Holderness Offshore MCZ are predicted to have a maximum sensitivity of **medium** and the magnitude of effects were assessed as **minor**, resulting in a significance of **minor** (not significant in EIA terms) for impacts arising from increases in SSC and sediment deposition during the decommissioning phase.

7.2.4.8 Using the proxy conservation advice documents noted above, it is considered appropriate to conclude that it is very likely that there will be no significant risk to the site achieving the sort of conservation objectives that are likely to be set out for the Holderness Offshore MCZ site.

7.2.5 Cumulative Effects

7.2.5.1 The approach to the CEA for the Holderness Offshore MCZ is as previously described for the Holderness Inshore MCZ under **Section 7.1.5**.

7.2.5.2 The activities within the CEA buffer of the Holderness Offshore MCZ are summarised in **Table 5** and shown in **Figure 5**. None of these sites directly overlap the Holderness Offshore MCZ; the Westermost Rough offshore windfarm is located in closest proximity to the MCZ at 0.9 km from the site boundary, however this site was constructed prior to the surveys undertaken for Hornsea Four and is therefore considered part of the baseline. Any impacts from maintenance activities along the ECC are expected to be intermittent, with any indirect impacts from SSC and deposition occurring local to the ECC. All disposal sites are used intermittently, and no information is available on the frequency of deposition. One of the key impacts associated with the disposal of spoil at these sites is a resulting increase in SSC and sediment deposition.

Table 5: Distances of disposal sites to Holderness Offshore MCZ within a 15 km buffer.

Site	Distance to Holderness Offshore MCZ (km)
Westermost Rough (offshore wind farm)	0.9
Bridlington A (Disposal Site)	10.2
Triton Knoll (Disposal Site, and Offshore Wind Farm)	11
Hornsea Disposal Area 1 (Disposal Site)	4.3

7.2.5.3 The disposal activities, generation and persistence of SSC and subsequent deposition are predicted to be similar to those previously described for the CEA for the Holderness Inshore MCZ (see **Section 7.1.5**). It is expected that the highest levels of SSC and the majority of the deposition will occur in close proximity to the source, with finer sediments persisting in a plume over a greater distance but at low concentrations and with limited levels of sediment deposition. It is, therefore, concluded that there will be no cumulative impacts from these sites on the Holderness Offshore MCZ.

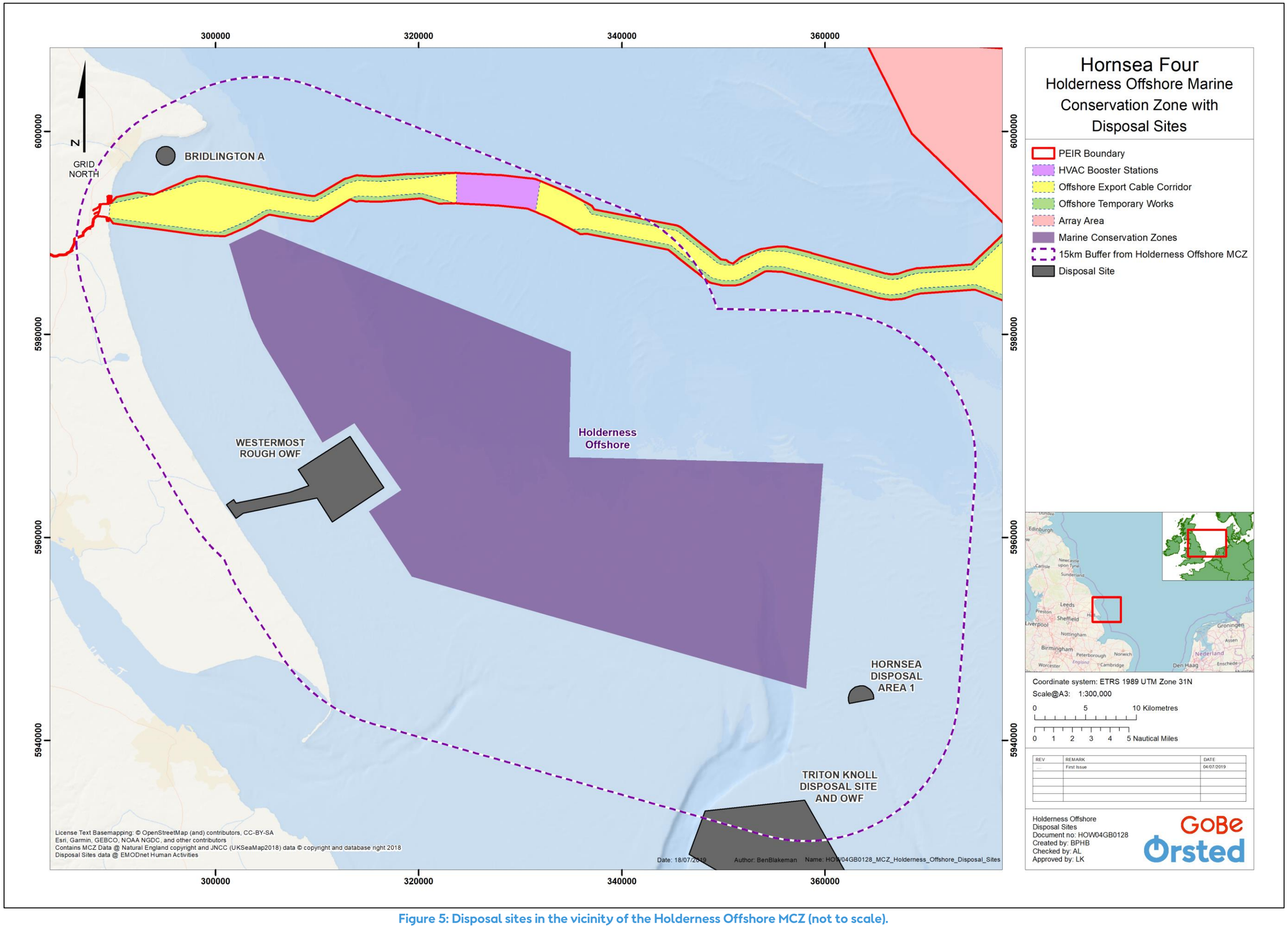

Figure 5: Disposal sites in the vicinity of the Holderness Offshore MCZ (not to scale).

8 Conclusion

8.1.1.1 This MCZ Assessment has been produced provide the necessary information to allow the MMO to meet their specific duty for MCZs as outlined in section 126 of the MCAA. It is intended (with reference to the detailed information set out in the relevant parts of the PEIR) to provide the necessary information on the impacts of Hornsea Four to inform the MCZ assessment process.

8.1.1.2 The first stage in the assessment process was Screening to identify those MCZs that had the potential to be affected by the Hornsea Four proposed development. The screening stage identified two MCZs, Holderness Inshore MCZ and the Holderness Offshore MCZ as being relevant and these were both were carried through to the Stage One Assessment for full assessment against the relevant Conservation Objectives in relation to the potential indirect impacts arising from the construction, operation and maintenance and decommissioning activity in the Hornsea Four ECC. Note that direct impacts were scoped out from further assessment given that the ECC does not spatially overlap with either MCZ site.

8.1.1.3 The Stage One Assessment considered the effects of Hornsea Four construction, operation and maintenance, and decommissioning on the protected features of the Holderness Inshore MCZ and Holderness Offshore MCZ, with each of the impacts identified in the screening stage discussed individually. This included consideration of effects on attributes and targets of the relevant protected features, and subsequently on the conservation objectives, using the best available scientific evidence to support the assessment process and with due regard to the relevant Advice on Operations.

8.1.1.4 Indirect effects during construction, operation and maintenance and decommissioning associated with increases in SSC and associated deposition were assessed. It was concluded that the construction, operation and maintenance and decommissioning activities would result in only short term and localised increases in SSC and localised sediment deposition, resulting in a low magnitude of effect. The sensitivity of the features at each site were assessed as, as a maximum, medium, with a maximum significance of **minor** attributed in each case.

8.1.1.5 Cumulative effects on features of the Holderness Inshore MCZ and the Holderness Offshore MCZ were also considered in the Stage One Assessment. A number of disposal sites were considered, along with the Thanet and Westermost offshore wind farms, in each case and in relation to SSC and sediment deposition effects; no significant cumulative effects were predicted.

8.1.1.6 As a result, it is concluded that the Hornsea Four construction, operation and maintenance and decommissioning activities within the ECC will not hinder the achievement of the conservation objectives of either MCZ either alone or cumulatively. The outcomes of the impact assessments for the Holderness Inshore MCZ and the Holderness Offshore MCZ on their relevant features (and in terms of the attributes of those features), with reference to the pressures and attributes associated with Hornsea Four, are summarised in full in **Appendix A**.

9 References

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Appendix A – Summary of Impacts in Respect of Hinderance to Conservation Objectives of the MCZs Assessed

Table A 1: Summary of impacts on the features, attributes and conservation objectives of the Holderness Inshore MCZ and the Holderness Offshore MCZ.

Protected Feature(s)	Pressure and Activity	Attribute	Summary of Assessment	Mitigation
Spurn Head (Subtidal) - *feature of Holderness Inshore MCZ*	Changes in suspended solids (water clarity)	Extent: extent of geomorphological feature	Spurn Head is not considered sensitive to increased SSC. No barrier to nearshore sediment transport to Spurn Head is expected. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
		Structure: structure of geomorphological feature		
		Supporting processes: Sediment transport pathways and connectivity with wider environment		
	Smothering and siltation rate changes	Extent: extent of geomorphological feature	Spurn Head is not considered sensitive to increased sediment deposition. No barrier to nearshore sediment transport to Spurn Head is expected. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
		Structure: structure of geomorphological feature		
		Supporting processes: Sediment transport pathways and connectivity with wider environment		
Intertidal sand and muddy sand - *feature of Holderness Inshore MCZ*	Changes in suspended solids (water clarity)	Distribution: presence and spatial distribution of biological communities	This feature is considered to have medium sensitivity to increased SSC. Increased SSC is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
		Extent and distribution		
		Structure and function: presence and abundance of key structural and influential species		
		Structure: sediment composition and distribution		

		Structure: species composition of component communities		
		Supporting processes: water quality - turbidity		
	Smothering and siltation rate changes	Distribution: presence and spatial distribution of biological communities	This feature is considered to have medium sensitivity to sediment deposition. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
		Extent and distribution		
		Structure and function: presence and abundance of key structural and influential species		
		Structure: sediment composition and distribution		
		Structure: species composition of component communities		
		Supporting processes: water quality - turbidity		
High/Moderate energy circalittoral rock - *feature of Holderness Inshore MCZ*	Changes in suspended solids (water clarity)	Distribution: presence and spatial distribution of biological communities	This feature is considered to have medium sensitivity to sediment deposition. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
		Extent and distribution		
		Structure and function: presence and abundance of key structural and influential species		
		Structure: species composition of component communities		
		Supporting processes: sedimentation rate		
		Supporting processes: water quality - turbidity		

	Smothering and siltation rate changes	Distribution: presence and spatial distribution of biological communities Extent and distribution Structure and function: presence and abundance of key structural and influential species Structure: species composition of component communities Supporting processes: sedimentation rate Supporting processes: water quality - turbidity	This feature is considered to have medium sensitivity to sediment deposition. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
Subtidal mixed sediments, subtidal coarse sediment, subtidal mud, subtidal sand - *features of Holderness Inshore MCZ and Holderness Offshore MCZ*	Changes in suspended solids (water clarity)	Distribution: presence and spatial distribution of biological communities Extent and distribution Structure and function: presence and abundance of key structural and influential species Structure: sediment composition and distribution Structure: species composition of component communities Supporting processes: sediment movement Supporting processes: water quality - turbidity	These features are considered to have a maximum of medium sensitivity to sediment deposition. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.

	Smothering and siltation rate changes	Distribution: presence and spatial distribution of biological communities Extent and distribution Structure and function: presence and abundance of key structural and influential species Structure: sediment composition and distribution Structure: species composition of component communities Supporting processes: sediment movement Supporting processes: water quality - turbidity	These features are considered to have a maximum of medium sensitivity to sediment deposition. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.
North Sea Glacial Tunnel Valleys (assessed in context of broadscale habitat type, subtidal mixed sediments) - *feature of Holderness Offshore MCZ*	Changes in suspended solids (water clarity)	Distribution: presence and spatial distribution of biological communities Extent and distribution Structure and function: presence and abundance of key structural and influential species Structure: sediment composition and distribution Structure: species composition of component communities Supporting processes: sediment movement Supporting processes: water quality - turbidity	Hornsea Four is not expected to affect sediment pathways (longshore drift) to the glacial tunnel valley. The feature was assigned a maximum sensitivity of medium to the pressure. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	None proposed beyond existing commitments.

	Smothering and siltation rate changes	Distribution: presence and spatial distribution of biological communities Extent and distribution Structure and function: presence and abundance of key structural and influential species Structure: sediment composition and distribution Structure: species composition of component communities Supporting processes: sediment movement Supporting processes: water quality - turbidity	Hornsea Four is not expected to affect sediment pathways (longshore drift) to the glacial tunnel valley. The feature was assigned a maximum sensitivity of medium to the pressure. Increased sediment deposition is expected to be of low magnitude, and therefore results in a minor significance of effect. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted. No hinderance on conservation objectives. nce on conservation objectives.	None proposed beyond existing commitments.
Ocean quahog (Arctica islandica) - *feature of Holderness Offshore MCZ*	Changes in suspended solids (water clarity)	Population size Presence and spatial distribution of the species Supporting habitat: extent and distribution Supporting processes: sediment movement	Ocean Quahog are considered not sensitive to increased SSC. No impacts are predicted to occur on the supporting habitat or supporting processes. There are not expected to be any impacts on population size, presence and spatial distribution of Ocean Quahog. No hinderance to conservation objectives in terms of cumulative effects from disposal sites are predicted No hinderance on conservation objectives.	None proposed beyond existing commitments.
	Smothering and siltation rate changes	Population size Presence and spatial distribution of the species Supporting habitat: extent and distribution Supporting processes: sediment movement	Ocean Quahog are not considered sensitive to smothering and siltation rate changes. There are not expected to be any impacts on population size, presence and spatial distribution of Ocean Quahog. No impacts are predicted to occur on the supporting habitat or supporting processes. No hinderance to conservation objectives in terms of	None proposed beyond existing commitments.

			cumulative effects from disposal sites are predicted. No hinderance on conservation objectives.	

Appendix B – Natural England Advice on Operations and Pressure Screening

The table below summarises the Advice on Operations provided by Natural England for the Holderness Inshore MCZ (Table B 1). Only pressures which are described as 'High-Medium Risk' have been included. As the Holderness Offshore MCZ has only been recently designated (31 May 2019) no Advice on Operations have been published, and therefore the following Advice on Operations below has been used as proxy for the site (Table B 2).

Table B 1: Holderness Inshore MCZ Advice on Operations (S = sensitive, NS = not sensitive, NA = not assessed).

Pressure	Spurn Head	Intertidal sand and muddy sand	Subtidal coarse sediments	Subtidal mixed sediments	Subtidal mud	Subtidal sand	High energy circalittoral rock	Moderate energy circalittoral rock
Changes in suspended solids (water clarity)	NA	S	S	NS	S	S	NS	S
Smothering and siltation rate changes (Light)	NA	S	S	S	S	S	S	S
Changes in suspended solids (water clarity)	**NA**	**S**	**S**	**NS**	**S**	**S**	**NS**	**S**

Table B 2: Holderness Offshore MCZ Advice on Operations Proxy Features sources from the Holderness Inshore MCZ and the Runswick Bay MCZ (S = sensitive, NS = not sensitive).

	Habitat/Feature			
Pressure	Subtidal coarse sediments	Subtidal mixed sediments	Subtidal sand	Ocean Quahog
Power cable: laying, burial and protection				
Changes in suspended solids (water clarity)	S	NS	S	NS
Smothering and siltation rate changes (Light)	S	S	S	NS
Power cable: Decommissioning				
Changes in suspended solids (water clarity)	S	S	S	NS
Smothering and siltation rate changes (Light)	**S**	**S**	**S**	**NS**