



THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES  
2010

**Appendix B to the Relevant Representations of Natural England**  
**Marine Geology, Oceanography and Physical Processes**

For:

The construction and operation of the Five Estuaries Offshore Wind Farm located approximately 57km from the Essex Coast in the Southern North Sea.

Planning Inspectorate Reference EN010115

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13 August 2024

## **Appendix B – Marine Geology, Oceanography and Physical Processes**

In formulating these comments, the following documents have been considered:

- [APP-063] 6.1.3 Environmental Impact Assessment Methodology
- [APP-064] 6.1.3.1 Cumulative Effects Assessment Methodology
- [APP-069] 6.2.1 Offshore Project Description
- [APP-070] 6.2.1.1 Detailed Offshore Project Description Envelope
- [APP-071] 6.2.2 Marine Geology, Oceanography, and Physical Processes
- [APP-081] 6.2.12 Infrastructure and Other Marine Users
- [APP-083] 6.3.1 Onshore Project Description
- [APP-099] 6.5.2.1 Physical Processes Baseline Technical Report
- [APP-100] 6.5.2.2 Physical Processes Model Design and Validation
- [APP-101] 6.5.2.3 Physical Processes Technical Assessment
- [APP-238] 9.8 Dredge Disposal Site Characterisation Report
- [APP-239] 9.9 Outline Cable Burial Risk Assessment
- [APP-242] 9.12 Outline Cable Specification and Installation Plan
- [APP-243] 9.13 Margate and Long Sands SAC Benthic Mitigation Plan
- [APP-248] 9.17 Outline Offshore Operations and Maintenance Plan
- [APP-261] 9.28 Outline Landfall Methodology
- [APP-262] 9.29 Offshore Connection Scenario
- [APP-263] 9.30 Coordination Document
- [APP-264] 9.31 Schedule of Mitigation – Routemap
- [APP-265] 9.32 Offshore In-Principle Monitoring Plan

### **1. Natural England's Advice and Recommendations**

A summary of Natural England's key concerns in relation to Marine Geology, Oceanography and Physical Processes is set out in Table 1. Our detailed advice and recommendations are presented in further detail in Table 2.

In order to reduce the repetition in our advice, the advice and recommendations within this appendix, notably regarding sandbanks and sandwaves, are applicable to and should be read in conjunction with the advice presented Appendix E Benthic and Intertidal Ecology.

## Glossary of Acronyms and Abbreviations

CEMP	Construction Environmental Management Plan
EIA	Environmental Impact Assessment
ES	Environmental Statement
HDD	Horizontal Directional Drilling
MDS	Maximum Design Scenario
MLS SAC	Margate and Long Sands Special Area of Conservation
O&M	Operations and Maintenance
OECC	Offshore Export Cable Corridor
OSP	Offshore Platform
OWF	Offshore Wind Farm
PLGR	Pre-lay Grapnel Run
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
UXO	Unexploded Ordnance
VE	Five Estuaries
WCS	Worst Case Scenario
WTG	Wind Turbine Generator
ZOI	Zone of Influence

**Please note:** This appendix should be read in conjunction with the Summary of Key Environmental Concerns contained within our Relevant Representations.

**Table 1 Summary of Key Issues – Marine Geology, Oceanography and Physical Processes.**

NE Ref	Summary of Key Concerns	Natural England's Recommendations to Resolve Issues.	Risk
B1	Natural England is concerned that there is a potential impact to sediment transport processes at Margate and Long Sands Special Area of Conservation (MLS SAC) due to the presence of cable protection measures. Natural England advises that there is insufficient evidence to support the impact assessment of cable protection on Annex I Sandbanks of MLS SAC.	The Applicant needs to demonstrate that the presence of cable protection measures within and outside of MLS SAC will not affect the sediment transport processes at the placement location to the detriment of the Annex I features of the SAC.	
B2	Natural England advises that cumulative impacts to MLS SAC require further consideration.	Natural England advises that the Applicant should consider potential seabed morphology, volumetric, extent, and distribution changes to MLS SAC arising from VE construction activities in combination with other plans, projects, or activities. The WCS should also be assessed.	
B3	Natural England is concerned that the Maximum Design Scenario (MDS)/Worst-Case Scenario (WCS) for impacts to SPA and SAC supporting habitat, protected habitats and significant bedforms within the arrays has not sufficiently considered. We advise that all aspects of construction such as drill arisings etc., impacts to sandbanks/sandwaves, seabed morphology and prey availability are considered in more detail	Natural England advises that the Applicant should fully consider all potential impacts to SPA and SAC supporting habitats, protected habitat and significant bedforms within the arrays, to inform the MDS/WCS.	
B4	Natural England highlights uncertainty regarding the MDS/WCS for volume of sediment disturbed due to cable trenching.	Natural England advises the Applicant to adopt the assumption that up to 100% of material is fluidised and displaced from the trench and to update the impact assessments accordingly for other relevant receptor groups.	

**Table 2 Natural England's Detailed Advice and Recommendations – Marine Geology, Oceanography and Physical Processes.**

Natural England's Key Considerations	Natural England's Advice				
Relevant and Written Representations	NE Ref	Ref	Comment	Recommendation	Risk (RAG)
<b>Project Parameters - Document(s) Used:</b> [APP-069] 6.2.1 Offshore Project Description, [APP-071] 6.2.2 Marine Geology, Oceanography and Physical Processes, [APP-261] 9.28 Outline Landfall Methodology					
Project Description	B5	6.2.1	We have no comments to raise at this stage.	N/A	
Natural England's Position on Worst Case Scenario or Scenarios	B6	6.2.1	<p>From the coastal perspective, Natural England does not agree that Scenario 1 (undertaking the works for both Five Estuaries and North Falls) represents the worst-case scenario (WCS). Instead, we would advise that Scenario 3 (Five Estuaries completes works then North Falls completes works at a later time) appears to be a more impactful scenario as habitats and features may not have recovered from the first works. Thus, this scenario could result in a cumulative impact over a longer duration due to successive works rather than concurrent works, even though the damage done would essentially be equivalent.</p> <p>However, for the intertidal and foreshore area this may not be the case. It could be argued that repeated interventions that do not give the site or features time to recover</p>	Natural England advises that the EIA is updated with Scenario 3 being presented at the WCS in terms of impact to both the coastal zone/shoreline and intertidal/foreshore areas. We advise that if the WCS assessment is not correct, there could be an impact pathway (i.e. temporary disturbance) to any features from the Holland Haven SSSI using the intertidal or grassland area resources.	

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			may lead to greater impacts over a longer timeframe.		
	B7	9.28	Natural England advises that there is insufficient detail at present regarding potential sheet piling installation in the intertidal zone to fully understand the likely impacts. However, if mitigation measures are applied if stated then we are content that there are unlikely to be significant impacts on Holland Haven SSSI notified features, and that sheet piling is unlikely to create an impact pathway to up- and downdrift of designated sites.	We advise that the Applicant should apply and secure appropriate mitigation measures in named plan/s as stated, to avoid impacts to the SSSI features and intertidal/beach when sheet piling in the beach/intertidal zone.	
	B8	6.2.2, Section 2.10.4	Natural England welcomes the consideration of a coordinated energy transmission approach. However, we acknowledge that the feasibility of the coordinated offshore connection with North Falls and Sea Link is still in the exploration phase, and therefore potential environmental impacts of this option, have not been considered or assessed in the EIA. Therefore, until more information is presented, we are unable to advise on this design option.	Natural England advises if/when further information becomes available during examination on the offshore transmission connection scenario, full consideration should be given to the potential environmental impacts of the scheme. Until then, Natural England provides no further comment during examination	
	B9	6.2.2, Table 2.8, Pages 58-59	Natural England notes that the Applicant has assumed that for installation of inter-array and export cables ' <i>up to 50% of material is actually ejected from the trench. The rest is fluidised, but retained as</i>	Natural England advises that, owing to the uncertainty regarding WCS, the Applicant adopts the assumption that up to 100% of material is fluidised and displaced from the trench due to cable installation. This	

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			<p><i>sediment cover within the trench.</i> But, evidence has not been included to support this assumption. We advise a consistent industry approach to assessing the worst-case scenario (WCS) i.e., up to 100% of sediment is fluidised and displaced from the trench. This would effectively lead to a doubling of the volume of sediment disturbed which may have implications to the assessment of pathways for impacts to other receptor groups.</p>	<p>should be updated in the assessment of impacts pathways for all receptor groups.</p>	
	B10	6.2.2, Table 2.8, Pages 60-61	<p>Natural England notes that the Assessment of the WCS for potential morphological impacts to sandbanks and designated areas of seabed (e.g. MLS SAC) during construction is based on sandwave clearance via dredging only. It does not consider boulder clearance, UXO clearance or pre-lay grapnel run activities which have the potential to disrupt marine processes and cause impacts on marine habitats and species and alter the morphology of sandbanks and designated areas of seabed.</p>	<p>Natural England advises that the Applicant needs to include all potential construction-related impacts in the WCS assessment of morphological impacts to sandbanks and designated areas of seabed.</p>	
	B11	6.2.1, Section 1.11, Figure 1.12 &	<p>Natural England agrees with the Applicant that there is an expected cable crossing of the planned NeuConnect and Sea Link interconnector cables, and a potential requirement to cross the proposed North Falls cables in proximity to MLS SAC.</p>	<p>Natural England advises that the Applicant should consider potential (indirect) impacts to MLS SAC due to adjacent cable <u>crossing(s)</u> (e.g. with North Falls, Sea Link and NeuConnect). If required, appropriate mitigation measures</p>	

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		Table 1.27	However, there are insufficient details currently to assess cumulative impacts of potential sediment disruption of the multiple cable crossings of the 2 VE cables with other plans and projects on the SAC.	should be applied, such as minimising the number and extent of cable crossings adjacent to MLS SAC.	
	B12	6.2.2, Table 2.8, Sections 2.10.78-82 and 9.2.8, Section 3.2.8	Although, trenching operations across the beach/intertidal and associated impacts are likely to be relatively short-lived (days to a few weeks), Natural England notes that the MDS does not include anticipated length and location of trenching at landfall. Similarly, intertidal Horizontal Directional Drilling (HDD) works may include sheet piling and/or an anchored or spud barge which can dry out on the beach. It is unclear what the MDS would be for this scenario. Therefore, there is currently insufficient information to enable us to agree with the assessment conclusions for impacts to landfall morphology.	Natural England advises that the WCS for intertidal/beach trenching and HDD operations should be updated, once more information is available, and appropriate mitigation applied. We also advise the Applicant to consider any lessons learned from the installation of the Gunfleet Sands OWF export cable installation at Holland Haven.	
	B13	6.2.2, Table 2.8	Natural England queries whether the number of array and export cable repairs/replacements over the project lifetime are realistic, as well as how the total impact amounts in Table 1.31 were determined.	Natural England advises that further consideration is given operations and maintenance (O&M) marine licence applications for similar activities at Galloper OWF and revise the VE MDS for array and/or export cable repairs/replacements, if necessary. We would welcome this to be provided in an Outline Operation and Maintenance Plan	



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				which is updated and agreed prior to construction.	
	B14	9.8, Section s 5.13 & 5.14	Natural England advises that the MDS for Array Area drill arising dimensions and distribution of grain sizes/sediment type have not been provided.	Natural England advises that the Applicant should evaluate the MDS for drill arising/spoil mounds within the Array Areas in order to inform the assessment of bed level change extent and thickness and any disruption of sediment transportation	
<b>Baseline Characterisation - Document(s) Used:</b> [APP-069] 6.2.1 Offshore Project Description, [APP-083] 6.3.1 Onshore Project Description, [APP-261] 9.28 Outline Landfall Methodology, [APP-264] 9.31 Schedule of Mitigation Routemap, [APP-071] 6.2.2 Marine Geology, Oceanography and Physical Processes, [APP-081] 6.2.12 Infrastructure and Other Marine Users, [APP-099] 6.5.2.1 ES Annex Physical Processes Baseline Technical Report, [APP-100] 6.5.2.2 ES Annex Physical Processes Model Design and Validation, [APP-101] 6.5.2.3 ES Annex Physical Processes Technical Assessment.					
Data Gaps	B15	6.2.2	Natural England advises that seabed mobility and erosion potential have not been assessed in the EIA.	Natural England advises that the Applicant should assess seabed sediment mobility or erosion potential and the natural variability of sediment depth within the Zone of Influence (Zol), to inform the cable burial and scour assessments.	
Analysis, Modelling and Reporting	B16	6.2.2	Natural England notes that the Applicant has concluded that the SEASTATES hindcast model data (taken from an offshore location) is sufficiently validated. However, Natural England highlights that	As a note of caution to the competent authority, Natural England highlights that we do not agree with the assessment of level of model performance (and lack of performance statistics) carried out by the	

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			Figure 12 shows that SEASTATES hindcast slightly overpredicts some of the significant wave height peaks, but the modelled peak wave period appears to underpredict measured peak wave period for approx. 25% of the time series shown.	Applicant and their consultants, because it does not align with best practice. However, unless there are significant changes to the project design and/or mitigation measures cannot be delivered, we do not believe that updating the modelling and/or assessment would make a material difference to the predicted project impacts as this time.	
<b>Environmental Impact Assessment - Document Used:</b> [APP-040] 5.4 Report to Inform Appropriate Assessment, [APP-069] 6.2.1 Offshore Project Description, [APP-071] 6.2.2 Chapter 2: Marine Geology, Oceanography and Physical Processes, [APP-101] 6.5.2.3 Annex 2.3: Physical Processes Technical Assessment, [APP-083] 6.3.1 Onshore Project Description, [APP-261] 9.28 Outline Landfall Methodology, [APP-264] 9.31 Schedule of Mitigation Routemap, [APP-081] 6.2.12 Infrastructure and Other Marine Users, [APP-099] 6.5.2.1 ES Annex Physical Processes Baseline Technical Report, [APP-097] 6.5.2.2 ES Annex Physical Processes Model Design and Validation.					
Identified impacts	B17	6.2.2, Section 2.11.19 - 2.11.26	Natural England notes that impacts to seabed morphology (i.e. sandwaves) related to changes to the tidal regime due to the presence of Wind Turbine Generator (WTG) and Offshore Platform (OSP) foundation structures, have not been considered or assessed.	Natural England advises that further consideration of potential impacts to seabed morphology (and SAC supporting habitat) arising from changes to the tidal regime due to the presence of WTG and OSP foundation structures is required by the Applicant and the assessment updated accordingly	
	B18	6.2.2, Section 2.11.26	Natural England notes that the significance of effects arising from changes to the tidal regime in the Array Areas has not been	Natural England advises that the Applicant should consider the likely extent and significance of impacts upon SAC	

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			assessed. We highlight that changes to the tidal regime may indirectly impact seabed morphology (including bedforms) through interaction of the OWF infrastructure foundations with the tidal regime. Therefore, changes to the physical environment within the Array Areas have the potential to impact SAC supporting habitat.	supporting habitats/protected habitat morphology within the Array Areas, due to changes to the tidal regime.	
Methodology	B19	6.2.2, Section 2.10.12 and 6.5.23, Section 2.6	<p>Natural England is unable to agree with the impact assessment for potential changes to Suspended Sediment Concentrations (SSCs), bed levels, and sediment type arising from construction related activities within the Array Areas, because the information provided lacks sufficient detail.</p> <p>Whilst it is stated that the assessment of changes to SSC and associated sediment deposition is informed by location and project-specific numerical modelling, the results presented are largely qualitative. For example, within the zone of highest SSCs increase and thickness of sediment deposition (0-50m of the construction activity), it is stated that '<i>sands and gravels may deposit in local thickness of tens of centimetres to several metres...</i>', which is an order of magnitude difference.</p>	Given the presence of sensitive species/habitats (e.g. spawning herring), supporting habitat, designated areas of seabed, and significant bedforms within the Array Areas, Natural England advises that the Applicant should gather more detailed evidence to inform their impact assessment. This should include MDS changes to SSC and bed levels (and sediment type) arising from the different construction-related activities listed, taking into consideration the different locations and sediment types. The spatial pattern and magnitude of SSC change and associated levels of deposition (and sediment type) should also be clearly presented to inform the impact assessment(s).	

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	B20	6.2.2, Section 2.13	<p><u>Cumulative Impacts to MLS SAC</u>            Natural England notes that the Cumulative Effect Assessment for physical processes does not consider volumetric, extent and distribution changes to MLS SAC arising from VE construction-related activities in combination with other plans, projects, or activities (e.g. aggregate dredging). In turn, we are concerned that these cumulative/in-combination effects may push the conservation objectives of maintain/restore further away from there desired trajectory.</p>	Natural England advises that the Applicant should consider potential seabed morphology, volumetric, extent, and distribution changes to MLS SAC arising from VE construction activities in combination with other plans, projects, or activities. The WCS should also be assessed.	
Have the impacts been avoided/reduced by the use of appropriate mitigation?	B21	6.2.2, Tables 2.8 & 2.9	<p>Natural England notes that the present EIA may not be sufficient to determine decommissioning impacts at the end of the OWF lifespan. This is because the baseline conditions at the end of the Project life may differ significantly from those at pre-construction and the value of receptors may also have changed over the lifetime of the project. However, we advise that the following is used to inform an outline decommissioning plan at the time of consent:</p> <ul style="list-style-type: none"> <li>- potential long-term impacts to the physical environment and marine processes, of any assets left <i>in situ</i>;</li> </ul>	Natural England advises that the outline decommissioning plan is updated to consider emerging alternatives to decommissioning and secure any associated monitoring.	

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			<ul style="list-style-type: none"> <li>- emerging alternatives to decommissioning, including repowering and life extension.</li> </ul>		
	B22	6.2.1	Natural England advises that there is insufficient detail at present to inform the impact assessment of sheet piling within the beach/intertidal zone.	Natural England advises that more detail should be provided regarding impacts from the installation of sheet piling in the beach/intertidal zone at the consenting phase to ensure that mitigation measures are fit for purpose. This will need to be secured within the final Construction Environmental Management Plan (CEMP)/CMP.	
	B23	6.2.2 Section 2.10.83	Natural England notes that it is anticipated that cable protection in the intertidal section will be installed below the (winter) beach level, which we welcome. However, there remains a risk (e.g. climate change impacts) that buried infrastructure may become exposed during the lifetime of the project.	Natural England advises that the Applicant provide further evidence at the consenting phase on the predicted vertical change in beach elevation through the lifetime of the project to ensure that the cable (and associated protection) remains buried. We advise monitoring of elevation change across the intertidal area through the lifetime of the project to assess buried infrastructure integrity is secured within the DCO and/or named plan. Climate change impacts should also be considered.	
Assessment Conclusions	B24	6.2.2 Section 2.10.43	Natural England notes the overall level of effect of morphological change due to sandwave clearance and cable installation has been assessed as being of minor significance for designated areas of	Natural England advises that pre- and post-installation surveys should be secured in the DCO and/or In Principle Monitoring Plan to demonstrate geomorphological recovery after	

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			seabed in the Array Areas. However, given the large volumes of sediment that could be removed through levelling/bed preparation, we are concerned that sufficient uncertainty remains regarding the recovery potential of sandwaves (and other similar bedforms) in the Array Areas.	sandwave levelling and cable burial and ensure remedial measures will be undertaken should impacts be greater than predicted.	
	B25	6.2.2, Sections 2.10.50 & 2.10.53	<p>Natural England notes that the overall level of effect on Annex I sandbanks and designated areas (including Margate and Long Sands SAC) in the Offshore Export Cable Corridor (OECC) due to sandwave clearance and cable installation has been assessed as being of minor adverse significance. We are unable to support this conclusion owing to insufficient supporting information in the EIA.</p> <p>With regards to MLS SAC, in particular, Natural England is concerned that there are existing anthropogenic activities occurring with the SAC which have caused a significant alteration of the sandbanks and are hindering the conservation objectives for the designated site. Additional pressures are, therefore, likely to push the meeting of the conservation objectives further away from their desired trajectory.</p>	Natural England advises that every effort must be made to mitigate project impacts to reduce project alone effects and cumulative/in-combination effects due to existing pressures. We also advise that a robust baseline should be established against which to assess the impacts of the project on Annex I sandbanks and protected habitats. In addition, we advise pre- and post-installation surveys should be secured to provide evidence of geomorphological recovery after sandwave levelling and cable burial and ensure remedial measures will be undertaken should impacts be greater than predicted.	

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	B26	6.2.2, Section s 2.10.74 2.10.86	<p>Natural England notes the Applicant has proposed up to 8 export cable installation vessel laydown areas in the nearshore subtidal, with an indicative total maximum seabed preparation area of 57,600m<sup>2</sup> and an indicative depth of 1m. This is an area equivalent to 8 Wembley stadium football pitches, which is substantial.</p> <p>Consequently, there are currently insufficient details regarding the location of the laydown areas and their potential impact on seabed morphology to agree with the effect significance conclusion. Furthermore, we do not agree that the coastline is of medium sensitivity/importance. The coastline is regionally, nationally, functionally, and strategically, important. It also provides a buffer between the sea and an ecologically important hinterland.</p>	We advise that the Applicant needs to fully consider the potential impacts of the laydown areas on the nearshore hydrodynamic conditions, seabed, and coastal morphology.	
	B27	6.2.2., Section s 2.11.12 8-130, 2.11.78 & 5.4, Section 11.2.92	<p><u>Impacts to Sediment Transport Regime in MLS SAC due to external cable protection</u></p> <p>Natural; England notes that it is stated that <i>'only very minor changes are expected to the sediment transport regime and any associated morphological impacts are also expected to be very limited'</i> due to the presence of 900m (5400m<sup>2</sup>) of cable protection within MLS SAC. However, we are concerned that MLS SAC has already</p>	Natural England advises that wherever possible, the placement of external cable protection should be avoided (as North Falls OWF project has done). If this is not possible, the impacts should be reduced as much as possible and then appropriate mitigation measures applied. Currently, there is insufficient evidence to support the impact assessment. We advise that the Applicant needs to provide further	

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			<p>been adversely affected by anthropogenic pressures. These pressures may have reduced the capacity of the site to withstand further impacts in terms of its extent, volume, form, and function. We highlight that the Applicant has assessed</p> <ul style="list-style-type: none"> <li>- the sensitivity/importance of the designated seabed at MLS SAC has been assessed as medium.</li> <li>- The magnitude of impact of change to sediment transport regime as low.</li> <li>- the overall level of effect of scour as minor.</li> </ul> <p>However, we advise that there is insufficient evidence to support these conclusions.</p>	evidence to demonstrate that the presence of cable protection measures within MLS SAC will not affect sediment transport processes operating at the site.	