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Identification Number: 20029896

20 June 2022

Dear Jo Dowling,

Planning Act 2008 - Application by Ørsted Hornsea Project Four (UK) Limited (“Ltd”) for an Order Granting Development Consent for Hornsea Project Four Offshore Wind Farm

Deadline 5 Submission

On 4 November 2021, the Marine Management Organisation (the “MMO”) received notice under Section 56 of the Planning Act 2008 (the “PA 2008”) that the Planning Inspectorate (“PINS”) had accepted an application made by Orsted Hornsea Project Four (UK) Ltd (the “Applicant”) for a development consent order (the “Application”).

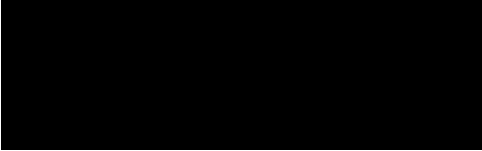
The Application seeks authorisation to construct, operate and maintain Hornsea Project Four offshore wind farm, comprising of up to 180 offshore wind turbines together with associated offshore and onshore infrastructure and all associated development (the “Project”).

The MMO submits the following as part of our Deadline 5 submission:

- 1. Deadline 5 Comments**
- 2. Responses to ExQ2**
- 3. Progressed Statements of Common Ground (SoCGs) and an updated Statement of Commonality of SoCGs**
- 4. Comments on any submissions received at Deadline 4 and 4a**
- 5. Any further information requested by the ExA under Rule 17 of the Examination Procedure Rules**



This written representation is submitted without prejudice to any future representation the MMO may make about the Application throughout the Examination process. This representation is also submitted without prejudice to any decision the MMO may make on any associated application for consent, permission, approval or any other type of authorisation submitted to the MMO either for the works in the marine area or for any other authorisation relevant to the proposed development.



Gregg Smith
Marine Licencing Case Officer



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1. Deadline 5 Response- additional comments

1.1. Marine Plan Policy Review [REP1-062]

- 1.1.1. The MMO has reviewed the Deadline 1 Submission of the Marine Plan Policy Review Revision:01 and would like to make the following comments:
- 1.1.2. The MMO note that the assessment included assessments for both the North East, and the East marine plan areas. On further interrogation of the Explore Marine Plans tool (<https://explore-marine-plans.marineservices.org.uk/>) The MMO has determined that the DCO order limits are wholly within the Eastern Marine Plan area.
- 1.1.3. The MMO has reviewed the Applicant's responses to the policies they have considered, and the documents and reasons given by the Applicant to demonstrate compliance.
- 1.1.4. Whilst the MMO has found the plan largely compliant with the East marine policy the MMO is unable to finalise the assessment. This is due to the requirement for Natural England to confirm the conclusions of the HRA and any compensation measures. Once these are secured the MMO will confirm the proposal as compliant or non-compliant.

1.2. Outline Offshore Operations and Maintenance Plan [REP2-043]

- 1.2.1. Schedule 11 (and same for Schedule 12), Part 2, Article 4- The MMO notes and appreciates the inclusion of an Operation and Maintenance plan to be submitted to the MMO prior to any maintenance works taking place. We advise a timeframe for submission to be six months prior to the planned works commencing. The MMO enquires whether in light of this inclusion of (6) "*No maintenance works authorised by this licence may be carried out until an operations and maintenance plan substantially in accordance with the outline operations and maintenance plan has been submitted to and approved by the MMO in writing*", that (2) "*No maintenance works whose likely effects are not assessed in the environmental statement may be carried out, unless otherwise approved by the MMO in writing*" and (4) "*Where the MMO's approval is required under paragraph (2), approval may be given only where it has been demonstrated to the satisfaction of the MMO that the approval sought is unlikely to give rise to any materially new or materially greater environmental effects from those assessed in the environmental statement*" should be removed?
- 1.2.2. The MMO notes at 1.1.1.2, the reference to the definition of "maintain". The MMO previously has raised the request that further information is included within this interpretation (as seen in the Development Consent Order (DCO) and Deemed Marine Licences (DMLs), and that it should be similar to: "maintain" includes inspect, upkeep, repair, adjust, and alter, and further includes remove, reconstruct and replace (like for like) but only in relation to any of the ancillary works in Part 2 of Schedule 1 (ancillary works), any cable, any component part of any wind turbine generator, offshore electrical



substation, offshore accommodation platform, meteorological mast, and the onshore transmission works described in Part 1 of Schedule 1 (authorised development) not including the removal, reconstruction or replacement of foundations and buildings associated with the onshore project substation), to the extent assessed in the environmental statement; and “maintenance” must be construed accordingly”.

- 1.2.3. The MMO notes the Applicant's position is that it should not be changed. As such the MMO leaves this to the ExA during determination.
- 1.2.4. The MMO Notes that Table 1 of the plan (Maximum design parameters for general offshore operation and maintenance activities) include "Ad hoc" for supply vessels and Jack up Vessels, we query whether these could be quantified in line with assessments from the ES.
- 1.2.5. In Table 3 (Maximum design parameters for total offshore operation and maintenance activities.) for “Foundation anode replacement”, we note that the contents have been interrupted by the row on “Seabed Surveys” and that this is replicated throughout the table where it has crossed onto another page. We advise that this is corrected, we also request that it references its limitations of the replacement to be in line with "*like-for-like or as within the project envelope*".
- 1.2.6. In Table 3 the same issue has occurred for “Cable protection replacement” and this has also been cut off by Seabed Surveys. We also request further detail is added to the description.
- 1.2.7. For "Array cable repairs", we request that for any replacement of all components, limitations are added to be in line with "*like-for-like or as within the project envelope*".

1.3. Outline Cable Specification and Installation Plan [REP2-030]

- 1.3.1. The MMO notes "*Co188- Secondary: No cable protection will be employed within 350 m seaward of MLWS2*". The MMO understands that there are ongoing discussions on the location of Smithic Bank, with regards to Coastal Processes, and as such flags a watching brief on this limitation accordingly (it may move depending on further information on the Bank). This also applies to Co189 (Dogger Bank cable crossing).

1.4. Outline Marine Mammal Mitigation Protocol [APP-240]

- 1.4.1. The MMO has reviewed the information provided at Deadline 4, however are working with our scientific advisors at Centre for Environment, Fisheries, and aquaculture Science (CEFAS) for technical advice, as such we will defer a response on this document to Deadline 6.

1.5. Outline Marine Written Scheme of Investigation [APP-240]



1.5.1. The MMO defers to Historic England for consideration of the Marine Written Scheme of Investigations.

1.6. **Outline Marine Monitoring Plan [APP-242]**

1.6.1. The MMO notes monitoring is still a subject under discussion relating to a number of subject areas, and that this plan may need to be updated to reflect the final outcome of those discussions.

1.7. **Outline Ornithological Monitoring Plan [APP-254]**

1.7.1. The MMO defers to Natural England as the Statutory Nature Conservation Body (“SNCB”) regarding the contents of this monitoring plan, however the MMO flags that this plan is conditioned to be put forward 4 months prior to the planned commencement of works. The MMO maintains that 6 months should be provided for, for a more precautionary timeframe.

1.7.2. Please note, with the inclusion of a condition for this, a definition for the plan should be included in Article 1 of both Schedules 11 and 12 to be certified for the purpose of this order under Article 38.

1.8. **Outline Southern North Sea Special Area of Conservation Site Integrity Plan [APP-246]**

1.8.1. The MMO defers to Natural England as the SNCB for the contents of this plan.

1.8.2. The MMO has updated the standard condition in relation to designated sites for harbour porpoise. This is due to the outcome of the Review of Consents undertaken by the Secretary of State, the MMO advise that, like any new application, it will need to be in line with the Review of Consents condition.

1.8.3. The MMO would like condition 13 (1)(j) to be removed and replaced with the new standalone condition outlined below. When the standalone condition is added, the Interpretations section (Article 1) will need to be updated to include:

1.8.4. *““JNCC Guidance” means the statutory nature conservation body ‘Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs’ Joint Nature Conservation Committee Report No.654, May 2020 published in June 2020 as amended, updated or superseded from time to time”.*

1.8.5. The MMO propose the following wording for the new SIP condition:
“Southern North Sea Special Area of Conservation Site Integrity Plan 25-
(1) No piling activities can take place until a Site Integrity Plan (SIP), which accords with the principles set out in the in principle XX Project Southern North Sea SAC Site Integrity Plan, has been submitted to, and approved in writing, by the MMO in consultation with the relevant statutory nature conservation body.
(2) The SIP submitted for approval must contain a description of the conservation objectives for the Southern North Sea Special Area of



Conservation (SNS SAC) as well as any relevant management measures and it must set out the key statutory nature conservation body advice on activities within the SNS SAC relating to piling as set out within the JNCC Guidance and how this has been considered in the context of the authorised scheme.

(3) The SIP must be submitted to the MMO no later than six months prior to the commencement of the piling activities.

(4) In approving the SIP the MMO must be satisfied that the authorised scheme at the pre-construction stage, in-combination with other plans and projects, is in line with the JNCC Guidance.

(5) The approved SIP may be amended with the prior written approval of the MMO, in consultation with the relevant statutory nature conservation body, where the MMO remains satisfied that the Project, in-combination with other plans or projects at the pre-construction stage, is in line with the JNCC Guidance."

1.9. **Outline Fisheries Coexistence and Liaison Plan [REP1-033]**

- 1.9.1. The MMO strongly maintains its position that it is made clear within the document that *"the MMO will not act as arbitrator and will not be involved in discussions on the need for, or amount of, compensation being issued"*. The MMO believes this should be made clear at this stage to ensure all parties are aware that the MMO will not be part of this process. We note the Applicant has outlined that they do not intend on updating this.

1.10. **Unexploded Ordinance**

- 1.10.1. The MMO notes that Unexploded Ordinance (UXO) is not included in this application. However, notes that this was included in the East Anglia 1 and East Anglia 2 determinations. As such, should they be considered for Hornsea 4, they should form, and be considered as part of this Examination. The MMO requests that if UXO clearance remains out of the DCO application, that surveying is conducted prior to a marine licence application.

1.11. **MCA Dropped Objects**

- 1.11.1. The MMO has been made aware that the Maritime Coastguard Agency (MCA) have asked the Applicant to include the below text for inclusion in the MMO's MLDIR dropped object report form:
"Immediate notification (as soon as reasonably possible, but no later than 6 hours) must be made to the relevant HM Coastguard Coordination Centre by telephone, and the UK Hydrographic Office (UKHO) (navwarnings@btconnect.com) where there is debris or a dropped object which is considered a danger or hazard to navigation."
- 1.11.2. The MMO approves that this can be added within the MLDIR dropped object report form for this Project.

1.12. **Compensation**



- 1.12.1. The MMO is reviewing its position regarding the securement of compensation requirements within the DCO and DMLs to capture mitigation appropriately as part of the authorised development.
- 1.12.2. Regarding without prejudice compensation measures, such as offshore nesting platforms, the MMO maintains its request that these are included as an official schedule into the DCO. For example, the use of an offshore artificial nesting platform to increase the annual recruitment of black-legged kittiwake and northern gannet (APP-057 Environmental Statement Volume A4 Annex 6.1 Compensation Project Description).
- 1.12.3. We further advise that the commitments made under the Commitments Register need to be clearly contained within the conditions under the DCO and DMLs.

2. Responses to ExQ2 issued on Monday 30 May 2022

Heading	Question Number	Question	MMO Response for DL2
DCO Draft Development Consent Order (draft DCO)	2.1	<p>Extent of the landfall works</p> <p>Sheet 1 of 28 of the Works Plans (Onshore) [APP-212] depicts Works Nos. 9a, 9c and 6 extending eastwards over the current cliff line and on to the beach area. Inset Plan A and Inset Plan B of Appendix A of [REP4-038] depicts this in more detail and appears to indicate that the eastern boundary of Works Nos. 6, 9a, and 9c corresponds with the '0m Mean High Water (OS)' line, which lies lower down the beach than Mean High Water Springs (MHWS).</p> <p>Do you have any concerns with the proposed eastern extent of Work No. 6 (Onshore Connection Works), Work No. 9a (Temporary Access Tracks) and Work No. 9c</p>	<p>The MMO note that the works area will fall under Mean High Water Springs (MHWS), and as such, within our jurisdiction. We await the Applicant's answer and will provide a further response at Deadline 6 where appropriate.</p>



		(Temporary Logistics)	
	2.3	<p>Temporary access ramp to beach potentially extending into intertidal zone</p> <p>Would ERYC and the MMO please confirm what their in-principal requirements would be if the temporary ramp to beach level was to extend into the intertidal zone (see [APP-010 Figure 4.16] and [REP4-038 Appendix A])?</p>	<p>The MMO's jurisdiction is below Mean High Water Springs (MHWS), should the access ramp extend below this mark, then it would need to be incorporated into the Deemed Marine Licence (DML) as a licensable activity, over which the MMO would enforce should it be required. There would need to be a duplication of requirements within both the DMLs and within the DCO, to allow for ERYC to regulate the works within their jurisdiction. The Applicant would require sign off from both authorities, as one does not negate the need for another. The MMO welcomes discussions with ERYC if required.</p>
	2.4	<p>Drafting of the DCO</p> <p>In your various written submissions, you have raised a number of concerns in relation to the general drafting of the DCO and Deemed Marine Licences (DMLs). Can you advise if these concerns have been addressed by the most recent version of the draft DCO submitted at D4 [REP4-050].</p>	<p>The MMO has reviewed the updated DML's provided by the Applicant at Deadline 4 (REP4-014). Comments relating to this can be found in 4 of this submission.</p>
	2.14	<p>Schedule 1, Part 1</p> <p>Having regard to overlapping responsibilities between ERYC and the MMO over the intertidal zone, in your answer [REP3-052] to Action Point 2 from Issue Specific Hearing 1 [EV-008a] you</p>	<p>The MMO has yet to receive any information on this matter from the Applicant.</p> <p>As it stands the response from question 2.3 regarding dual consent from both the MMO and the ERYC applies.</p>



		state that it is not possible to be satisfied if the Applicant's response to ExQ1 DCO.1.24 is adequate until "an agreement is in place". Please clarify when you expect such an agreement would need to be in place and what progress if any has been made towards clarifying how potential for conflict or omission of responsibilities in this overlap area might be managed.	
	2.17	Unexploded ordnance Noting your previous submissions on unexploded ordnance, review whether the matter of clearing unexploded ordnance should be controlled by condition in light of Condition 16 of the DMLs for East Anglia ONE North and East Anglia TWO and, if not, why not?	If this is to be considered for this DCO, the MMO would support this. However, we strongly advise it is considered fully within the Examination process. The MMO requests that if UXO clearance remains out of the DCO application, that surveying is conducted prior to a marine licence application. We await a response from the Applicant.
Environmental Impact Assessment (EIA) and Environmental Statement (ES)	2.4	Management plans required before the commencement of any marine activities ExQ1 ES.1.18 explored the plans that would need to be produced before the commencement of marine licensed activities. The Applicant responded at Deadline 2 [REP2-038]. Your Deadline 2 document [REP2-077] suggested that you would address this at Deadline 4. Please clarify where your consideration and conclusion can be seen and indicate if you	The MMO is in the process of considering the plans provided by the Applicant during Examination. This can be found within section 1 of this submission.



		are now content with the matter.	
Marine and Coastal Geology, Oceanography and Physical Processes	2.3	<p>Consideration of climate change scenarios in modelling</p> <p>Natural England suggested [RR-029] that the marine process modelling and assessment in the ES should have taken various climate change scenarios into account. The Applicant does not believe this to be a relevant consideration in the timescales associated with the construction of the Proposed Development [REP1-038]. Please signpost or provide an update on any progress on positions in relation to this matter.</p>	The MMO continues to engage with Natural England and the Applicant regarding this matter. For further information please see the Coastal Processes comments within section 4 of this submission.
	2.4	<p>Cumulative modelling of cable crossings</p> <p>In your Relevant Representation [RR-020], you raised an outstanding request for further cumulative modelling of the proposed cable crossings in respect of changes to sediment transport. The Applicant provided a response [REP1-038] and [REP2-038]. Do you have any remaining concerns in relation to this matter?</p>	The MMO continues to engage with Natural England and the Applicant regarding this matter. For further information please see the Coastal Processes comments within section 4 of this submission.
	2.5	<p>Sediment sampling and analysis</p> <p>Following the Applicant's submission of additional signposting and documentation (eg [REP4-032]), are you now content that you have all of the</p>	The MMO is still not content that we have all the necessary information. This is discussed further within the section 4.2 of this submission.



		<p>necessary information about the analysis of marine sediment to make a judgement about the suitability of the dredged sediment for disposal? Please confirm if any matters or required information remain outstanding in relation to the use of a Mini-Hamon Grab to collect sediment samples for contaminant analysis, and whether you now have sufficient information about the seabed depth from which the samples were taken.</p>	
	2.7	<p>Dredged sediment sampling during construction At Issue Specific Hearing 4 [EV-027], in discussions about the ongoing monitoring of sediment samples from the proposed dredge area during construction, the Applicant suggested that, as construction lasts less than five years, monitoring of this nature would be unnecessary. In response, the MMO has advised [REP4-052] that sampling is required either every three years, or every five, depending on the results of the sediment sample analysis. The MMO has also asked for clarity on how OSPAR requirements would be adhered to, and how this would be secured, should there be a delay in construction. MMO suggests that the OSPAR sampling</p>	<p>The MMO is still waiting for information from the Applicant regarding the sampling during construction. The MMO's initial advice remains. Further issues with the sampling is discussed in section 4.2 of this submission.</p>

		<p>requirements are clearly outlined as a matter to be signed off in the DMLs. Please indicate if there has been a full resolution of these matters, and, if so, detail the outcome. If not, please confirm how and when discussions will progress and be reported in future versions of the SoCG to achieve resolution before the close of the Examination.</p>	
Marine Ecology	2.4	<p>Benthic ecology survey results Your Relevant Representation [RR-020] noted a concern about the Applicant's interpretation and presentation of benthic ecology survey results, and whether more of the information from the technical annex should be brought into the relevant chapter of the ES. Your SoCG with the Applicant at Deadline 3 [REP3-017] notes your view as, "3.4.13 Although the evidence gathered appears appropriate, the evidence presented is insufficient to allow a decision on the project to be made". Please indicate if your subsequent review of the application documentation with the benefit of signposting from the Applicant has changed your position on this. In particular, please confirm if you have remaining concerns about the 'interpretation', 'presentation' and</p>	<p>The MMO is seeking technical advice on this question, and as such defers its response to Deadline 6.</p>

		completeness of the survey results, noting that the information in the technical appendices is inherently part of the ES.	
Noise, Vibration, Electro Magnetic Fields and Light	2.1	<p>Other underwater noise Please signpost any progress between the parties in relation to the MMO's Relevant Representation [RR-020, 3.7.11 and 3.7.19] that 'other continuous sources' of underwater noise may not be realistic, and that further modelling and assessment may be necessary. Please include consideration of the two specific points raised in relation to the duration of the activity and exposure period used, and the rationale behind the effect ranges applied for these sources. The Applicant's position that no further modelling is required is noted [REP2-038].</p>	The MMO is seeking technical advice on this question, and as such defers its response to Deadline 6.

3. Progressed Statements of Common Ground (SoCGs) and an updated Statement of Commonality of SoCGs

- 3.1. The MMO has engaged with the Applicant and understands that an updated SOCG will be submitted at this Deadline.

4. Comments on any submissions received at Deadline 4 and 4a

4.1. Marine Processes Supplementary Report [REP4-043]

- 4.1.1. The MMO has reviewed the information within this document and consulted with our scientific advisors at the CEFAS and wish to make the following comments:
- 4.1.2. Two main issues have been addressed in this report, namely the impact of export cable on the integrity of Smithic sand bank and the impact of the offshore wind farm structures on the Flamborough front. We address each of these issues in turn.



4.1.3. Smithic sand bank

The Applicant has chosen to use an EGA (Expert Geomorphological Assessment) to determine the degree of impact of the cables. Whilst this process is relatively new and to our understanding no formal guidance on the methodology are available, it has been used successfully in a number of high-profile projects that are of national significance. Our understanding of an EGA is where a number of recognised experts are brought together who have diverging points of view. Over the course of a few days, the strength of the evidence is tested, and a number of agreed scenarios developed. The strength of the process is that opposing views have been brought to a consensus. In this document the adherence to this general procedure is not documented.

4.1.4. The Supplementary report makes a series of logical and well-founded comments on the sediment transport regime and thus the form and function of the bank based on bathymetric changes (report Figures 3 and 17 bottom panels). e.g., clockwise circulation of North Smithic along with large sand waves, a general transport of the main Smithic bank westward and north westward along with a general lowering of the bank. The Applicant should make an assessment of the volume changes within these zones to determine if the bank is a closed or an open system i.e. is the total volume fixed or are there “leaks” towards the coast.

4.1.5. In section 2.4.5.2 the impacts of the cable on the bank are considered to be “*negligible and remain local to the infrastructure*”. This is key to the concerns about Smithic bank. In Figure 1 of this submission (based on Figure 6 of the report) show that whilst on the flanks of the bank significant changes of up to 2.5m have been observed between 1979 and 2020/21. Furthermore, if the location of the rock berms identified in Figure 2 of this submission are added to this plot the distance to the geomorphological boundary (red line) is considerably smaller. In summary, the final planned position of the Dogger A and B export cables, should be overlain on Figure 1 (this submission) with the planned berm positions and Hornsea 4 cable routes from Figure 2 (this submission) along with the geomorphological boundary (dashed red line). Once completed, the interaction (or not) between these structures will become more apparent.

4.1.6. Figure 6 of the report (document 4) also introduces the blue line of sources of sediment from the preeminent authors of Pye, Blott and Pye (2015). Using a technique based on rare earth elements (REE) they infer the source of the sediment and therefore the sediment transport direction (see Figure 3 of this submission). They split this into two sources, the Holderness, and Flamborough coasts and infer transport along gradients. Whilst they agree with the clockwise circulation of North Smithic, the data suggests an anti-clockwise circulation of the main Smithic bank. Two issues arise out of this. Firstly, how does the Applicant reconcile the evidence from swath bathymetry represent in this report of a west and North West movement against the anti-clockwise circulation in Pye, Blott and Pye (2015). Secondly, northerly transport near to the coast could be considered to isolate Smithic from the coast (except for the frontage directly opposite the town of Bridlington). Can Smithic Bank be considered to be closed



or at least semi enclosed and thus not the “dynamic reservoir” that was recently considered to be the most likely sources of sediments along the Holderness coastline?

- 4.1.7. In section 2.4.2.2 The authors recognise that Smithic Bank has reduced in height from 1979 to 2020/21. Is this a long natural trend e.g. driven by sea-level rise or changing wave climate) or a cyclical process and just reworking of the sediments? For instance, the 1794 chart (https://www.usna.edu/Users/oceano/pguth/website/shipwrecks/logbooks_lesson/logbooks_lesson.htm, shown in Figure 4 of this submission) shows Smithic in a similar position but with shallower depths (note depths in Fathoms).
- 4.1.8. Furthermore, the cumulative impact of the Scotland-England Green Link needs to be assessed especially as it passes over Smithic Bank.
- 4.1.9. The MMO requests that the following mitigation/monitoring options are considered:
- Moving the crossing further east would reduce any residual impacts on Smithic Bank.
 - Whilst it's normal industry practice to cross at 90 degrees, could an exception be agreed so that the whole crossing envelope is moved further east?
 - A commitment to zero scour protection with the 20m contour would de-risk impacts on sediment transport.
- 4.1.10. **Flamborough Front**
Summarising the issue, the mixing from the Gravity Based Structure and Monopiles will mix cold, high nutrient bottom waters through the water column to the surface.
- 4.1.11. In section 4.3.3.2 the Applicant concedes that “*there will changes to the flow regime immediately adjacent to the obstacle and downstream of the foundation within three times the length scale of the obstacle*”, we disagree with the length scale. Observations of suspended sediment plumes show that they can extend to the next monopile (Forster, 2018) and see Figure 5 of this submission. Whilst the process of sedimentation of particles within the plume back to the seabed does result in a reduction of suspended sediment concentration along the length of the plume, this process is likely to be slower than the diffusivity associated with mixing of the cold-water plume laterally. Therefore, the cold-water plumes will be smaller than then suspended sediment plume. Please can the Applicant use standard long sea outfall mixing models to predict the length of any plume as these could be typically, of the order, 500m?
- 4.1.12. Whilst cold water plumes will only exist during the summer and their location, intensity and duration is probably beyond the limits of shelf sea predictive



modelling, can archives of surface seawater temperatures and chlorophyll concentrations be used to determine the time within the license area?

4.1.13. Furthermore, along with the temperature inversion, the vertical mixing will bring higher concentration nutrients to the surface that will aid primary productivity at the surface where sufficient sunlight is available to start production. Will this additional productivity be used within the site (e.g. by mussels on the structures) and thus could result in a relocation of productivity from further offshore (e.g. Dogger Bank) as nutrients have been utilised inshore?

4.1.14. The MMO requests that the following mitigation/monitoring options are considered:

- Gravity based structure will add significantly more turbulence to the water column than monopile and thus advect large quantities of cold water. Reducing the maximum number of gravity-based structures (GBS) will reduce the overall vertical mixing.
- Additional monitoring of the cold-water plumes from high resolution satellite imagery should be undertaken to determine the impact of the plumes. Alongside this, similar high resolution chlorophyll imagery should be collected to identify if a relocation of the bloom from offshore to inshore has taken place. Furthermore, consideration of monitoring the mid water chlorophyll maxima should be undertaken using undulating vehicles.

4.1.15. **Summary**

The supplementary report concerning the integrity of Smithic Bank and the impact of structures on the Flamborough Front has been considered. The MMO considers that the reduction in crossing to twelve is a significant mitigation. However, bathymetric evidence still suggests that sediment transport is active even on the flank of the banks. Whilst some considerations of the impact of the cold water plume due to vertical turbulence have been made, these have not been satisfactorily answered. Mitigation and monitoring options are present for each issue.

4.1.16. The MMO advises that there may be the requirement for the inclusion of an “outline marine processes management plan”, or an update to the “the outline marine monitoring plan” to capture this monitoring, depending on the resolution of the ongoing discussions on the matter. These would need to be appropriately secured into the Order, within DML conditions.

4.1.17. The MMO, Natural England, and the Applicant have continued to engage in discussions over the points raised above.

4.1.18. A memo capturing the outcomes of a meeting between the MMO (including CEFAS), and Natural England has also been produced, this has been sent to the Applicant outlining the view of both organisations. This has been provided in Annex A of this submission.



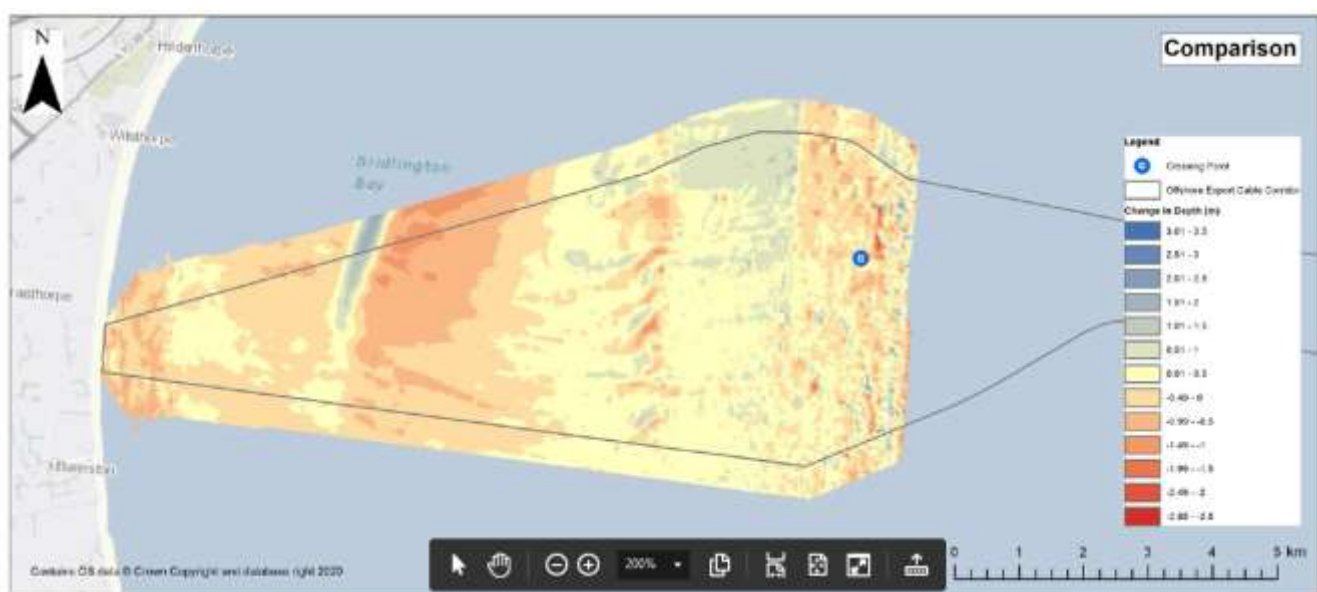


Figure 1- Based on Figure 6 (bottom panel) from the supplementary report (1979-2020/1). An additional red dashed line has been added showing the geomorphological eastern boundary of Smithic Bank.



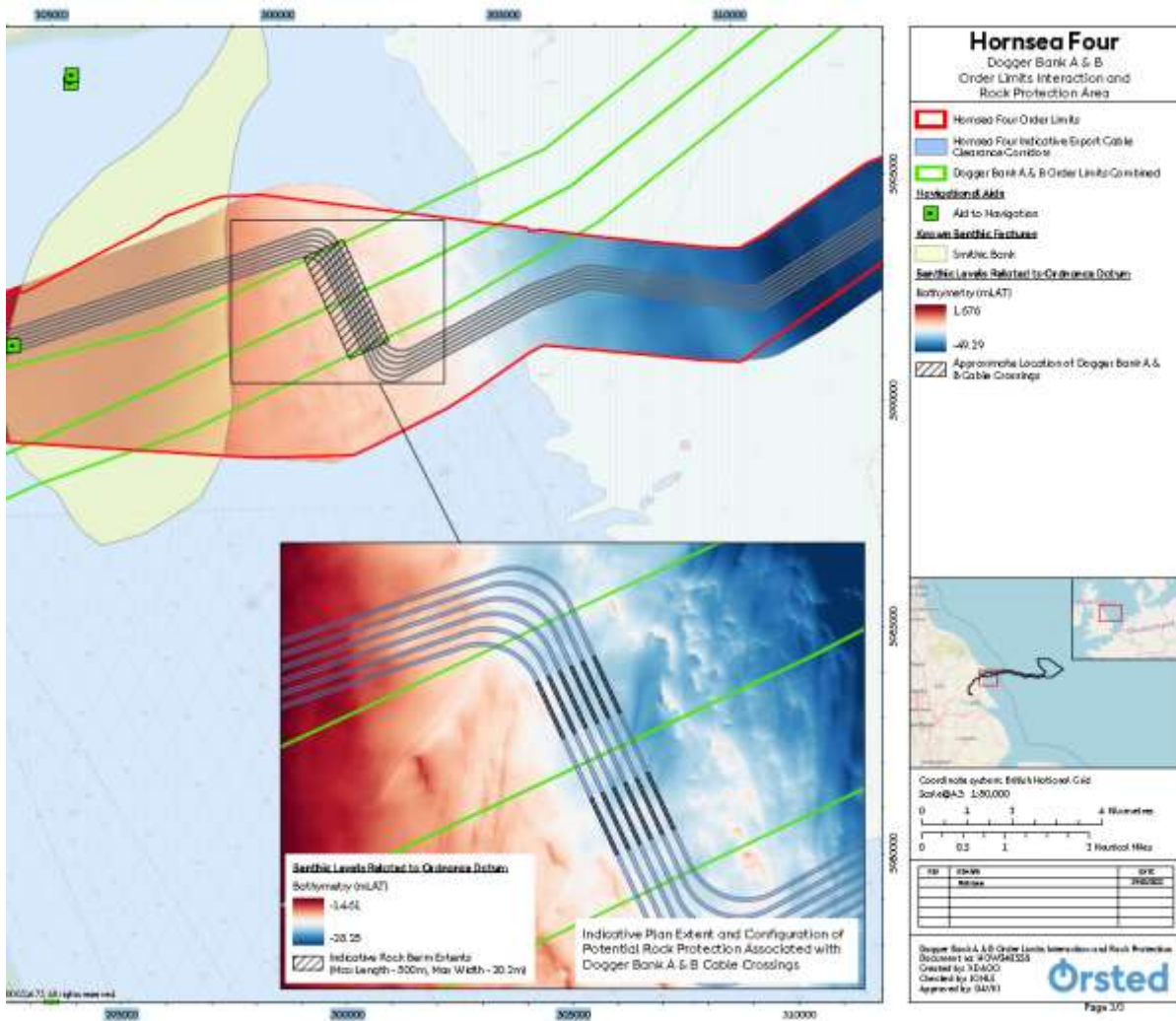


Figure 2 - Based on document (5). Note That the green Dogger bank A and B are order limits are for 2 bundles of 2 cables each. Therefore, the six Hornsea 4 cables would cross the 2 trenches of Dogger A+B producing twelve rock berms/crossing points.

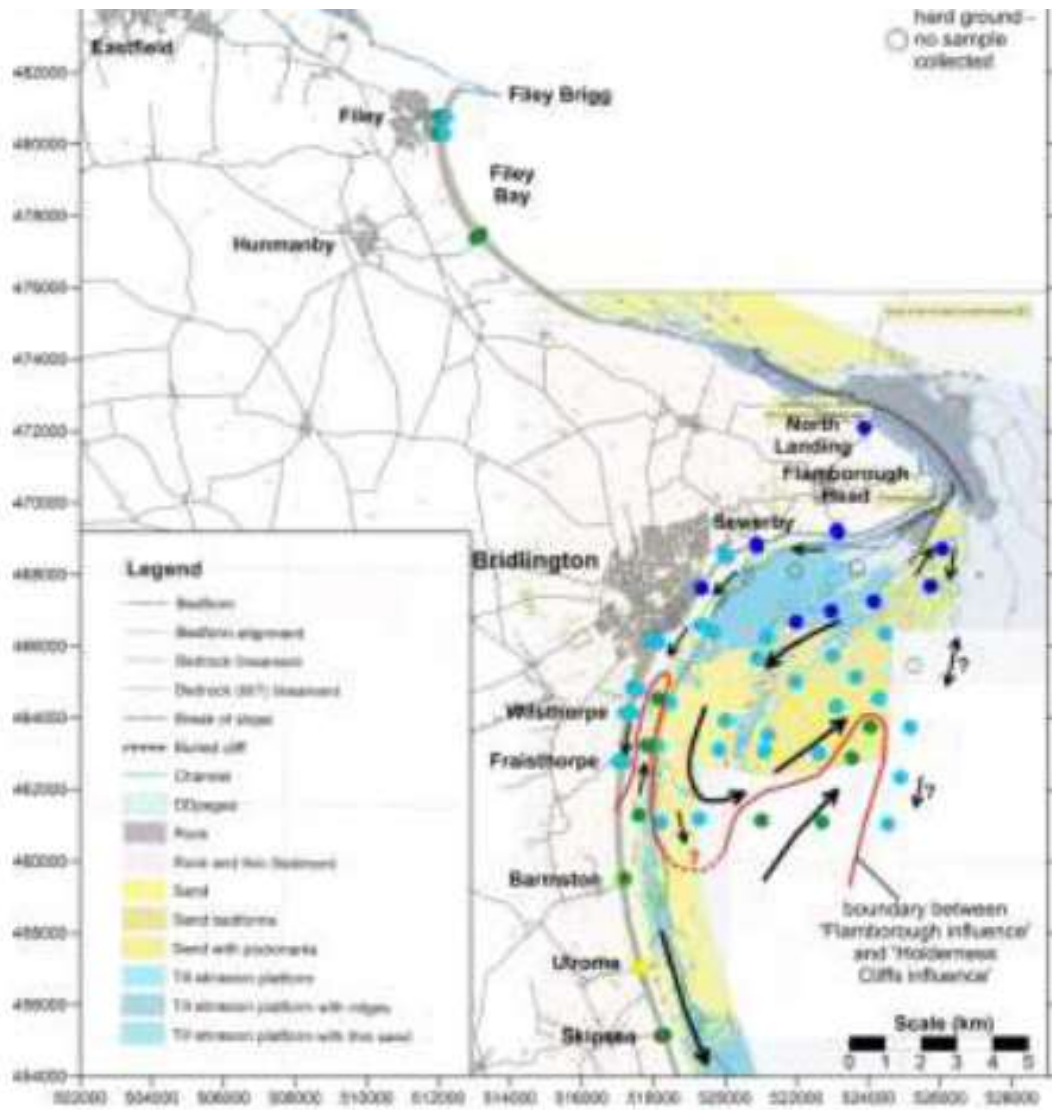


Figure 3 - Sediment transport vectors based on a Rare Earth elements tracer study based on their Figure EX1 (Pye, Blott, Pye, 2015).

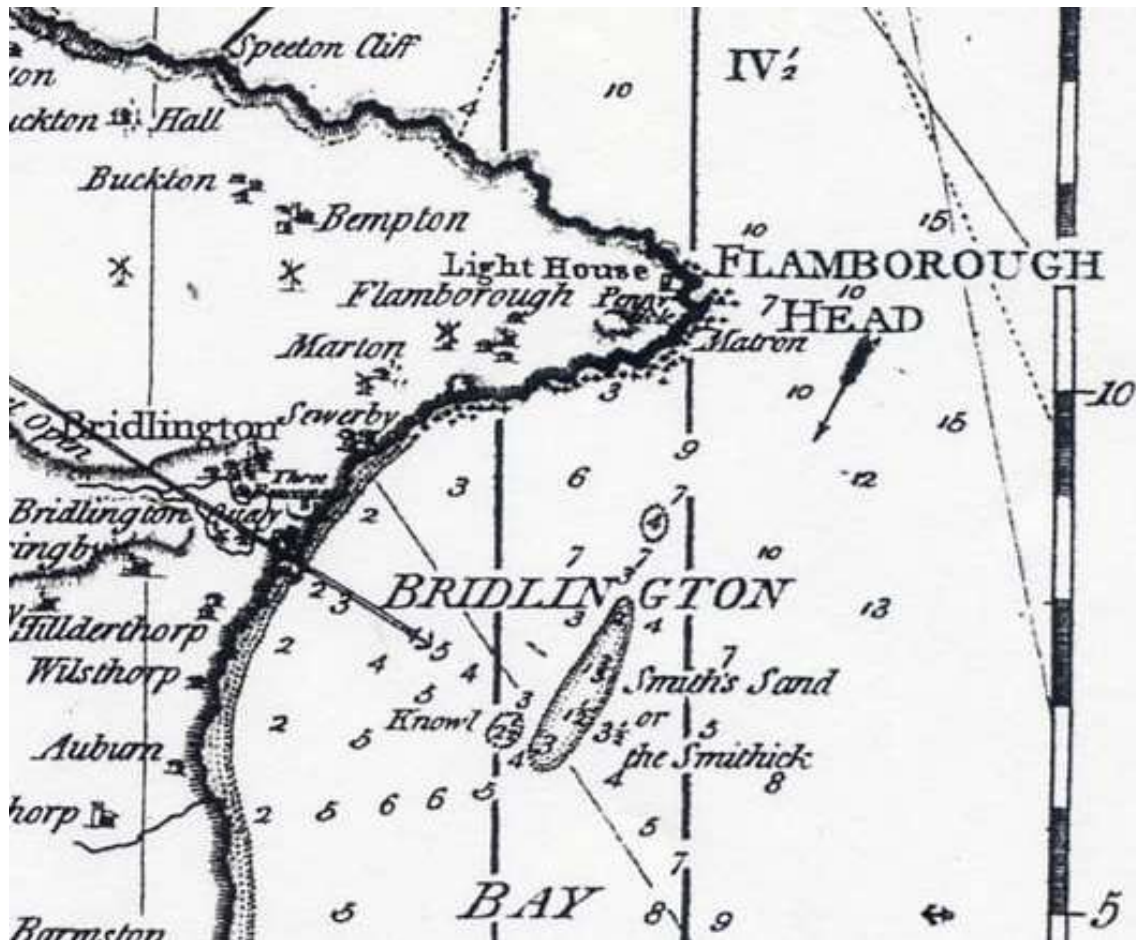


Figure 4 - 1794 chart of Bridlington bay showing Smithic Bank
 (https://www.usna.edu/Users/oceano/pguth/website/shipwrecks/logbooks_lesson/logbooks_lesson.htm)



Figure 5 - Satellite Image from Thanet offshore wind farm showing the suspended sediment plumes from each monopile.



4.2 Clarification Note on Marine Sediment Contaminants - Revision: 02 [REP4-031].

4.2.1 The MMO has reviewed the updated information within this document following an initial MMO review that was included within our Deadline 3 response and consulted with our scientific advisors at the CEFAS.

4.2.2 The MMO's initial response at Deadline 3 compromised the following:

a) The MMO has identified that the depth of the samples are unclear from the results template. Our review of this analysis has been carried out under the assumption that the depth provided was water depth and not sediment depth, and that all samples were taken from the seabed surface. However, this will need to be confirmed by the Applicant as a Mini-Hamon Grab is not appropriate for depth samples.

b) Regarding section 3 of the Clarification Note, the MMO has major concerns, and cannot accept the results provided at present. The analysis laboratories are noted as "Gardline Limited" for the array samples and "Bibby HydroMap Limited/Benthic Solutions Limited" for the Export Cable Corridor. Neither of these are validated laboratories by the MMO for analysing marine sediments. Confirmation of the analysing laboratories is required to allow the interpretation of the results. The MMO did request this information from the Applicant on 7 April 2022, however, has been advised it may be a number of weeks before this information can be provided by the Applicant. The MMO cannot undertake a robust review of the analysis results with the outstanding matters mentioned within 2.2.5 and 2.2.6 of this response. As such the MMO will provide a further response on the contaminants at a later Deadline when the information is provided.

c) The MMO has also previously asked the Applicant to confirm the units of the polyaromatic hydrocarbon [PAHs] results.

4.2.3 The concern from comment "a" is outstanding. The results template (document referenced in para 4b) lists the sample depths as ranging from 8 – 65m. It is highly likely that this refers to the water depth of the sample location, rather than the sediment depth below the seabed. The latter depth is what's required. The Applicant should confirm the sediment depth of the sample locations – if samples were only taken from the seabed surface, then the sediment depth is 0m.

4.2.4 With reference to comment "b", the report (document referenced in para 4a) now includes the certificate of analysis for PAHs as an appendix. The certificate of analysis is watermarked as being published by SOCOTEC, who are validated by the MMO for PAH analysis. This indicates that the PAH analysis may have been conducted by SOCOTEC, however, document referenced in para 4b still lists the contracting laboratory as "Bibby HydroMap Limited /



Benthic Solutions Limited” for all analytes (this/these is/are not validated by the MMO for any analysis).

- 4.2.5 It is essential that methods used to analyse marine sediments are standardised, as different methods and standards can lead to very different results. It may be the case that SOCOTEC have subcontracted the analyses to Bibby HydroMap Limited / Benthic Solutions Limited. If this is the case, the results generated from such an approach would not be acceptable as the MMO laboratory validation process validates not only the methods used, but also the capabilities and standards of the laboratory conducting the analysis. If Bibby HydroMap Limited / Benthic Solutions Limited did not conduct any of the analyses, it is unclear why they have been included on the Results Template (document referenced in para 4b) and clarification should be provided.
- 4.2.6 The Applicant should also note that, if SOCOTEC did indeed conduct all listed analyses, the Particle Size Analysis (PSA) data would not be acceptable as SOCOTEC are not validated by the MMO for PSA.
- 4.2.7 Given the discrepancies now present within the application, the MMO requests written clarification from the Applicant as to which laboratories conducted which analyses. The Results Template should also be updated in this regard. Until this is clarified, the MMO consider the data presented to be inadequate to support any conclusions concerning contaminant levels.
- 4.2.8 Comment “c” has now been resolved as the Applicant has given the PAH units within the report proper and in Appendix B (mg/kg). This is corroborated by document referenced in paragraph 4b. However, please note that we have been unable to review the results in terms of the potential risk due to outstanding concerns
- 4.2.9 Section 4.2.1.3 states: *“It should also be noted that contaminants within the seabed sediments are highly likely to be remobilised during storm events, and as such there will not be a novel or acute introduction of contaminants into the environment beyond natural baseline conditions.”* The MMO believe this comparison of the proposed activities to storm surge is questionable, as the effects of storm surge can vary greatly dependent on water depth, i.e. such effects are likely to be more notable in shallower, coastal waters compared to deeper offshore waters. If this argument is adequately supported by the plume modelling referenced earlier in the paragraph, in that the results show that potential disturbance will be comparable to storm surge effects, then the point is acceptable, but should be better justified.
- 4.2.10 Tables 3 and 7 list the Action Levels (ALs) for all PAHs as 0.1 mg/kg. This is not the case for dibenz(a,h)anthracene, the associated AL1 for which is 0.01 mg/kg due its relative higher toxicity at lower concentrations. In Table 7 this affects samples ECC19, ECC20 and ECC21, which should be colour-coded amber/yellow.



4.2.11 The document references the “Gorham test”. The Applicant should note that the correct reference is “Gorham-Test” which is the name of the author of the relevant PAH effect ranges (Gorham-Test *et al.*, 1999). CEFAS typically refers to this as the Gorham-Test approach.

4.2.12 **Summary**

Of the concerns raised at the previous stage, the Applicant has:

- Resolved the concern relating to the ambiguity of reporting units for PAH results.
- Not resolved the concern relating to sample location depths.
- Not resolved the concern relating to contracted laboratories.

4.2.13 Both outstanding concerns should be resolved, however, the latter concern is more critical to the application. The MMO recommend that the MMO Results Template (document referenced in para 4b) is updated to reflect the actual laboratories which conducted the analyses, and that written clarification is provided to the MMO to resolve the discrepancies present. The data are not considered adequate to support the application until this is resolved.

4.3 **Clarification Note on Marine Mammals - Revision: 01 [REP4-045]**

4.3.1 The MMO has reviewed the information provided at Deadline 4, however are still working with our scientific advisors at CEFAS for technical advice, as such we will defer a response on this document to Deadline 6.

4.4 **Updated version of the draft Development Consent Order (DCO) [REP4-050]**

4.4.1 The MMO has noted the Applicant’s updated positions on the draft DMLs within the DCO. The MMO were made aware that this version was the Applicant’s intended final position on the DML’s on 26 April 2022 during ISH3.

4.4.2 The MMO has therefore reviewed the DCO and DMLs and provides the following latest positions on them:

4.4.3 **DCO Part 1, Article 2, “box-type gravity base structures”; “gravity base structure”; “jacket foundation”; “monopile foundation”; “mono suction bucket foundation”; “pontoon gravity base type 1 structure”; and “pontoon gravity base type 2 structure”.** The MMO maintains the position that additional information would be useful within these interpretations such as: transition piece, fenders and maintenance equipment, boat access systems, access ladders and access and rest platform(s) and equipment. However, this is a minor point.

4.4.4 **DCO Part 1, Article 2, “horizontal directional drilling”.** The MMO maintains that further information could be set out in this definition such as “*horizontal directional drilling*” means a trenchless technique for installing an underground duct between two points without the need to excavate vertical shafts”. However, this is a minor point.



- 4.4.5 **DCO Part 1, Article 2: “maintain”.** The MMO maintains that further information should be included within this interpretation and that it should be similar to: *“maintain” includes inspect, upkeep, repair, adjust, and alter, and further includes remove, reconstruct and replace (but only in relation to any of the ancillary works in Part 2 of Schedule 1 (ancillary works), any cable, any component part of any wind turbine generator, offshore electrical substation, offshore accommodation platform, meteorological mast, and the onshore transmission works described in Part 1 of Schedule 1 (authorised development) not including the removal, reconstruction or replacement of foundations and buildings associated with the onshore project substation), to the extent assessed in the environmental statement; and “maintenance” must be construed accordingly*. This provides greater clarity on the extent to which “maintain” can be applied throughout the Order.
- 4.4.6 **DCO, Part 2 Article 5.** The MMO does not agree with the inclusion of Article 5 in its current form and requests that all references to the MMO and DMLs should be removed from Article 5 of the DCO. The MMO maintains the position that that once a DCO is consented the DMLs become standalone consents to be administered by the MMO and governed by the Marine and Coastal Access Act 2009 (“MCAA 2009”). The MMO does not believe the Applicant has provided adequate justification or rationale as to why these provisions and a deviation from the provisions of MCAA 2009 are required for the purpose of the two DMLs for this project. See section 2.1.1 to 2.1.3 of AS-031 for further details on this.
- 4.4.7 **DCO, Schedule 1, Part 3, Article 5 (5).** The MMO requests that *“unless otherwise agreed with the MMO”* includes “in writing” at the end.
- 4.4.8 **DML Schedule 11, Part 1, Article 1.** The MMO notes the typographical error in footnote “c”, there should be no spaces between “c.” and “23”.
- 4.4.9 **DMLs Schedule 12, Part 1, Article 1(12).** The MMO notes the error in the wording *“must not ten”*.
- 4.4.10 **DMLs Schedule 11 and 12, Part 1, Article 2 (a).** The MMO maintains the position that this condition should be updated to include reference to the disposal sites and also to separate the volumes per disposal activity, and that boulder clearance needs to be included within the description. This would provide the most appropriate clarity. The MMO reiterates it’s suggestion of the following wording: *“(a) the deposit at sea within the Order limits seaward of MHWS of the substances and articles specified in paragraph 4 below and within Work No.1 when combined with the disposal authorised within the array area disposal site by the deemed marine licence granted under Schedule 12 of the Order of up to 7,300,596 cubic metres of inert material of natural origin produced during construction drilling or seabed preparation for foundation works and cable installation preparation works, including sandwave clearance and boulder clearance within the array area disposal site reference [XX] comprising;*
(i) XX m3 for cable installation;



- (ii) XX m3 for the wind turbine generators; and
- (iii) XX m3 for the offshore accommodation platform”.

- 4.4.11 **DMLs Schedule 11 and 12, Part 1, Article 2.** The MMO maintains the advice that drill arisings should be included within this section and include the following section: “(h) the disposal of drill arisings in connection with any foundation drilling up to a total of 399,776 cubic metres”.
- 4.4.12 **DMLs Schedule 12, Part 1, Article 6.** The MMO enquires whether “(reviews and revisions of decommissioning programmes)” should be included after “section 108”.
- 4.4.13 **DMLs Schedule 11 and 12, Part 1, Article 7.** The MMO requests that this is removed, in line with the position to remove all reference to the MMO and the DMLs from DCO Article 5.
- 4.4.14 **DMLs Schedule 12, Part 2, Article 3(1).** The MMO notes the inclusion of “[]” brackets, and queries whether this is in error.
- 4.4.15 **DMLs Schedule 11 and 12, Part 2, Article 4 (6).** The MMO notes and appreciates the inclusion of an Operation and Maintenance plan to be submitted to the MMO prior to any maintenance works taking place. We advise a timeframe for submission to be six months prior to the planned works commencing. The MMO enquires whether in light of this inclusion of (6) “No maintenance works authorised by this licence may be carried out until an operations and maintenance plan substantially in accordance with the outline operations and maintenance plan has been submitted to and approved by the MMO in writing”, that (2) “No maintenance works whose likely effects are not assessed in the environmental statement may be carried out, unless otherwise approved by the MMO in writing” and (4) “Where the MMO’s approval is required under paragraph (2), approval may be given only where it has been demonstrated to the satisfaction of the MMO that the approval sought is unlikely to give rise to any materially new or materially greater environmental effects from those assessed in the environmental statement” should be removed?
- 4.4.16 **DMLs Schedule 11 and 12, Part 2: Article 5 (1).** The MMO notes that the phrase “under its control” should be deleted as it restricts the provision to only those vessels under the direct control of the undertaker and not agents or contractors.
- 4.4.17 **DML Schedule 11, Part 2, Article 6.** The MMO notes there is a full-stop missing from the end of this Article.
- 4.4.18 **DMLs Schedule 11 and 12, Part 2, Article 7 (1)(b).** The MMO notes whether “confirmation form” should be included under Part 1 Article 1(1)?
- 4.4.19 **DMLs Schedule 11 and 12, Part 2: Article 7 (8)(b).** The MMO flags whether the term “all offshore activities” is sufficiently clear? It is not used elsewhere in



the Order and is referred to as “*the construction of the authorised project or relevant stage*” in the provision of Article 7 (8) itself.

- 4.4.20 **DMLs Schedule 11 and 12, Part 2, Article 7 (7).** The MMO maintains that this should be updated to “*at least fourteen days prior*” instead of five days. This is the updated wording for this standard condition to allow for better inspection management.
- 4.4.21 **DMLs Schedule 11 and 12, Part 2, Article 7 (9) and (10).** The MMO advises that “*UKHO*” should state “*UK Hydrographic Office*” as this is what is defined.
- 4.4.22 **Schedule 11 and 12: Part 2, Article 7 (11).** The MMO notes the Applicant has inserted “*within 5 days*”, the MMO reiterates the request that this should state “*within 24 hours of the notification*”.
- 4.4.23 **DMLs Schedule 11 and 12, Part 2, Article 11(4).** The MMO advises [REP4-052] that sampling is required either every three years, or every five, depending on the results of the sediment sample analysis. There are still ongoing issues with the sampling, as outlined within section 4.2 of this submission. The MMO requests clarity on how OSPAR requirements would be adhered to, and how this would be secured, should there be a delay in construction. The MMO suggests that the OSPAR sampling requirements are clearly outlined as a matter to be signed off in the DMLs.
- 4.4.24 **DMLs 11 and 12, Part 2, Article 11(10).** The MMO advises a 6 hour period for reporting dropped objects which are considered a danger or hazard to navigation.
- 4.4.25 **DMLs Schedule 11 and 12, Part 2, Article 12.** The MMO continues to advise that this provision is not necessary, there is already a defence under Section 86 of MCAA 2009. It provides a defence for action taken in an emergency in breach of any licence conditions.
- 4.4.26 **DMLs Schedule 11 and 12, Part 2, Condition 13 (1)(a).** The MMO notes that “*conditions 1 to 3 above*” at the end of section (a) for Schedule 12 is worded “*conditions 1, 2 and 3*” in Schedule 11, and notes that wording should remain consistent across the Schedules.
- 4.4.27 **DMLs Schedule 11 and 12, Part 2, Article 13(1)(h)(ii).** The MMO notes that the term “*Chart Datum*” is not defined and should be.
- 4.4.28 **DMLs Schedule 11 and 12, Part 2, Condition 13 (1)(j).** The MMO still strongly maintains the following position:
- 4.4.29 The MMO has updated the standard condition in relation to designated sites for harbour porpoise. This is due to the outcome of the Review of Consents undertaken by the Secretary of State, the MMO advise that, like any new application, it will need to be in line with the Review of Consents condition. The MMO would like condition 13 (1)(j) to be removed and replaced with the new standalone condition outlined below.



- 4.4.30 When the standalone condition is added, the Interpretations section will need to be updated to include: “*JNCC Guidance*” means the statutory nature conservation body ‘Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs’ Joint Nature Conservation Committee Report No.654, May 2020 published in June 2020 as amended, updated or superseded from time to time”.
- 4.4.31 The MMO propose the following wording for the new SIP condition: “*Southern North Sea Special Area of Conservation Site Integrity Plan 25-* (1) No piling activities can take place until a Site Integrity Plan (SIP), which accords with the principles set out in the in principle XX Project Southern North Sea SAC Site Integrity Plan, has been submitted to, and approved in writing, by the MMO in consultation with the relevant statutory nature conservation body. (2) The SIP submitted for approval must contain a description of the conservation objectives for the Southern North Sea Special Area of Conservation (SNS SAC) as well as any relevant management measures and it must set out the key statutory nature conservation body advice on activities within the SNS SAC relating to piling as set out within the JNCC Guidance and how this has been considered in the context of the authorised scheme. (3) The SIP must be submitted to the MMO no later than six months prior to the commencement of the piling activities. (4) In approving the SIP the MMO must be satisfied that the authorised scheme at the pre-construction stage, in-combination with other plans and projects, is in line with the JNCC Guidance. (5) The approved SIP may be amended with the prior written approval of the MMO, in consultation with the relevant statutory nature conservation body, where the MMO remains satisfied that the Project, in-combination with other plans or projects at the pre-construction stage, is in line with the JNCC Guidance.”
- 4.4.32 This is to ensure it is in line with the MMO’s latest measures to enable efficient management of SIPs.
- 4.4.33 **DMLs Schedule 11 and 12, Part 2, Article 13(2)(f).** The MMO advises contact details for the National Record of the Historic Environment are added. We also highlight the typographical errors in “(‘Online AccesS to the Index of archaeological investigationS’)” that should be corrected.
- 4.4.34 **Schedule 11 and 12, Part 2, Article 13(8).** Without prejudice to our comments regarding DCO Part 2: Article 5, the MMO is unclear as to the purpose of this provision. It relates to the relationship between the licence holder and any third party to which the benefit of the Order has been transferred to and does not relate to the relationship between the MMO and the undertaker.
- 4.4.35 **DMLs Schedule 11 and 12, Part 2, Condition 14.** The MMO strongly maintains its position set out in sections 3.3.1 to 3.3.8 of AS-031 regarding 4 month timescales. We note that the Applicant has extended this to 6 months for a few of the plans, however we continue to request it is extended for all plans. Specifically, the plans in addition to those added already, the “outline operations and maintenance plan” (in Part 2, Article 4 of both Schedule 11 and 12); the “outline southern north sea special area of conservation site integrity



plan” (which should also have its own condition (4.4.29 of this submission); and the “outline marine mammal mitigation protocol”.

4.4.36 **DMLs Schedule 11 and 12, Part 2, Condition 14 (3).** The MMO strongly maintains its position set out in sections 3.3.9 to 3.3.12 of AS-031. It is inappropriate to apply a strict timeframe to approvals under the conditions of the DML given this would create disparity between licences issued under the DCO process and those issued directly by the MMO, as marine licences issued by the MMO are not subject to set determination periods. The MMO’s view is that it is for the developer to ensure that it applies for any such approval in sufficient time as to allow the MMO to properly determine whether to grant or refuse the approval application.

4.4.37 Whilst the MMO’s position on determination dates remains as follows (AP-031): *“The MMO has major concerns with the inclusion of Article 14 (3) “(3) The MMO must determine an application for consent made under Condition 13 within a period of four months commencing on the date the application is received by the MMO, unless otherwise agreed in writing with the undertaker such agreement not to be unreasonably withheld or delayed” and requests that this is removed. The MMO strongly considers it inappropriate to put timeframes on decisions of such a nature. Under such tight restrictions if the evidence obtained does not provide the MMO with confidence that risks have been dealt with robustly, the determination may result in a refusal of the application for discharge. The undertaker would then have to restart the process and provide updated documentation in this instance. The MMO acknowledges that the Applicant may wish to create certainty around when to expect a determine on applications for approvals required under the conditions of a licence, and whilst the MMO acknowledges that delays can be problematic for developers, the MMO advises that it does not delay determining whether to grant or refuse such approvals unnecessarily, we make determinations in as timely a manner as is possible.”*

The MMO observes that the Applicant has actioned our request, that should it be included, the following wording has been added at the end of the clause *“such agreement not to be unreasonably withheld or delay”*.

4.4.38 **DMLs Schedule 11 and 12, Part 2, Condition 17(5).** The MMO advises “UKHO” should state “UK Hydrographic Office” rather as this is what is defined.

4.4.39 **DMLs Schedule 11 and 12, Part 2, Condition 18 (2)(b).** The MMO maintains the request that this is updated to include *“the first four monopile foundations of each piled foundation type to be constructed”*.

4.4.40 **DMLs Schedule 11 and 12, Part 2, Condition 18 (3).** The MMO maintains the request that this condition is updated to the following wording: *“The results of the initial noise measurements monitored in accordance with subparagraph (1) must be provided in writing to the MMO within six weeks of the installation of the first four piled foundations of each piled foundation type. The assessment of this report by the MMO will determine whether any further noise monitoring is required. If, in the opinion of the MMO in consultation with the statutory nature*



conservation body, the assessment shows significantly different impacts to those assessed in the environmental statement or failures in mitigation, all piling activity must cease until an update to the marine mammal mitigation protocol and further monitoring requirements have been agreed."

- 4.4.41 **DMLs Schedule 12, Part 2, Condition 19 (2)(c).** The MMO enquires as to why vessel traffic monitoring was removed?
- 4.4.42 **DMLs Schedule 11, Part 2, Condition 23.** The MMO advises that a timescale is included for clarity, the MMO would advise a six month time scale.
- 4.4.43 **DMLs Schedule 12, Part 2, Condition 23.** The MMO maintains the position that the restriction should be "*between 1st August and 31st October each year*".
- 4.4.44 **Reference to "immaterial" and "materially".** The MMO strongly maintains its consideration that the activities authorised under the DCO and DML should be limited to those that are assessed within the EIA, and so the statements such as "*unlikely to give rise to any materially new or materially greater environmental effects*" should be updated to clarify this. Please see our full position within written representation RR-020 sections 2.1.16-2.1.20.
- 4.4.45 The Applicants comments "*The Environmental Statement captures the results of the EIA, meaning that this paragraph limits the activities permitted by the DCO and DMLs to those assessed by the EIA. Any change to approved details which leads to a change in the likely significant effects assessed in the Environmental Statement would be considered material and would no longer be authorised by the DMLs*" [REP1-038] provides us with comfort, however, the use of the wording "immaterial changes" continues to leave this unclear within the DCO and DMLs. The MMO notes that the Applicant could add the later comments within a definition for "immaterial changes" within Article 1 of the DML and this could help resolve this matter.

5. Any further information requested by the ExA under Rule 17 of the Examination Procedure Rules

- 5.1. The MMO deferred our responses to Deadline 5 within its Deadline 4 submission [REP4-052] on the Rule 17 letter dated 03 May 2022. However, we can now confirm that our Deadline 4 submission, where all action points of our interest were addressed, captures our response to this letter.
- 5.2. The MMO notes one matter was deferred to Deadline 5, this being an action point regarding Issue Specific Hearing 4 (ISH4) where the MMO commented: "*AP 10: "Provide clarification of concerns regarding exclusion of SELcum impact ranges in the approach to Marine Mammal Mitigation Protocol following Applicant's response [REP1-038] to [RR-020-4.3.4] and discussions at ISH4". The MMO are currently seeking technical advice on this matter, and so shall provide a response at Deadline 5.*" [REP4-052]. As outlined within this Deadline, the MMO are still reviewing these details, alongside our advisors at CEFAS, and as such will need to defer to Deadline 6 on this matter.





Gregg Smith
Marine Licencing Case Officer



References

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Gorham-Test, C., Wade, T., Engle, V., Summers, K., & Hornig, E. (1999). Regional Environmental Monitoring and Assessment Program — Galveston Bay 1993. Proceedings, Galveston Bay Estuary Program, State of the Bay Symposium IV, January 28–29, Galveston, TX, 97–109.



Annex A – Memo from the MMO and Natural England to the Applicant regarding coastal processes.

Memo

To: Hornsea Project Four

From: Natural England, MMO and Cefas

Date: 09 June 2022

Subject: Hornsea Four: Marine Processes Supplementary Report, Doc. Ref. No: G4.9 (Rev 01)

We welcome the Hornsea Four Marine Processes Supplementary Report, Document Ref. No: G4.9 (Rev. 01) and the additional analysis and information that has been provided. We have reviewed this report and have the following detailed comments on this report to inform the ongoing Technical Panel discussions regarding Smithic Bank and Flamborough Front.

1. Smithic Bank

1.1 Characterisation

We note that it is only the lower resolution 1979 bathymetric survey that provides near full coverage of Smithic Bank (with the exception of the most southerly tip), whilst the later, higher resolution surveys carried out in 2011, 2016 and 2020/22 provide only partial coverage of the sandbank. Furthermore, there exists only a very small area of overlap between the 2011 and 2016 surveys and the 2020/2021 survey data across the southern part of Smithic Bank. These data limitations have also been highlighted in section 1.2.2.2 of the Supplementary Report. Consequently, only broad-scale changes have been assessed between 1979, 2011, and 2020/2021, and it is only the period 2011-2016 where it has been possible to map changes in detail.

Furthermore, the bathymetry interpretation that has been carried out is based on cross-sections at specific locations. Interpretation of individual bedform-scale movements drawn from the comparison of these cross-sections is subjective. For example, the nine cross-sectional profiles presented in Figures 4 & 5, 9-11, 12 & 13, 15 & 16 represent short two-dimensional profiles of the morphology at the northern tip and along the western flank of Smithic Bank. There are insufficient data (both temporally and spatially) to draw any broader conclusions about the overall direction and rate of bedform migration. Mapping migration of sandwaves through comparison of cross-sectional profiles for data from different years is highly subjective as it is based on the premise that specific individual bedforms can be identified several years apart. Therefore, whilst we agree that bedform asymmetry exists across North



Smithic Bank, and that this is a highly dynamic region of large-scale mobile bedforms, there are insufficient data to conclusively demonstrate the direction and rate of bedform migration.

The comparative study of bathymetric data presented in the report shows a general trend of lowering of South Smithic and the westward migration of the western flank of the sandbank. However, we note that there is no estimate of sandbank volumetric change over the time periods analysed. This would be useful as it would provide some indication of the volume of sediment being lost from the sandbank over time and, therefore, we would advise that this analysis be carried out. Moreover, whilst we are content that the data show evidence of bedform asymmetry across North Smithic, there is insufficient evidence to allow comparison of individual bedforms between survey years and, in turn, assess their migration directions and rates.

Section 2.3.3.3 correlates the lack of sediment observed in the deeper area to the west of South Smithic with “little exchange of sediment between Smithic Bank and the Bridlington foreshore”. However, this correlation is hypothetical and, conversely, it is possible that under a specific set of wind wave, ebb tidal flow, and wind conditions onshore sediment transport could occur towards the coastline. Furthermore, with the exception of the 1979 bathymetric data, there are no bathymetric survey data for the southern part of South Smithic and, thus, no information on the changes to sandbank morphology or sediment transfer between the sandbank and coastline at this location.

Section 2.3.4.1 states that “rotational sand transport around Smithic Bank is likely to be contained within Bridlington Bay, with little or no transport from this source south along the Holderness Coast.”. However, Pye et al (2015) showed that sediment from the southern parts of Smithic Bank exhibit a high degree of similarity to beach sediment from between Fraisthorpe and Skipsea. Moreover, section 2.3.3.2 in the Supplementary Report discusses the sediment accumulation due to the clockwise movement of the tidal gyre, yet Pye et al. (2015) also provide evidence of a net sediment transport pathway driven by anticlockwise residual circulation from the nearshore towards the southern part of Smithic Bank. Therefore, whilst it is acknowledged that Smithic Bank is at the centre of a tidal gyre, and that the sandbank(s) acts as a sediment depository, it cannot be inferred that this is a predominantly self-contained system without supporting evidence. This is a complex sedimentary system and could potentially be a semi-enclosed system, or even a dynamically leaking system.

A vital part of establishing the pre-construction baseline for the Hornsea Four marine processes impact assessment, with regard to Smithic Bank, is defining the geographical extent of the sandbank. Figure 1 below shows the comparison of the 1979 and 2020/21 bathymetric data what is not clear is the location of the geomorphological eastern boundary (flank) of Smithic Bank relative to the Dogger Bank A & B Cable Crossing location. The combined effect of increased seabed roughness, decreased water depth, and a potential barrier to sediment as a result of the crossing elevating the seabed could influence sediment transport processes, which in turn could trigger morphological change(s). We would, therefore, advise that the geomorphological boundary and extent of Smithic Bank should be



defined as accurately as possible, presented on the latest Dogger Bank A & B Cable Crossing map, and agreed with Natural England, MMO and CEFAS.

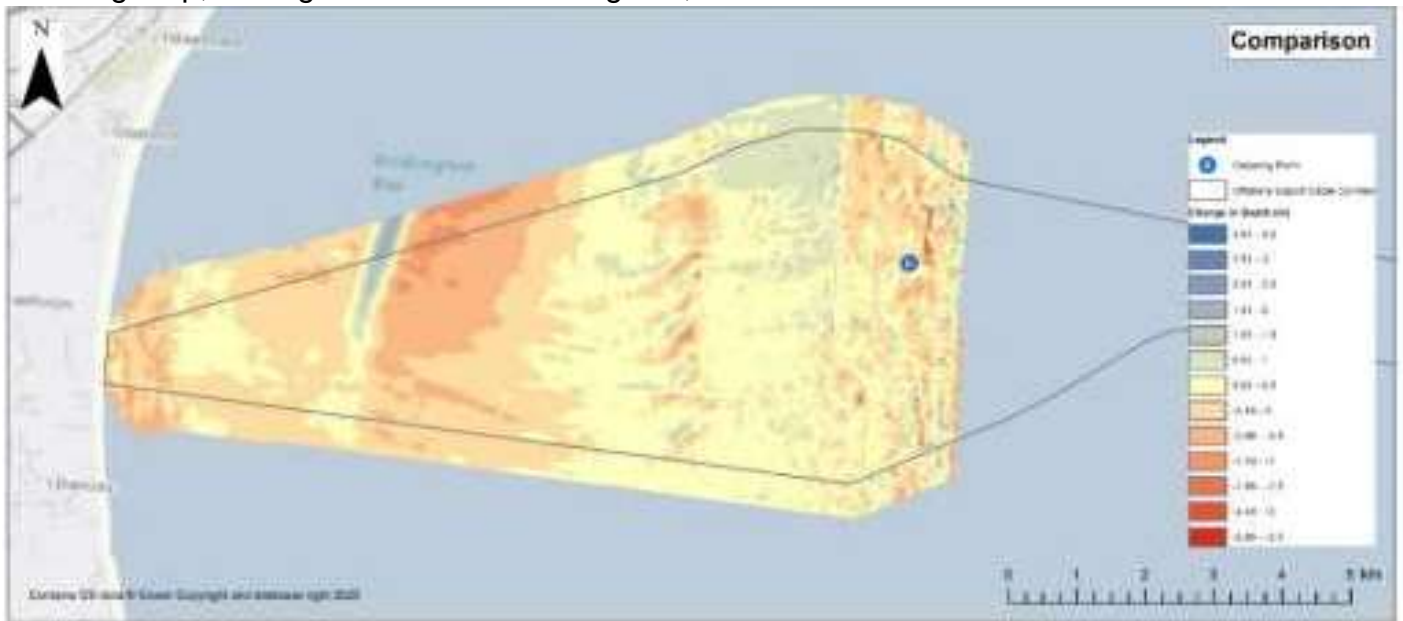


Figure 1. Comparison of 1979-2020/21 bathymetric survey data (taken from Ørsted, 2022)

1.2 Impacts from cable installation

Whilst it is anticipated that the volume of sediment removed due to cable installation across Smithic Bank may be small compared to sediment loss due to natural processes, given that this is a semi-contained system, we would advise that sediment removed from the sandbank be retained within this system in order to ensure that the integrity of the sandbank is maintained. In other words, we would advise that Bank sediments removed through cable installation should be deposited on Smithic Bank and thus be retained in this circulatory system. Natural England and MMO/CEFAS request further information on the likely disposal locations that can be used by Hornsea 4 to ensure that material removed from Smithic Bank can be retained within the sandbank system.

We also remain concerned with the installation of cables (and any associated protection) across or near Smithic Bank when considered in-combination with multiple developments (e.g. Dogger Bank A & B, SEGL2, Dogger Bank South etc). Successive cable (and cable protection) installations could act cumulatively to increase morphological alteration of the sandbank through the combined influence of sediment removal through dredging, and potential changes to sediment transport pathways arising from the presence of cable protection. Therefore, we would advise that a detailed assessment of the cumulative impacts of multiple developments on Smithic Bank needs to be carried out. Similarly, the potential impact of cable reburial, cable replacement, and cable remediation activities through the lifetime of the project (i including climate change impacts) need to be adequately assessed.



We note that in section 2.4.1.2 of G4.9 Marine Processes Supplementary Report it is stated that sand-wave clearance will not be required along the cable corridor across Smithic bank and therefore there is no pathway to sandbank lowering. This was new information that does not appear within the Clarification Note: Justification of Offshore Maximum Design Scenarios (Ørsted, 2022). Whilst Natural England and the MMO/CEFAS would welcome this commitment (and wish to see it secured in the DCO/dML) it is not the only mechanism by which sandbank lowering could occur as it is not known what barrier affect the cable crossing to the east might have on sediment supply and sandbank stability. Furthermore, owing to the uncertainty regarding whether South Smithic is an erosional or depositional environment, we are also concerned that burial of the export cable may not be achieved.

Due to the dynamic nature of the sandbank margins and uncertainly around the effects of cable installation and crossings in this area, we advise monitoring of Smithic Bank, and the area between the Holderness Coastline and the Dogger Bank Cable Crossing by swath bathymetry pre- and post-cable installation and five years later. This should be secured through a licence condition.

1.3 Impacts from the placement of cable protection

We note that the Applicant proposes 5% cable protection along the length of the ECC that that extends across Smithic Bank. We remain concerned that the placement of cable protection on Smithic Bank by the Hornsea Four project alone or in-combination with other projects could alter hydrodynamics and sediment transport with the potential for associated morphological impacts. Consequently, our position is that cable protection should **not** be placed on Smithic Bank and that this should be secured in the DCO/dML. We would therefore like to better understand the likely need for this level of protection, the likely locations of rock placement, and to understand the inter-relationship between the commitment not to undertake sandwave clearance and the anticipated need for cable protection.

Furthermore, the current commitment is for there to be no cable protection out to 350m, which we do not consider to sufficient to exclude impacts to nearshore hydrodynamics, sediment transport processes, and morphological change. It is not simply cumulative effects which are concerning, but cumulative effects of protection measures in a dynamic environment over the lifetime of these projects. It is therefore our position that cable protection should not be permitted westward of the eastern morphological boundary of Smithic Bank.

1.4 Dogger Bank A & B Cable Crossing

Figure 1 above shows comparison of the 1979 and 2020/21 bathymetric data for the Dogger Bank A & B Cable Crossing. This shows that there is evidence for up to 2.5m bathymetric change at the Dogger Bank A & B Cable Crossing site over the period 1979-2020/21 which raises concerns regarding the potential for morphological change.



Figure 2 below shows the Hornsea Four/Dogger Bank A & B Order Limits Interaction and rock protection area. The Dogger Bank A & B Cable Crossing includes 12 cable crossings with individual rock berms at each cable crossing that have maximum length and width of approximately 500m by 20.2m, and a berm height of up to 3m. Given the close proximity of the Dogger Bank A & B Cable Crossing to the geomorphological eastern boundary of Smithic Bank, we remain concerned that the presence of these cable protection measures could cause morphological change (e.g. enhanced lowering of the sandbank) through the modification of the hydrodynamic regime or via diversion of sediment transport pathways and, therefore, we advise that the cable crossing be moved as far seawards as possible within the Order Limits. Whilst noting the constraints Orsted face with regards to moving the cable crossing eastwards due to the Order Limits, Natural England and MMO/CEFAS also propose that any reduction in the MDS of cabling and crossings which could be secured before consent would also help limit any impact on the Bank, such as bundling Hornsea 4 cables within fewer trenches and using HVDC technology to reduce the total number of cables and crossings required. It is also worth noting that Dogger Bank A&B has confirmed that their export cables will be bundled in 2 trenches.

Given the indicative nature of the current Hornsea Four plans showing the location of the Dogger Bank A & B Cable Crossing, we advise that the most up-to-date Dogger Bank A & B cable routing plans should be used to generate more accurate cable crossing plans by the Applicant. In turn, this more up-to-date and accurate plan of the Dogger Bank A & B Cable Crossing will provide a clearer indication of the location of the crossing relative to the eastern geomorphological boundary of Smithic Bank and inform the impact assessment.

1. 12 cable crossings (6*2)
2. Outside of 20m contour – tidal transports only

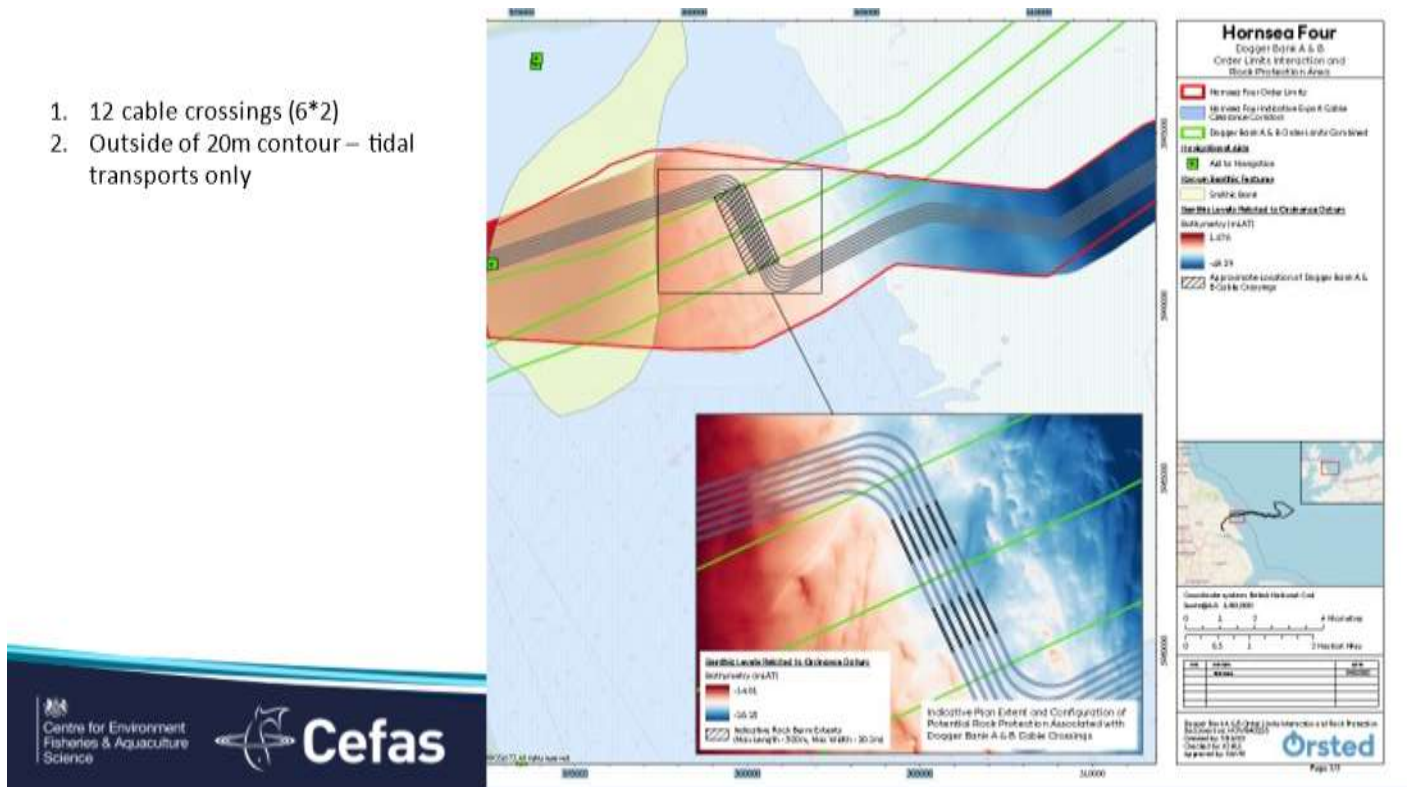


Figure 2. Dogger Bank A & B Export Cable Crossing Rock Protection (adapted from Ørsted, 2022).

1.5 Summary of Concerns

Smithic Bank, along with Flamborough Head, provides shelter to the town of Bridlington, Bridlington Beach, and the northern quarter of the Holderness coast, it provides a buffer to the shore by dissipating direct waves, and refracting away oblique waves. Moderate elevation changes to the sandbank and significant changes to sandbank morphology through cable installation activities, associated cable protection, and remedial works by Hornsea Four alone, or in-combination with other developments, could alter the nearshore hydrodynamic regime, sediment transport (including longshore flux), shoreline response to storms, and alter shoreline morphology over the long-term. These changes have the potential to be far reaching.

The Supplementary Report provided by the Applicant highlights the challenge of accurately characterising the baseline conditions in this area due to only partial coverage of the available data. Whilst inferences can be (and have been) made, there remains a high degree of uncertainty and the risks associated with these proposals both alone and combined with other plans/projects cannot be ruled out on the basis of the evidence available.

1.6. Potential Mitigation and Monitoring Requirements

Therefore, we advise that, in line with the mitigation hierarchy, measures are incorporated to avoid or reduce the potential for impact as far as possible. This should include the following:

- (a) Disposal sites for cable installation across Smithic Bank should be clearly defined and it should be demonstrated that dredged material will be retained within the Smithic Bank system;
- (b) Cable protection should be avoided within the nearshore area and across the full extent of the sandbank;
- (c) The Dogger Bank A & B Cable Crossing should be sited as far to the east of the accurately defined geomorphological boundary as possible. (The most up to date information on Dogger Bank A&B's layout should be used to inform this);
- (d) Bundling of cables should be implemented where possible in the nearshore to reduce the impact and the number of cable crossings;
- (e) Due to the dynamic nature of Smithic Bank and the anticipated Dogger Bank A&B cable installations, monitoring of the area between the Holderness Coastline and the Dogger Bank Cable Crossing by swath bathymetry should be undertaken prior to construction to allow additional mitigation to be incorporated as required.
- (f) To identify and manage any residual risk, a robust monitoring plan should be agreed upon which incorporates "trigger points" to allow interventions or remediation as required.

Lastly, we would advise that the impacts discussed above will need further consideration in the context of the HRA and MCZ assessments.

2. Flamborough Front



2.1 Characterisation

We welcome the supplementary information provided on the Flamborough Front by the Applicant. This additional information provides further evidence that the Hornsea Four array sits within the region of the Flamborough Front. Moreover, this demonstrates that the cluster of Hornsea (and potentially Dogger Bank) offshore wind farms will also sit within the region of the Flamborough Front. The report also usefully highlights the paucity of information regarding the formation and operation of the Front.

The Flamborough Front gives rise to nutrient-rich waters which create a biodiversity hotspot attracting seabirds and marine mammals to the area each year. Consequently, the Flamborough Front plays a key role in primary production, the marine ecosystem and biogeochemical cycles. As nutrients are limited (at least on the short-term), this could result in a reduction in productivity as a far field site (Dogger Bank) and thus result in a translocation of productivity inshore.

2.2. Impacts of Windfarms

Recent research (e.g. Carpenter et al. (2016), Christiansen et al. (2022), and Dorrell et al. (2022)) has shown the potential for large-scale hydrodynamic changes due to clusters of wind farms in seasonally stratified seas. The impact of clusters of offshore wind farm developments on large-scale stratification could lead to significant changes in regional primary production and, in turn, marine ecosystem dynamics through turbulent mixing of the water column. Furthermore, the majority of research conducted to date has focussed on turbulent mixing due to monopile foundation structures, and not GBS, which have significantly larger dimensions and, thus, far greater potential for turbulent mixing of the water column. For example, the HP4 MDS for GBS type WTG foundations is 53m in diameter at the base, compared to the monopile type WTG foundation diameter of 15m.

We are also concerned that cold water plumes could form in the lee of the foundation structures of the Hornsea Four array, thus altering the sea temperature. In Figure 3 below, a hypothetical scenario is described in which cold water plumes are seen to develop in the lee of a **monopile** foundation structure as the tidal currents continuously move past. It is feasible that cold water plumes could form in a similar manner to sediment plumes that have been observed in the lee of existing WTG foundation structures due to scouring of the seabed. These cold-water plumes could, on an array-scale, also have a significant ecological impact on the primary production and the wider marine ecosystem. The use of GBS is likely to intensify the likelihood of these arising.



Working Hypothesis

1. Say 10 GBS/Monopiles on ebbtide edge of licence areas ebb frontage each of (worst case) 50m diameter
2. Say, Packing density along this axis is 1 in 1000m
3. Therefore each plume (at worse (2d)) is $1/10^{\text{th}}$ of area
4. The ecological impact of each plume is associated with high nutrients rather than temperatures
5. Question – beyond core advice

What is the significance of this in terms of primary productivity? Coupled with the frequency, duration and intensity of the front crossing these areas?



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Figure 3. Image showing the formation of sediment plumes in the lee of offshore windfarm turbines

2.3 Summary of Concerns

Based on recent research, there is the potential for large-scale changes to annual primary productivity due to the presence of the Hornsea Four array, either alone and/or in-combination with a cluster of OWFs, due to impacts on the Flamborough Front. Furthermore, changes to the Flamborough Front could have far-reaching and long-term consequences that affect the function of protected areas such as the Flamborough Head SAC, Flamborough and Filey Coast SPA and Southern North Sea SAC.

2.4 Potential Mitigation and Monitoring Requirements

We recognise that the nature and extent of these changes are difficult to quantify and therefore assess. Consequently, we advise that Hornsea 4 seek to reduce the risks as far as possible.

Key to this would be to reduce the MDS for foundations structures within the Hornsea Four array as much as possible, or removal of GBS as an option (i.e. using monopiles in place of the larger GBSs). There may also be merit in further consideration of the placement of structures within the developable area to reduce the potential for the effects of individual turbines acting in combination with each other.

Again, it will be important to establish a monitoring programme to record any changes to stratification and primary productivity, which would require surveys pre-construction, post-construction, and for the lifetime of the project. This should include “trigger points” to allow interventions/remediation if required.



Lastly, we would advise that the impacts discussed above will need further consideration in the context of the HRA and MCZ assessments.

