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(By email only)

Planning Inspectorate Reference: EN010098  
MMO Reference: DCO/2018/00014  
Identification Number: 20029896

27 July 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 6 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”).

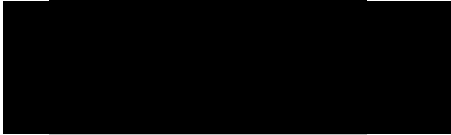
The MMO submits the following as part of our Deadline 6 submission:

- 1. Post-hearing submissions including written summaries of oral case put at hearings during w/c 18 July 2022**
- 2. Comments on any other submissions received at Deadline 5a**
- 3. Progressed SoCGs and an updated Statement of Commonality of SoCGs**
- 4. 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.

Yours Sincerely



Gregg Smith  
Marine Licencing Case Officer

D [Redacted]  
E [Redacted]



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## 1. Post-hearing submissions including written summaries of oral case put at hearings during w/c 18 July 2022

### 1.1 Issue Specific Hearing 7 (ISH7) on the draft Development Consent Order (DCO) – Monday 18 July 2022

1.1.1 The MMO has reviewed the transcript and Action Points (AP) for ISH7 held on Monday 18 July and has the following comments to make:

Action	Description	Response Deadline	Response
1	Provide opinion whether the minimum air draft for the 'bridge link' should be specified in the draft Development Consent Order (DCO) Article 2 definition and/ or in draft Deemed Marine Licenses (DML).	Deadline 6	The MMO would support the inclusion of a minimum air draft to be included within the definitions of the DCO and DMLs. Although not a major issue, we believe it would add clarity to the current definitions. The MMO adds that we believe definitions should be mirrored between the DCO and DML where applicable.
5	Comment on the changed coordinates listed in the draft DCO for the intertidal area.	Deadline 7	The MMO are reviewing the revised coordinates and will aim to provide comments on this matter at Deadline 7.
6	Review documents submitted by the Applicant including its [AS-036] response to Natural England's (NE) [REP5a-031] and provide a written response on any outstanding matters of concern.	Deadline 6	<p>The MMO provides the following comments on AS-036. The MMO has only included the points where we have comments on, as such where points are not included here, it is because we have "no comments".</p> <p>Point 1: Part 1 Article 2 –The approach outlined by the Applicant is in line with our requests and expectations.</p> <p>Point 4: Schedule 1 Part 3 Requirement 2(2)(c)- The MMO supports the updates made regarding LAT and HAT.</p> <p>Point 5: Schedule 1 Part 3 Requirement 2(6)- The MMO agrees that detailing the maximum footprint for each turbine would add clarity to both the DCO and</p>



		<p>DMLs, however, ultimately Part 2, Condition 1 (9) and 2 (6) of Schedule 11 alongside the certified documents in Schedule 15, do limit the Applicant's design parameters adequately within the consent.</p> <p>Point 7: Schedule 11 Part 2 Condition 4- The MMO confirm the position put forward by NE. This matter is considered closed.</p> <p>Point 8: Schedule 11 Part 2 Condition 13(1)(j)- The MMO confirms that the approach put forward by the Applicant is appropriate, however, request the reference to 4 months is updated to 6 months within both the outline southern north sea special area of conservation site integrity plan (SIP) and DMLs. The MMO further maintains the position that a standalone SIP condition would be preferable. The MMO also clarifies that the intention of the SIP is to capture more accurate details of noise implications from projects, which is why a 6 month period is ideal, it is soon enough to the proposed commencement of works to provide an accurate depiction of noise impacts (including cumulative from other projects), but long enough to be considered accurately.</p> <p>Point 9: Schedule 11 Part 2 Condition 13 (5) and (6)- The MMO confirm the position put forward by NE. This matter is considered closed.</p> <p>Point 10: Schedule 11 Part 2 Condition 14- the MMO maintains the position that a number of timescales should be increased to 6 months, as put forward in REP5-</p>
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			<p>107.</p> <p>Point 11: Schedule 11 Part 2 Condition 18- the MMO supports the inclusion of this condition and will await NE comments on the additional wording before confirming our final position regarding its contents.</p> <p>Point 13: The MMO confirms that ultimately the outline marine monitoring plan, which is referenced within conditions 17, 18, and 19 of Part 2 of Schedules 11 and 12, and is a certified document, secures marine mammal monitoring. However, the MMO does note that other projects, such as East Anglia TWO, have included a specific reference to the Marine Mammal Monitoring Plan within the DMLs (condition 16(2)(c)). Whilst the MMO considers the difference in approach to be minor, the Applicant may wish to consider adding a provision to add clarity within the DML itself.</p> <p>Point 17: The MMO agree with Natural England in that a close out report for the transmission DML will be required. However, the MMO require a close out report covering both Generation and Transmission DMLs as we need a complete “as built” picture of the development.</p> <p>Point 18: The MMO believe that it is appropriate for the landfall works to be included as part of the Transmission DML (Schedule 12).</p>
7	Review the recording of today’s ISH7 discussion and provide any comments by D6.	Deadline 6	The MMO has reviewed the recording and the updated DCO/ DMLs. Our comments on the DCO/DML can be found in section



			2.5.
8	Confirm satisfaction or not that the Layout Principles in the DMLs would be sufficient in terms of offshore design parameters and that these don't need to be specified in Requirement 3 of the draft DCO.	Deadline 6	The MMO note that the Layout Principles being within the DML's make no difference in as much as the DCO and DMLs are ultimately consented by the Secretary of State and that this consent as a whole would secure offshore design parameters. Although the DMLs will fall to the MMO to regulate, it will remain part of the wider consent order.
9	Comment on the [REP5a-031] concerns raised by NE about Condition 4 of the DMLs regarding licence for cable repair protection (see Condition 26 of Schedule 11 and Condition 26 of Schedule 12).	Deadline 6	The MMO are content that the cable repair deployment licensed is limited under the DCO to 15 years. This is in line with the approach agreed between the Statutory Nature Conservation Bodies and MMO.
10	Listen to the recording of ISH7 and provide comments on the wording of Part 2 Condition 5(1) and Part 2 Condition 13(1) as appropriate.	Deadline 6	The MMO's remaining comments on the DCO/DML can be found in section 2.8.
12	Provide comments regarding updates for Schedule 11 Part 2, Conditions 17 to 19, Management Plans.	Deadline 6	The MMO's comments on the DCO/DML can be found in section 2.8.  The MMO continue to review management Plans and will raise any issues when/ should they arise.
13	Comment on NE suggestion that landfall activities should be covered in a separate schedule of the draft DCO and the Applicants response in [AS-036].	Deadline 6	The MMO has been unable to review this request in time to provide substantial comments, as such we defer our comments until Deadline 7.
36	Liaise to produce final, signed Position Statements including any areas of disagreement if required.	Deadline 7	The MMO has provided an update on the statement of common ground in Section 3 of this submission, and has liaised with the Applicant to allow for an updated SOCG to be submitted at Deadline 6, and will provide an updated at Deadline 7.



**1.2 Issue Specific Hearing 8 (ISH8) on onshore environmental matters – Tuesday 19 July 2022**

1.2.1 The MMO has no comments to make on the matters addressed at ISH8 on onshore environmental matters on Monday 19 July 2022. This is due to our remit lying below Mean High Water Springs.

**1.3 Issue Specific Hearing 9 (ISH9) on offshore environmental matters – Tuesday 19 July 2022**

1.3.1 The MMO has reviewed the transcript and AP and has no comments to make at this time.

**1.4 Issue Specific Hearing 10 (ISH10) on the Marine Processes and Ecology (excluding ornithology) – Wednesday 20 July 2022**

1.4.1 The MMO attended ISH10 and has the following comments to make:

Action	Description	Response Deadline	Response
1	Discuss, and provide comments on, the depth of cable burial required in the intertidal area and any allowances required to account for climate change and possible exposure.	Deadline 6	The MMO has provided it's updated comments on Marine Processes verbally at ISH10 and under section 2.7 of this submission.
6	Provide feedback on any implications of the updated marine processes information for the reliability of the benthic ecology baseline.	Deadline 6	The MMO have provided our updated Benthic comments within this submission, under "Section 2.8".  The MMO has no comments on the implications of the updated marine processes on the reliability of the benthic ecology baseline at this stage.
10	Provide an	Deadline 6	The MMO have





	updated position on the potential impacts of piling and redeposition of suspended sediment on herring spawning.		provided our comments on this matter within this submission, under "Section 2.1".
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- 1.4.2 The technical information which formed the basis of our position for the hearing can be found in Section 2.6. We supply the following written comments in summary of our positions put forward at the ISH verbally.
- 1.4.3 Regarding Smithic Bank monitoring the MMO advise a high-resolution pre-construction survey is undertaken followed by a post-cable installation survey every 6 months for 2 years (including two winters periods and one summer) and further surveys every 5-years for the duration of the project. Comparison reports should be produced, incorporating a comparison with existing bathymetric survey data.
- 1.4.4 The MMO consider that tighter control measures should be implemented to ensure that the least amount of rock protection is deployed within Smithic Bank, in line with the proposed maximum 5% of cables getting rock protection in the Smithic Bank area. We believe the Applicant should be conditioned to submit the detailed pre-construction surveys and the cable burial risk assessment for the Smithic Bank area showing the % of cables that will be buried, and what the method of construction will be. This would then be reviewed and approved by the MMO.
- 1.4.5 Regarding the Flamborough Front, the MMO confirms that we believe the Applicant is making progression regarding satellite monitoring, we confirm that the level of detail, and resolution of the satellite monitoring proposed is good. However, the MMO believes that this monitoring needs to expand to an array scale in the first instance, and not wait to see if monitoring of 3 distinct locations triggers the need for a wider scale monitoring. We believe this monitoring should look at productivity, by looking at chlorophyll, and sediment plumes which will help illustrate and monitor turbine wake interactions. Regarding the timing of monitoring the MMO believe we would need to see the stratification and as such, covering periods of spring, summer and autumn. The MMO proposes a first set of monitoring is undertaken to then help with the identification and the wider design of the monitoring to be suitably tailored.
- 1.4.6 The MMO confirm that the Doggerbank A and B Export Cable Corridor (ECC) is not an open disposal site, and as such the Hornsea Project Four will be able to have its ECC designated for disposal. The issue of overlapping disposal sites is not applicable. The MMO supports the re-implementation of this area as a disposal site to allow for the retention of sediment within the Flamborough Front System.



- 1.4.7 For the extent, assessment and monitoring of the proposed temporary access ramp, the MMO are content with the monitoring that East Riding of Yorkshire Council undertake, it produces high quality and robust data that should capture any impacts from the temporary access ramp. The MMO have no further comments on this matter.
- 1.4.8 The MMO has reviewed the Applicant’s position regarding the monitoring of sediment samples put forward at Deadline 5a. The MMO confirms that we are referring to the OSPAR Guidelines for the Management of Dredged Material in our comments referencing OSPAR. Furthermore, due to the laboratories used for carrying out the Particle Size Analysis (PSA) not being MMO validated, we are yet to be able to review the analysis and provide advise as to whether the frequency of sampling for sediment will need to be every 3 years or every 5. As such our advice on an explicit condition to address sampling remains. The MMO will consider the Applicant’s suggestion regarding the approval of this matter being contained within the construction project environmental management and monitoring plan, however, we caveat if this route is pursued, it would need to be clearly outlined within this plan. The MMO also notes Condition 30 within the East Anglia 2 DML’s (Schedule 13 and 14) where sampling requirements have been specifically outlined. Please see section 2.4 of this submission for further comments on sediment contamination.

**1.5 Issue Specific Hearing 11 (ISH11) on Marine Ornithology – Thursday 21 July 2022**

- 1.5.1 The MMO has no comments to make on the matters addressed at ISH11 held on Thursday 21 July 2022 that addressed marine ornithology.

**1.6 Issue Specific Hearing 12 (ISH12) on the Habitats Regulations Assessment – Friday 22 July 2022**

- 1.6.1 The MMO has reviewed the transcript and AP for ISH12 held on Friday 22 July and has the following comments to make:

Action	Description	Response Deadline	Response
11	Marine Management Organisation (MMO) to ensure that it submits its position on whether the SELcum impact range should be considered in addition to the instantaneous SPLpeak PTS-onset impact range for marine mammals and the agreement reached by the Applicant and NE on this agreement at Deadline 6, especially relating to any implications for the HRA.	Deadline 6	The MMO have provided our comments on this matter within this submission, under “Section 2.2”.



## 2 Comments on any other submissions received at Deadline 5a

### 2.1 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction Revision: 03 [REP5-048]

- 2.1.1 The MMO has reviewed the clarification note on the Peak Herring Spawning Period and Seasonal Piling Restriction [REP5-048] along with our scientific advisors at the Centre for Environment Fisheries & Aquaculture Science (CEFAS) and wish to make the following comments. Please note that all references to Sections, Figures, and Tables relate to the clarification note [REP5-048] unless otherwise specified.
- 2.1.2 The Applicant notes that the ICES 2020 report acknowledges the existence of 2018 IHLS data for the Banks stock. However, the Applicant confirms that this data is not publicly available via the ICES data portal. The Applicant has contacted ICES and the respective authors of the report, requesting that this data is made available and will seek to include it in a future update of G1.10 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction, if this data becomes available to the Applicant during Examination.
- 2.1.3 We thank the Applicant for their efforts to gain access to the data, and accept that under these circumstances, 2018 IHLS data for the Banks stock can be excluded for the purpose of this assessment.
- 2.1.4 The Applicant notes that while temperatures lower than 12°C were identified in the vicinity of the hotspots, the lowest temperature recorded within the hotspot in any year was 11.9°C, with all other years generally much higher than the 12°C mean temperature (which includes all values from the survey area, not just the hotspot). Notwithstanding this, the Russell *et al.* (1976) paper does not provide values for yolk absorption and egg development at such a resolution to enable the use of an 11.9°C value, the 12°C temperature remains the most appropriate value to use. Specifically, this value can still be considered a precautionary temperature to determine the durations for egg development and yolk absorption as in all other years the temperature within the hotspot (i.e. the region of greatest importance) was above this value and so the durations would be faster than those used within the calculations (and it is unlikely that a 0.1°C difference in temperature would materially change the durations). As such, the Applicant considers that to use a lower temperature than the already conservative 12°C, particularly as low as 8°C proposed by the MMO, would be excessively conservative as to be meaningless when considering the temperature values associated with the hotspot (i.e. the primary area of spawning).
- 2.1.5 The hotspots in larval densities represents the areas where the highest concentrations on larval densities are found, rather than the specific locations of spawning, egg laying and egg and larval development. Therefore, whilst it can be seen as a reference point in relation to the intensity of spawning activity, it should not be delineated from spawning activity across the wider Flamborough Head spawning area, particularly in relation to the impact of noise and vibration which has a far-reaching impact. A basic interrogation of temperatures at maximum



sampling depth for each mapped year (Appendix C, Figures 6 – 17) shows that temperatures within the mapped area showing larval densities of 150.1/m<sup>2</sup> and above vary considerably between years, as do the temperatures within mapped area of historic spawning ground – see Table 1 of this submission. It is also worth noting that sea temperatures at maximum sampling depth are lowest in more recent years. Accordingly, the MMO still does not support the Applicant’s proposal to use a value of 12°C to determine the durations for egg development and yolk absorption, as it is not conservative. A conservative approach should take the minimum values, which in this instance range from 8.56°C – 9.15°C. This range accounts for six out of twenty-four (25%) of these temperatures.

**Table 1:** Lowest recorded sea temperatures as maximum sampling depth during IHLS surveys:

<b>Year:</b>	<b>Minimum Temp (°C) within mapped area showing larval densities &gt;150.1 /m<sup>2</sup>:</b>	<b>Minimum Temp (°C) within area of historic spawning ground based on Coull <i>et al.</i> (1998):</b>
2007	14	13.8
2008	12.4	9.9
2009	12.6	12.6
2010	12.6	12.6
2011	12.2	12.2
2012	11.4	11.4
2013	11.9	11.9
2014	12.89	12.45
2015	11.81	11.81
2016	8.89	8.79
2017	No data	No data
2018	No data	No data
2019	9	9.15
2020	8.56	8.96

2.1.6 Since Russell (1976) only provides egg development periods for temperature ranges of 7 - 8°C (14 - 18 days) and 10 - 11°C (10 - 12 days) (Table 2 of this submission) but not for temperatures between 8 - 10°C, the MMO recommends that the Applicant uses an egg development period of 14 days for their calculations, based on using the lower temperature range of 7-8°C and the minimum development period for this range i.e., 14 days rather than 18 days.

**Table 2:** Egg development periods (Russell, 1976):

<b>Average temperature:</b>	<b>Days:</b>
12 - 13°C	7 - 9
10 - 11°C	10 - 12



7 - 8°C	14 - 18
3 - 4°C	49

2.1.7 Similarly, the yolk absorption period should be based on the nearest appropriate temperature given in Russell (1976), which in this case would be 10.3°C (Table 3 of this submission). The MMO recommends that the full 20-day period is used in the Applicant's calculation, on the basis that temperatures observed in IHLS data shown in Table 1 of this submission have been below 10.3°C in more recent years, and because the calculation being proposed needs to take a conservative approach.

Table 3: Yolk absorption periods (Russell, 1976):

Average temperature:	Days:
12.8°C	3 & 9
12.0°C	5 & 14
10.7°C	7 & 16
10.3°C	7 & 20

2.1.8 The Applicant notes the MMO's request to present the modelled noise contours for Group 3 stationary receptors, based on the thresholds described in Popper *et al.* (2014) in Figure 4 of G1.10 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction (REP5-048). In response, to this, the Applicant has overlaid the noise contours from the HVAC booster station search area (piling location closest to the IHLS hotspot) over the sampling depth temperature data (see Figure 4 of G1.10 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction submitted at Deadline 5 (REP5-048)). The Applicant can confirm that within the noise contours, the mean sampling depth temperatures from the temporal dataset range from 12.9°C to 13.7°C, is significantly higher than the 12°C mean temperature used to inform the parameters presented within the Clarification Note, ensuring that a precautionary approach has been utilised. As has been stated in previous submissions, the Applicant does not deem it appropriate to present the 135dB SEL threshold. This is due to the use of the 135dB SEL threshold (which is based on a study within a quiet loch) being expressly recommended by the authors of the paper (Hawkins *et al.* 2014) as not appropriate for use in determining impacts from underwater noise on fish. Notwithstanding the above, it would not be considered appropriate to use a threshold based on study from a quiet loch within a much noisier area such as the southern North Sea (which is subject to high levels of anthropogenic activity and consequently noise) as the



fish within this area will be acclimated to the noise and would be expected to have a correspondingly lesser sensitivity to noise levels.

- 2.1.9 The MMO thanks the Applicant for presenting the modelled noise contours in Figure 4 of the revised Clarification Note, as requested. This provides a useful visual overview of the predicted noise impact range for mortality and potential mortal injury, recoverable injury, and temporary threshold shift (TTS) (207dB, 203dB and 186dB respectively). However, we refer to our comments in points 2.1.4 – 2.1.7 of this submission, regarding sea temperatures across the whole spawning grounds (rather than just hotspot) and the need to take a precautionary approach to using an appropriate and precautionary minimum sea temperature. Accordingly, the MMO does not support the Applicant's statement "*that within the noise contours, the mean sampling depth temperatures from the temporal dataset range from 12.9°C to 13.7°C, significantly higher than the 12°C mean temperature used to inform the parameters presented within the Clarification Note, ensuring that a precautionary approach has been utilised*".
- 2.1.10 In reference to the second part of the Applicant's response, regarding modelling of behavioural responses in herring, the MMO requested that the modelled noise contour was presented for the received levels of the 135dB single strike sound exposure level (SELss) at the herring spawning ground, based on the findings in Hawkins *et al.* (2014) as this is considered best available scientific evidence by Cefas Fisheries and Underwater Noise specialists. In this instance the paper was co-authored by a scientist with extensive experience and a strong publication record in the field of fish bioacoustics. The application of the 135dB threshold has been accepted and widely used in underwater noise modelling by other offshore wind farm developers during the planning process. Our advice is based on scientific evidence and best available data. We recognise that the Applicant has a view on the level of risk, however this is not supported, in our view, in the evidence. The MMO would be willing to consider the use of an alternative threshold for modelling behavioural responses in herring (or a similar clupeid fish), should the Applicant be able to provide one which is based on suitable, peer-reviewed literature. In the absence of a suitable alternative threshold, we again request that this threshold is modelled, and the mapped noise contour presented for review.
- 2.1.11 The Applicant notes previous work undertaken by Rampion Offshore Wind Farm to estimate migration periods for herring to reach the Banks spawning ground prior to spawning. The Applicant confirms that the Banks herring stock migrate in a clockwise circuit in the North Sea, migrating from the Northeast to the Banks spawning ground, and then continuing in a northerly direction (Cushing, 2001). This migration circuit has been mapped alongside the herring larval hotspots, and the underwater noise contours for stationary receptors with a swim bladder involved in hearing (see Figure 18 of G1.10 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction, updated at Deadline 5 (REP5-048)). The Applicant notes that as illustrated in Figure 18, the noise contours fall outside of the migration circuit, and therefore noise effects from the Hornsea Four construction works will not cause a barrier effect to herring migration and as



such, there is no need to allow additional time for a migration period within the peak spawning period timing.

- 2.1.12 We thank the Applicant for mapping the herring migration route shown in Figure 18, however, please refer to comments in point 2.1.10 of this submission regarding the requirement for modelling the behavioural responses in herring. Behavioural responses based on the 135dB threshold will cover a much wider area, compared to those modelled for mortality and potential mortal injury, recoverable injury and TTS, so there remains uncertainty regarding behavioural responses in herring at the spawning grounds and migrating to/from spawning grounds owing to the lack of modelling for behavioural responses in herring.
- 2.1.13 The Applicant notes the MMO's request to adopt a slower growth rate in line with that proposed by Heath (1993). The Applicant however is confident that the equation presented by Oeberst *et al.* (2008) to calculate growth rates is appropriate to estimate the growth rate for the Banks herring stock. The growth rate presented by Heath (1993) is based on herring stocks distributed across the northeast Atlantic, which would equate for significant variations in temperature, with the temperatures within the more northerly stocks much lower than those within the Banks stock region. The calculation as presented in Heath (1993) does not account for temperature as a variable, whilst it is widely accepted that sea temperature affects herring larvae growth rates (Stevenson 1962; Keegen *et al.* 1986; McGurk 1984; Ottersen and Loeng 2000). It is on this basis, that the Applicant does not consider Heath (1993) to be a reliable source for the determination of growth rates. The Applicant is therefore confident that the calculation presented in Oeberst *et al.* (2008), which accounts for temperature as a variable, is appropriate to determine the growth rate of the Banks stock herring. The Applicant also draws the MMO's attention to Figure 4 of G1.10 Clarification Note on Peak Herring Spawning Period and Seasonal Piling Restriction (updated at Deadline 5 (REP5-048)), where the noise contours from piling at the HVAC booster station search area (the piling location closest to the herring spawning grounds) have been overlaid on the temperature data. Within the noise contours, the sampling depth temperatures range from 12.9°C to 13.7°C. These values are significantly higher than the 12°C mean temperature used to inform the calculation of the growth rate. The Applicant has utilised a lower temperature to inform the growth rate calculation, which results in a slower growth rate and as such, is therefore confident that a precautionary approach has been utilised.
- 2.1.14 Please see points 2.1.4 – 2.1.7 of this submission regarding the use of an appropriate conservative temperature. This is a key parameter when calculating daily larval growth rates. In our previous advice the MMO highlighted our concerns that a calculated growth rate of 0.46 mm d-1 was not conservative. The Oeberst *et al.* (2009) study used in the Technical Note to calculate daily larval growth rates collected larval growth rates in the field using Baltic Sea herring larvae which are a spring-spawning stock, that are anatomically different to Banks stock, and are located in an area where significant increases in temperature (from 5°C to 20°C) are observed during the larval growth period. The main difference in growth rates found by Oeberst *et al.* (2009) was at warmer temperatures which is probably a reflection of the different feeding



conditions in the Baltic (along with spring versus autumn spawners). In the case of autumn spawners (e.g., Banks herring), the temperature is dropping and daylength shortening (the opposite in spring spawners).

- 2.1.15 Whilst we maintain that using a larval growth rate based on Heath (1993) is appropriate for the purpose of a conservative calculation, we recognise that this paper has a more limited view on potential variability in herring larvae growth rates. Heath does at least remove the problem of having to figure out the thermal regime in a particular year (be it for forward or backward projections).
- 2.1.16 In summary, there are pros and cons with using either Heath (1993) or Oeberst *et al.* (2009) and we do acknowledge that the Oeberst *et al.* (2009) equation had strong agreement with values in the literature at the lower temperatures. On this basis, we are content to accept the use of the Oeberst *et al.* (2009) model using all the literature data ( $G=0.11+(0.017*T)$ ) subject to the use of an appropriate temperature (as per our comments 2.1.4 – 2.1.7 of this submission) and caveated that the model was not based on autumn spawning, Banks herring larvae. Workings for the calculated daily larval growth rate value should be presented in the Applicant's response.
- 2.1.17 With reference to number 3.1.11 of the clarification note (REP5-048), the Applicant directs the Examining Authority to the Applicant's response to point 3.1.9 of the document. The Applicant welcomes the MMO's review of the additional information presented as part of this response. However please see section 2.1.12 of this submission for our comments to the Applicant's response to point 3.1.9.
- 2.1.18 In conclusion, the MMO maintains that the proposed 'peak' spawning period of 1st September – 16th October is not appropriate for the reasons outlined above. We believe that the calculated 'peak' spawning period is neither precautionary nor conservative. Further revisions and amendments are needed including the requirement for behavioural response noise modelling and the use of appropriate minimum sea temperatures which influence the duration of egg and larval development, and larval growth rates, all of which are factors which will affect the calculation of a 'peak' spawning period. The MMO maintains the position that the restriction should be between 1st August and 31st October each year.

## 2.2 Clarification Note on Marine Mammals - Revision: 01 [REP4-045]

- 2.2.1 The MMO has reviewed the Clarification Note on Marine Mammals - Revision: 01 [REP4-045] along with our scientific advisors at the Cefas and wish to make the following comments. Please note that all references to Sections, Figures, and Tables relate to the clarification note [REP4-045] unless otherwise specified.
- 2.2.2 With regard to the cumulative Permanent Threshold Shift (PTS), the Applicant maintains that at present, the estimation of weighted cumulative sound exposure criteria (SELcum) onset ranges is highly over-precautionary and as such there should not be a requirement to implement mitigation based on the SELcum until





these conservatisms have been quantified and addressed.

- 2.2.3 The MMO disagrees with this statement. This particular issue has been discussed on previous occasions with the Applicant for Hornsea Project Four. As acknowledged previously, the Applicant does raise some valid points for consideration. Such as, there are uncertainties associated with predicting the true levels of sound exposure over long periods of time, as a result of uncertainties about responsive movement, the position of animals in the water column, the extent of recovery between pulses or in breaks in piling and the extent to which pulsed sound loses its impulsive characteristics over time.
- 2.2.4 Nevertheless, the most recent, peer reviewed noise exposure criteria for marine mammals (e.g. Southall *et al.*, 2019) are dual criteria, whereby both the peak sound pressure level (SPL<sub>peak</sub>) and the cumulative sound exposure level for impulsive sources should be evaluated, and that predicting the largest range of impact should be considered for the impact assessment. We endorse the application of the dual criteria, since this covers not only instantaneous auditory injury, but also auditory injury from accumulated exposure to noise pollution from pile driving, which tends to present a larger scale risk.
- 2.2.5 In general, there are many uncertainties regarding, and in assessing, the potential effects and impacts of underwater noise on marine life, and our recommendation is to utilise the most recent, peer-reviewed literature and guidance available to underpin assessments and assess the potential risks. Therefore, until such uncertainties and conservatisms have been quantified and addressed, we maintain that there should be a requirement to implement mitigation based on the SEL<sub>cum</sub> if necessary (e.g. in instances where the SEL<sub>cum</sub> is larger than the peak sound pressure level).
- 2.2.6 The Applicant acknowledges that the assessment of cumulative PTS is an area of active research. Ongoing studies are seeking to better understand the effects of duty cycle and how the impulsive characteristics of noise change with range. It is anticipated that these and other studies will reduce existing uncertainties and sources of conservatism and will result in developments to the process of estimating SEL<sub>cum</sub>. As such, the Applicant will maintain awareness of current research and maintain ongoing dialogue with Natural England as the project develops to ensure that the final MMMP presents an assessment and mitigation measures reflecting the state of knowledge at the time.
- 2.2.7 As noted in previous advice, the SEL thresholds assume the sound keeps its impulsive character regardless of the distance to the sound source. It is recognised that an impulsive sound is likely to lose its impulsive characteristics as a result of propagation, although no explicit guidance has been published on this. However, this is why it is important to consider the SEL<sub>cum</sub>, and not just the SPL<sub>peak</sub>, because the impulsive nature of the noise signal is more relevant to the instantaneous injury assessed by the SPL<sub>peak</sub>. Auditory injury caused by longer (cumulative) exposure and assessed through the SEL<sub>cum</sub> criteria is less dependent on the impulsive characteristics of the noise.



2.2.8 It is also worth noting the fact that the noise signal transitions into something less impulsive, does not preclude the injurious effects caused by accumulation of exposure. Auditory injury from cumulative exposure may also be caused from non-impulsive sources.

2.2.9 In summary, the MMO maintains the position that although there are uncertainties and some conservatism with estimating the weighted cumulative sound exposure, the requirement to implement mitigation based on the SELcum should remain, and the (dual) noise exposure criteria should be appropriately considered and applied.

### 2.3 Outline Marine Mammal Mitigation Protocol [APP-240]

2.3.1 The MMO has undertaken a review of the Outline Marine Mammal Mitigation Protocol (MMMP) and provides the following comments. The aim of the MMMP is to reduce to negligible the risk of PTS for marine mammal species in relation to pile driving for the installation of Hornsea Four foundation structures. The final plan will be agreed with the MMO and relevant Statutory Nature Conservation Bodies (and will be determined based on the final confirmed foundation options and hammer energies), but mitigation measures may include pre-piling deployment of Acoustic Deterrent Devices (ADDs), marine mammal observation and soft start procedures.

2.3.2 Section 4.2.1.3 of the MMMP states *“It is important to note that this Outline MMMP focuses on mitigating only the “instantaneous” SPLpeak PTS-onset impact ranges”*. The MMO disagree with this approach. As advised previously for this development, the MMMP should focus on mitigating both the predicted SPLpeak and SELcum impact ranges. Nevertheless, this same section then states: *“One of the potential mitigation measures that will be considered at this point, will be the use of at-source noise reduction measures in order to reduce the potential for cumulative PTS-onset risk to negligible levels”*.

2.3.3 Cumulative PTS is later discussed in more detail specifically in section 4.4.3 of the MMMP. The document acknowledges that in order to mitigate the large SELcum PTS ranges (i.e. up to 12 km for harbour porpoise and 11 km for minke whale), this would require extended duration of ADD activation which is likely to cause significant levels of disturbance and is therefore not considered to be a feasible mitigation option, which the MMO agree. Therefore, the Applicant will commit to providing at-source noise reduction measures (for example bubble curtains and double bubble curtains) in order to reduce the potential for cumulative PTS risk to negligible levels. The choice of at-source noise reduction method will be confirmed in the final MMMP and the need for any ADD activation periods will be confirmed (see section 4.4.3.3). The MMO fully support this proposal and welcome that the Applicant will commit to providing at source mitigation.

2.3.4 It is appropriate that frequency is considered in Appendix B of the MMMP under “Additional Modelling of Underwater Noise from Impact Piling Using Bubble Curtains”. As highlighted in the document, the efficacy of a noise abatement



system to reduce the risk of impact depends on the frequency range at which sound energy is reduced and on the target species, as each species is sensitive to a certain frequency range.

- 2.3.5 The MMO advises that it will be important to ensure that appropriate mitigation is put in place to reduce the risk of potential impact of underwater noise on marine receptors, and the MMMP for piling operations should focus on mitigating both instantaneous and cumulative auditory injury. The MMO fully support the commitment by the Applicant of using at-source noise reduction measures for the Hornsea Project Four Offshore Wind Farm. Using noise abatement technologies would also reduce the risk of Temporary Threshold Shift in marine mammals (for which large effect ranges are predicted), which is still a form of auditory injury.

#### 2.4 Clarification Note on Marine Sediment Contaminants [REP5a-014]

- 2.4.1 The MMO has also reviewed the comments provided by the Applicant regarding the Clarification Note on Marine Sediment Contaminants which formed part of the Applicant's comments on other submissions received at Deadline 5 - Revision: 01 [REP5a-014] along with our scientific advisors at Cefas and wish to make the following comments.
- 2.4.2 Reference 4.2.3 in document referenced in section 2.3.1, states that all samples were collected from the seabed surface and that the results template has been updated to reflect sediment sampling depth (0m). The Applicant states that the results template has been updated and submitted to the MMO. As the Applicant has confirmed the sample depths, the MMO consider this comment as now resolved.
- 2.4.3 Reference 4.2.4 and 4.2.5 in document referenced in section 2.3.1, states that SOCOTEC completed the contaminant analyses for both the offshore array and offshore ECC samples. The Applicant states that the results template has been updated and submitted to the MMO. As the applicant has confirmed the laboratory for contaminant analysis, the MMO consider this comment as now resolved.
- 2.4.4 Reference 4.2.4 and 4.2.5 in document referenced in section 2.3.1, states that the PSA was completed by Gardline Environmental Ltd. for samples collected within the array and by Benthic Solutions Ltd. for those samples collected across the export cable corridor. The Applicant has confirmed via an email of 22 July 2022 that Gardline Environmental Ltd. subcontracted the PSA analysis to Thomson Ecology.
- 2.4.5 Neither Gardline Environmental Ltd, nor Thomson Ecology are validated by the MMO for PSA analysis.
- 2.4.6 The MMO notes the Applicant's email of 22 July to the MMO in which they advised: *"The MMO provided detailed comments on the benthic and intertidal ecology elements of the PEIR, including specific comments related to the array*



area PSA, with no comments flagging this issue with PSA contractor validations. The Applicant considers that this mandate for all PSA laboratories to be validated by the MMO should have been raised at that time rather than being flagged at this late stage in the Examination process.” The MMO confirms we would not standardly check the details of the laboratories used within the context of benthic and intertidal ecology during the Preliminary Environmental Information Report (PEIR) stage. This is due to the fact that lab validation for PSA and contamination is required for disposal sediment analysis. These matters further relate to distinct benthic and intertidal ecology specialists, who would not comment on the validity of laboratories for sediment contaminants. As laboratory validation was not queried by the Applicant during the PIER stage, and the data was not presented using the MMO template until later in the Examination, the information was not presented in a way that validation would be checked until this later stage.

2.4.7 Please see the guidance at <https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#laboratory-validation> for further information on laboratory validation and the requirements for sediment sample analysis.

2.4.8 The MMO will consider its ability to review the sample analysis, without a validated laboratory for PSA, but would regardless be unable to provide a complete response regarding sediment contaminants without confirmation of the use of valid laboratories. We request an updated MMO results template capturing the clarifications to date to allow us to consider this further.

2.4.9 It should be noted that the validation process is a long process and even if an application was submitted to the MMO for validation, it will not be completed before the examination for Hornsea Project Four has closed.

## 2.5 Professor Mike Elliot's Marine Processes Report Review [REP5-066]

2.5.1 The MMO has reviewed Professor Mike Elliot's Marine Processes report [REP5-066] along with our scientific advisors at Cefas. The following comments also formed the technical advice for our comments during ISH10.

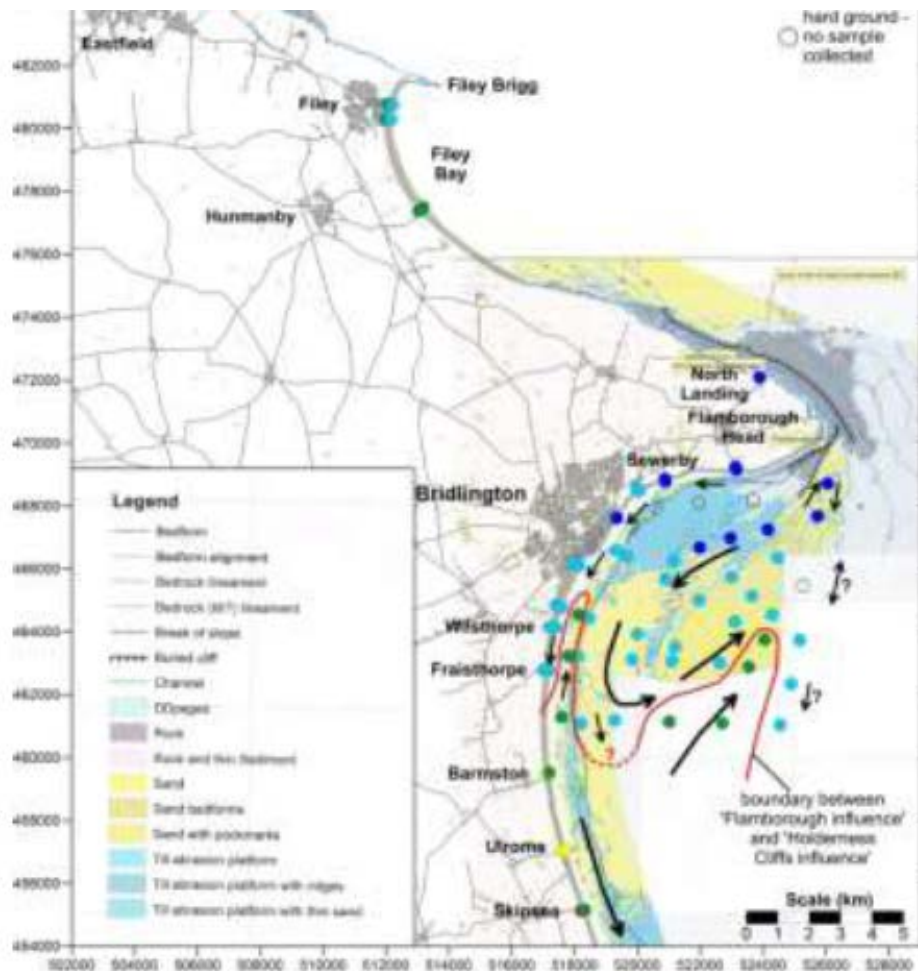
2.5.2 This substantive and authoritative report considers a wide range of issues encountered within the progression and review of the Environmental Impact Assessment for the Hornsea Project Four. It is well considered and backed up by the latest publicly available research papers.

2.5.3 In section 2.5.1.5 Professor Elliot considers the mechanism for the formation of Smithic Bank. It should be noted that we consider the whole of Flamborough Head, Smithic bank, Holderness to Spurn Point as a connected system. Whilst input from Flamborough are well documented, the status of Smithic Bank is still open to debate. The eastern sediment flow on northern tip of Smithic and the southward flow on the eastern side of the bank is well documented by numerous authors and from recent swath bathymetry campaigns. However, the authoritative geomorphologists Pye, Blott and Pye (2015) and shown in Figure 1 of this submission (below), using a tracer and concentration methodology show



an anti-clockwise circulation in the southern half of the Smithic Bank. Furthermore, the debate continues as to the function of Smithic Bank. Is it a “leaky reservoir” of sediment that episodically releases sediment onto the Holderness foreshore, is there a northern transport pathway close inshore (near Wilsthorpe) or does the Holderness coast itself contribute to Smithic Bank sands?

2.5.4 These sediments contribute to the Holderness Coast being transported south to Spurn Point. Therefore, in both terms of coastal protection of Bridlington and potential impacts on the Holderness Marine Conservation Zone we consider the whole of the system a “receptor”.



**Figure 1** - Sediment transport vectors based on a Rare Earth elements tracer study based on the applicant Figure EX1 (Pye, Blott, Pye, 2015).

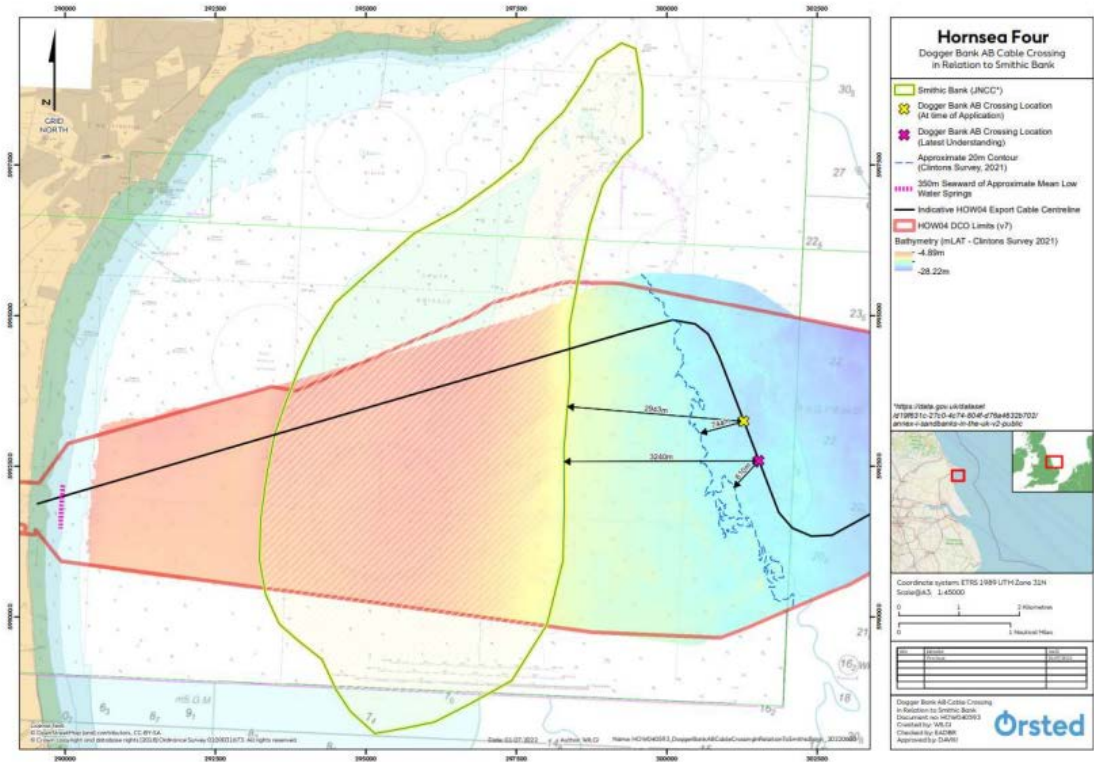
2.5.5 In 2.5.17 the position of the cable crossing is discussed east of Smithic. The latest chart showing the location of the bank and the proposed crossing point is shown in Figure 2 in REP5a-017. This shows approximately 2.943km from the active edge of the bank to the northern crossing point and 3.24km to the southern crossing point. Whilst these crossing point are approximately 1.5km long and 1.8m high we do not expect a significant impact on sediment transport associated with the flanks of Smithic Bank.

- 2.5.6 In section 2.6.1.5 Professor Elliot suggests that as “*as the light regime stays the same*” that primary productivity will remain the same. However, it has been hypothesized that the “cold , deep, high nutrient water” in the north will be advected to the surface due to the structure (monopiles and gravity based structures). These cold water plumes now at the surface will be in a high light regime thus allowing primary productivity to start. Thus the signature impact may consist of both a cold water plume and high productivity chlorophyll blooms.
- 2.5.7 In section 2.10.1.2 Professor Elliot considers potential impacts pathways. Our technical advisors at Cefas consider the source, the pathway and the receptor, using the S-P-R (source-pathway-receptor) method.
- 2.5.8 Whilst using the analogue of experiences referring to gravity base structures in Belgian waters could be considered robust, the oceanographic conditions in Hornsea Project Four are very different, with larger waves, longer wave periods (and hence increased bed shear stress). Furthermore, water depths are considerably different.
- 2.5.9 In section 2.13.1.4 the cumulative impact of the Hornsea Project Four, Dogger Bank A&B and the Scotland to England Green Link 2 cables are discussed. Whilst no formal assessment methodology has been agreed, coastal geomorphologists usually take a precautionary, conservative and pragmatic approach. For instance, are there indications of changes in sediment transport from existing cables (scour pits, scour streaks, freespan) that may cause a potential for cumulative impacts between two adjacent cables. Furthermore, the mobility of the local sediment should also be considered.

## 2.6 **Clarification Note on Marine Processes Mitigation and Monitoring [REP5a-017]**

- 2.6.1 The MMO has reviewed the Applicant’s Clarification Note on Marine Processes Mitigation and Monitoring [REP5a-017] along with our scientific advisors at Cefas. The following comments also formed the technical advice for our comments during ISH10.
- 2.6.2 In Figure 2 of this submission (from REP5a-017), the Swath bathymetry and export cable route for the Hornsea Project Four are plotted along with Joint Nature Conservation Committee (JNCC) shape file of Smithic Bank. We propose that this “lozenge” shaped area be the basis of the pre-conditioned swath bathymetry monitoring survey, subsequently when the actual laid routes of Dogger Bank A&B as well as Hornsea Project Four are determined then an export cable corridor (ECC) survey plan can be considered (the Scotland England Green Link 2 may also be nearer construction if approved). Only once all these routes are finalised can the ECC survey plan be agreed. It is noted that consideration of holistic swath bathymetry monitoring plan between the three developers may produce scientific more robust data and also save resources.





**Figure 2** – Dogger Bank AB Cable Crossing in Relation to Smithic Bank (from REP5a-017)

- 2.6.3 In section 2.3.4.1 Professor Elliot refers to the variability of the Flamborough Front in terms of locations, intensity and meanders and that there needs to be caution in determining “significant” signal to noise ration to which the MMO concurs.
- 2.6.4 Referring to Table 7 and Table 8 of the report, the MMO proposes that the satellite monitoring propose should be used as a planning tool to identify if and which turbine bases exhibit “cold water plumes”. Once the likely conditions have been determined we would propose to deploy the equipment in Table 7 along with chlorophyll sensors if this was observed. Instead of thermistor strings, we would propose using a Conductivity-Temperature-Depth Satellite (CTD) in a “yo-yo” mode in order to capture the horizontal and vertical variability.
- 2.6.5 In Table 7 we propose to monitor 3 wind turbine bases.
- 2.6.6 In Table 8 the Applicant’s plans to use the ESA Sentinel 3 SST (European Space Agency Sentinel 3 Sea Surface Temperature) which is sufficient. We would also propose to use Landsat 8 and 9 satellites which have a 100m resolution for plume monitoring (note that these two satellites overpass every 16 days but are offset by 8 days). Also that all remotely sensed instrumentation is subject to cloud cover. It should be noted that Sentinel 3 data dates back to 2017, thus allowing the creation of a baseline and determining natural variability of the front (see section 2.7.2 of this submission).
- 2.6.7 Summary:

2.6.8 The Applicant commissioned an external independent report on the coastal processes' issues associated with cable landing for Hornsea Project Four. Professor Elliot is highly regarded in the field and his comments are authoritative and constructive. Two main issues are discussed in depth - the integrity of Smithic Bank and the impact of structures on the Flamborough Front Secondly, building on Professor Elliot's report mitigation and monitoring options are considered.

2.6.9 The position of the crossing has been shown to be over 2.9km from the active eastern boundary of Smithic and is thus not an issue. Additionally, the Flamborough Front monitoring should be reversed, and the far-field converted into a planning tool and the near field supplemented with a chlorophyll sensor. Please see sections 1.4.3, 1.4.4 and 1.4.5 for our specific on monitoring.

**2.7 Benthic ecology- Table outlining the MMO's Deadline 6 comments on Benthic, Subtidal, and Intertidal ecology matters**

2.7.1 The MMO has updated it's comments regarding Benthic Ecology, we have provided these in the Table below to help capture where matters are resolved, and the remaining issues.

2.7.2 Regarding Benthic Monitoring, the MMO requests a minimum of 10% of the total amount of turbines proposed for construction should be monitored for benthic impacts.

Colour coding key:

Observational only	
Minor comment- No action	
Minor comment- Actions requested	

MMO Comments (R-020)	Applicant's response	MMO Deadline 6 comments
3.4.1: In providing this response the MMO has reviewed the following documents, unless otherwise stated all comments relate to Chapter 2 Benthic and Intertidal Ecology: a) EN010098-000697- A1.1 ES Volume A1 Chapter 1 Introduction b) EN010098-000700- A1.4 ES Volume A1 Chapter 4 Project Description c) EN010098-000701-	Noted.	N/a.





<p>A1.5 ES Volume A1 Chapter 5 Environmental Impact Assessment Methodology d) EN010098-000704- A2.2 ES Volume A2 Chapter 2 Benthic and Intertidal Ecology e) EN010098-000756- A5.2.1 ES Volume A5 Annex 2.1 Benthic and Intertidal Ecology Technical Report f) EN010098-000739- A4.5.1 ES Volume A4 Annex 5.1 Impacts Register g) EN010098-000741- A4.5.2 ES Volume A4 Annex 5.2 Commitments Register h) EN010098-000714- A2.12 ES Volume 2 Chapter 12 Cumulative and Transboundary Effects Offshore Summary i) EN010098-000743- A4.5.3 ES Volume A4 Annex 5.3 Offshore Cumulative Effects</p>		
<p>3.4.2: The MMO believes that the intertidal survey and subsequent characterisation are appropriate.</p>	<p>Noted.</p>	<p>N/a</p>
<p>3.4.3: The Array and export cable corridor have been characterised using a combination of historical data, geophysical data, drop down video (“DDV”) (for fauna and sediments at all stations and Annex I stony reef</p>	<p>The Applicant notes that the predictive habitat model utilised the best available data for the array area and ECC, in addition to the results obtained from site-specific surveys, to produce a detailed predictive survey habitat map. The primary purpose of creating the</p>	<p>The clarification regarding the prioritisation of site-specific survey data over predictive mapping is noted.</p> <p>However, the MMO notes the response provided by the Applicant states that all biotope classifications were analysed through a</p>



<p>under a separate survey design) and grab (for fauna and sediment composition).</p> <p>Each of the locations sampled by grab (and DDV) have been assigned a European nature information system (“EUNIS”) biotope and corresponding JNCC Marine Nature Conservation Review (“MNCR”) biotope classification.</p> <p>All information has been used to develop predictive habitat distributions across the Project area.</p> <p>Whilst this is a sensible approach, which has been alluded to in previous consultations, the MMO has major concerns regarding some of the classifications and model outputs following review of the raw data. The MMO</p>	<p>predictive habitat model was to address data gaps identified at PEIR, due to planned further survey work not being available at that time. The model was generally well-received by consultees, so it remained within the DCO Application, despite the data gaps being filled. Since the PEIR version of the model, further geophysical and benthic site-specific survey data (particularly with reference to the ECC) has been added to the model.</p> <p>With regards to concerns surrounding classification and model outputs, this has been considered within the data limitations of the predictive habitat model.</p> <p>However, the Applicant stresses that where site specific data have been collected, this has been prioritised within the predictive habitat model and supersedes the large-scale habitat maps.</p> <p>Further detail on data limitations is presented in <a href="#">Section 2.7.5 of Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a>. In addition, the Applicant would like to stress that all biotope classifications were allocated through a standardised approach using multivariate analysis. All the evidence for biotope classifications are presented in <a href="#">Volume A5, Annex 2.1:</a></p>	<p>standardised approach using multivariate analysis. For the Export Cable Corridor, whilst this appears to be true for the two large faunal groups (see Figure 3 of this submission) which were assigned biotopes based on the dominant species present, it does not appear to be true for the three faunal groups within the same nMDS ordination comprising stations ECC_17 to ECC_21, which were all dominated by <i>Sabellaria spinulosa</i>. Neither this species nor other abundant species observed in grab samples at these stations were used in the biotope classification nor mentioned in the text as the dominant infaunal taxa at these stations. The fauna observed from the drop-down video were solely used to classify the biotope (A5.444 ‘<i>Flustra foliacea</i> and <i>Hydrallmania falcata</i> on tideswept circalittoral mixed sediment) for these stations (as mentioned in paragraph 5.5.4.8 of Volume A5, Annex 2.1). Paragraph 5.5.4.9 of ES Volume A5, Annex 2.1 also describes the characterising epifaunal species present at stations ECC_17 to ECC_23 but fails to mention the presence of <i>S. spinulosa</i> (and other abundant infaunal species) despite the dominance of this species in the infaunal samples. The EUNIS description for A5.444 states that “<i>This biotope represents part of a transition between sand-scoured circalittoral rock where the</i></p>
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	<p><a href="#">Benthic and Intertidal Ecology Technical Report (APP-068)</a> and associated appendices.</p>	<p><i>epifauna is conspicuous enough to be considered as a biotope and a sediment biotope where an infaunal sample is required to characterise it and is possibly best considered an epibiotic overlay.</i>” <i>S. spinulosa</i> and other dominant infauna at these stations must therefore be mentioned as additional characterising species if a suitable infaunal biotope is not found.</p> <p>Paragraph 5.5.4.9 of ES Volume A5, Annex 2.1 also erroneously states that <i>Flustra foliacea</i> and <i>Hydrallmania falcata</i> were present in the grab samples of EEC_17 to ECC_23. Neither species are listed in the Macrofauna abundance tables in Appendix D5 of ES Volume A5, Annex 2.1. The MMO requests that this misleading erroneous text is corrected in all reports that state this.</p>
<p>3.4.4: While some of the biotope classifications reflect the dominant species present in the samples, many of the biotope classifications are only loosely based on the species present. This information has been provided in the appendices of the technical document but should be highlighted in the main technical document and ES Chapter e.g. in terms of</p>	<p>The Applicant notes that benthic ground-truthing data was classified using the EUNIS classification hierarchy to biotopes (to a maximum level five). This classification was primarily based on depth, sediment type and species composition.</p> <p>A detailed explanation of the benthic subtidal ecology and EUNIS classification process was presented within <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal</a></p>	<p>The MMO is not requesting that the Applicant replicates the significant detail of the technical report, we are asking that the Applicant presents a complete description of the biotopes and characterising species. This has not been undertaken for ECC17-ECC_21 as noted above.</p>



<p>biotope confidence, especially as biotopes have been taken forward for impact assessment.</p>	<p><a href="#">Ecology Technical Report (APP-068)</a> and the associated appendices.</p> <p>The Applicant notes that this explanation was provided within <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP014)</a> with a cross-reference to <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a> where the further detail was provided. The Applicant does not consider it appropriate or proportionate to replicate the significant detail across both the ES technical report and chapter documents</p>	
<p>3.4.5: Following on from the previous point, the echinoderm species, <i>Amphiura filiformis</i> (<i>A.filiformis</i>), is one of the dominant species in terms of abundance and distribution across the Array area but none of the biotopes account for this. This is similar for the polychaete, <i>Sabellaria spinulosa</i> (<i>S.spinulosa</i>), which was dominant at several stations along the ECC.</p> <p>Whilst the dominance of these species is recognised in the Appendices of <a href="#">Volume 5, Annex 2.1: Benthic and Intertidal Ecology Technical Report</a> this information does not come through into the ES chapter. This is</p>	<p>The Applicant notes that although <i>Sabellaria spinulosa</i> individuals were identified within benthic grab samples at five sampling stations within the offshore ECC (ECC_17 to ECC_21), the only aggregation observed in DDV footage was a small patch encrusting a pebble, which was not therefore classified as potential Annex I reef.</p> <p>A detailed review of the Side Scan Sonar (SSS) and multi-beam echo sounder (MBES) bathymetry data acquired within the Hornsea Four Order Limits found no evidence of the distinctive signatures which would typically be associated with the presence of biogenic reef.</p> <p>As a result, the inclusion of <i>S. spinulosa</i> has not been</p>	<p><i>Amphiura filiformis</i> is present in relatively high abundances (abundances in brackets) at stations ENV16 (66), ENV17(127), ENV19(177) and ENV21(81). In comparison, <i>Mysella (Kurtiella) bidentata</i> has a maximum abundance of five individuals at ENV16 and ENV19 and three individuals at ENV17. Only one record of <i>Thyasira flexuosa</i> is recorded in the entire Array dataset (ENV21), However, both ENV17 and ENV19 have been assigned to the biotope A5.443: SS.SMx.CMx.MysThyMx - <i>Mysella bidentata</i> and <i>Thyasira</i> spp. in circalittoral muddy mixed sediment. The MMO recognises that the biotope description states that <i>A. filiformis</i> may be found at high abundances at some sites, but overall the biotope is only loosely based on the fauna present. This needs to</p>



<p>extremely important in relation to <i>S. spinulosa</i>, where the biotope that has been assigned to stations EEC17- ECC21 is an epifaunal biotope that does not mention <i>S. spinulosa</i> in the list of species.</p> <p>The MMO recommends revising the biotopes for ECC17-ECC21 to SS.SBR.PoR.SspiMx (<i>Sabellaria spinulosa</i> on stable circalittoral mixed sediment) as it matches better with the species composition found at these stations</p>	<p>included in the ES and the Applicant does not consider it appropriate to revise the biotope to SS.SBR.PoR.SspiMx (<i>Sabellaria spinulosa</i> on stable circalittoral mixed sediment), as the individuals identified were not considered quantifiable as a reef feature, as detailed in Appendix A and Appendix B of <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>.</p> <p>Moreover, the Applicant recognises the concern from the MMO in relation to <i>A. filiformis</i>. However, the Applicant notes that <i>A. filiformis</i> is considered in the assessment, in relation to the biotope account of <i>A. filiformis</i>, <i>Kurtiella bidentata</i> and <i>Abra nitida</i> (SS.SMu.CSaMu.AfilMysAni t).</p>	<p>be highlighted in the ES Chapter (A2). The dominance of <i>A. filiformis</i> at the stations mentioned above also needs to be highlighted in the ES chapter. We also note that the biotope A5.351, '<i>Amphiura filiformis</i>, <i>Mysella bidentata</i> and <i>Abra nitida</i> in circalittoral sandy mud' has been considered in the ES chapter (A2) under the predictive mapping section, however according to paragraph 2.11.1.12 it was not assigned to any of the stations within the Hornsea Four Order Limits. This biotope was assessed as having medium sensitivity to disturbance. The MMO therefore recommends stating that the fauna and sediments observed at these stations are representative of both A5.351 and A5.443.</p> <p>Whilst the evidence suggests that the stations where <i>Sabellaria spinulosa</i> dominates do not represent reef habitat, the numbers of individuals per m<sup>2</sup> are indicative of reef potential. The MMO therefore recommends mention of this dominant species observed in grabs in the ES chapter (A2) as the current biotope classification does not sufficiently cover the infaunal community.</p>
<p>3.4.6: The MMO believes that maps showing distribution of dominant species along with maps of species</p>	<p>The Applicant does not consider it appropriate or proportionate to replicate the significant detail across both the ES technical report</p>	<p>The MMO notes that bar graphs have been provided in the ES technical report, but still believe that maps of dominant species should be</p>



<p>richness, abundance and diversity should be included. This would align with information provided in other offshore wind farms ES's and provide transparency within the ES.</p>	<p>and chapter documents. Abundance bar graphs have been provided in Appendix A (Figure 2.4 and 2.5) and Appendix D (Figure D6, D7 and D8) of <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>.</p>	<p>included as per other offshore wind project ES's. However, if the ES text can be amended to mention the presence and assess the sensitivity of <i>S. spinulosa</i> at EEC_17-EEC_21 and <i>A. filiformis</i> at ENV 16-ENV21, that will appease the MMO concerns.</p>
<p>3.4.7: Species composition of each of the multivariate groups identified in Figure 8 of the Annex 2.1 Benthic and Intertidal Ecology Technical Report (Annex 2.1 Benthic Report) should also be provided and transferred through to the ES chapter. The absence of this information in the ES chapter and main text of the technical report makes it extremely difficult to have confidence in the assessments.</p>	<p>The Applicant notes that the main contributing species of each multivariate grouping shown in Figure 8 is provided within paragraphs 5.5.2.10 to 5.5.2.18 of <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a> under the heading 'Multivariate Analysis of Community Composition'. These main species are detailed in Figure 2.4 and Figure 2.5 of Appendix A and Figure D7 and Figure D8 in Appendix D (<a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>). The Applicant does not consider it appropriate or proportionate to replicate the significant detail across both the ES technical report and chapter documents.</p>	<p>Whilst the characterising species from multivariate analysis have been noted in the ES technical report, some of the dominant species e.g. <i>S. spinulosa</i> and <i>A. filiformis</i>, are not mentioned as additional characterising species of specific stations/biotopes in the ES chapter (A2). These species should be mentioned as they are dominant at certain stations but are not necessarily official characterising species of the biotopes assigned.</p>
<p>3.4.8: Some biotope classifications do not reflect the sediment types or species present; this has resulted in the species distribution modelling to overestimate the distribution of certain biotopes.</p> <p>For example, Figure 19 of Annex 2.1 Benthic</p>	<p>The Applicant notes that the model collates all available physical and biological point data across the area of interest to help understand the occurrence of potential biotopes over the wider study area. The model predicts the biotopes likely to occur within the Hornsea Four Order Limits, in some cases these habitat</p>	<p>The Applicant's response is noted, we have no further comment on the predictive model outputs.</p>



<p>Report above shows that SS.SCS.CCS.MedLum Ven is predicted to occur along parts of the ECC and southern part of the Array, despite the biotope not being identified in the most recent sampling campaign. Similarly, although SS.SMx.CMx.MysThyMx was identified (loosely) at a couple of stations, the model predicts it to occur across the majority of the Project area despite the sediment across the area being classified as sands.</p> <p>The MMO requests that the model outputs are sense checked against the other data that has been collected across the Project area and for the confidence in these distribution models to be clearly articulated in the ES.</p>	<p>requirements overlap due to preferred ecological conditions.</p> <p>With regards to concerns surrounding model outputs, the Applicant notes that this has been considered within the data limitations of the predictive habitat model. However, the Applicant stresses that where site specific data have been collected, this has been prioritised within the predictive habitat model and supersedes the large-scale habitat maps.</p> <p>Further detail on data limitations is presented in Section 2.7.5 of <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a> as amended by <a href="#">A5.2.1.1 Benthic and Intertidal Ecology Technical Report Schedule of Change (AS-009)</a>.</p>	
<p>3.4.9: The Valued Ecological Receptors (“VER’s”) (Table 2.9 of Chapter 2: Benthic Ecology) should subsequently be revised to reflect any changed in biotope classifications</p>	<p>Based on the Applicant’s responses to the above points raised by the MMO, it is not considered appropriate to revise any of the VERs in <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a>.</p>	<p>The Valued Ecological Receptors (VER’s) table should include reference to <i>S. spinulosa</i> and <i>A. filiformis</i> as these are dominant species but not currently satisfactorily considered.</p>
<p>3.4.10: As certain information has been omitted from the ES chapter (species richness, abundance, diversity) it is difficult to assess Table 2.9 with</p>	<p>Based on the Applicant responses to the above points raised by the MMO, it is not considered appropriate to update <a href="#">Volume A2, Chapter 2: Benthic and Intertidal</a></p>	<p>We note the Applicants response and have no further comment.</p>



confidence.	<a href="#">Ecology (APP-014).</a>	
<p>3.4.11: Although the brittlestar dominated, biotope SS.SMu.CSaMu.AfilMysAnit was not identified using the data gathered, the Array was dominated by <i>A. filiformis</i>, therefore this needs to be recognised in the VERs: Table 2.9. This is also relevant for <i>S. spinulosa</i> along the cable route.</p>	<p>The Applicant notes that <i>A. filiformis</i> is considered in Table 2.9 under biotope under 'AfilMysAnit.' (see fourth row). <i>S. spinulosa</i>, is not considered in Table 2.9, as although it is a VER, a detailed review of the data acquired within the Hornsea Four Order Limits found no evidence of the distinctive signatures which would typically be associated with the presence of biogenic reefs.</p> <p>As a result, the limited abundance of <i>S. spinulosa</i> identified within the surveys is not considered high enough to quantify as an Annex I reef habitat, as detailed in the Gubbay (2007) JNCC Report. Further information can be found in Appendix A, Appendix B and Appendix D of <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>.</p>	<p>The MMO notes that the Applicant states that <i>A. filiformis</i> has been considered in Table 2.9 and agree with this. However, the text associated with biotope 'AfilMysAnit', states that this biotope was not observed within the Hornsea Four Order Limits. Whilst the biotope was not assigned to any of the stations from within Hornsea Four, the species was present in high numbers and therefore should be recognised as present in the Order Limits and assessed accordingly.</p> <p>We further note the Applicants response regarding <i>S. spinulosa</i> not being considered as a VER in Table 2.9 as it is not a reef. However, although we agree that the evidence suggest the absence of Annex I <i>S. spinulosa</i> reef, the presence of the species in the Order Limits is important to note in the ES Chapter (A2).</p>
<p>3.4.12: The potential impacts identified in Table 2.12 of Chapter 2 appear accurate for each stage of the development (construction, operation and decommissioning).</p>	<p>Noted – the Applicant welcomes this confirmation.</p>	<p>N/a.</p>
<p>However, the MMO has also reviewed the Impacts Register and note that although Electric Magnetic Field ("EMF") has been</p>	<p>The Applicant acknowledges recent research conducted in this field, notably papers by Scott <i>et al.</i> (2018 &amp; 2021) investigating the effects of</p>	<p>The MMO notes the information provided by the Applicant and are content that the effects of EMF can be scoped out based on this information.</p>





scoped out of benthic ecology, shellfish and fisheries early on in the scoping phase, further research has been conducted in this field and needs to be considered within the ES.

The MMO believes that this should be updated

EMF on crustacea. It is to be noted however, that these studies have investigated EMF strengths significantly greater than those produced by offshore wind farm cables in the marine environment. Specifically, the lowest experimental EMF used in Scott *et al.* (2021) was a factor of 10 higher than that expected from Hornsea Four cables, with no impacts identified at this EMF strength.

Effects were only noted in these studies using EMF strengths which were a factor of 20 to 1,000 times higher than those expected from Hornsea Four cables.

The Applicant notes that previous offshore wind farm monitoring of invertebrate species revealed no behavioural changes as a result of EMF (DONG, 2005; MMO, 2014). In addition to this, the embedded mitigation measures (e.g. Co83 'where possible, cable burial will be the preferred option for cable protection' [Volume A4, Annex 5.2: Commitments Register \(APP-050\)](#)) will increase the distance between potentially sensitive species and EMF, reducing the likelihood of any behavioural response.

For this reason, the Applicant considers the risk of impact from EMF during operations is not significant for benthic species and



	<p>should remain scoped out of assessment.</p> <p>In relation to fish and shellfish species, the Applicant notes that the spatial extent of EMFs will be limited to the immediate vicinity of the cable, and where possible cable burial will be the preferred option for cable protection (commitment Co83), therefore it is considered that the risk to fish and shellfish species from EMF during operations is not significant.</p> <p>Therefore, it is considered unlikely that there would be any impacts to crustaceans from EMF emitted by Hornsea Four cables. As such, the Applicant considers that impacts from EMF should remain scoped out of assessment.</p>	
<p>3.4.13: Although the evidence gathered appears appropriate, the evidence presented is insufficient to allow a decision on the project to be made. As indicated above, the MMO has major concerns about some of the biotope allocations, absence of key species from some of the biotopes and some of the biotope models. A review of information needs to be undertaken and information brought into the ES chapter to enable an accurate characterisation.</p>	<p>Based on the Applicant responses to the above points raised by the MMO, it is not considered appropriate to revise any biotopes considered within <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a>. Highly technical detail is set out in the ES technical reports, to ensure main ES chapters are not disproportionately long and unwieldy and so they remain accessible to non-specialists as well as specialists. The Applicant does not consider it appropriate or proportionate to replicate the significant detail across both the ES</p>	<p>The MMO notes the Applicants response. However, refers to our comments on the need to include <i>S. spinulosa</i> and <i>A. filiformis</i> as characteristic of certain stations in the ES chapter (A2) as the biotopes assigned to the stations within the Hornsea Four Order Limits do not reflect the presence of these species sufficiently.</p>



<p>Currently important information is buried within the technical appendices which does not allow this.</p>	<p>technical report and chapter documents. The location of where information is presented does not preclude the MMO from considering it.</p>	
<p>3.4.14: The impact assessments have compared biotopes identified within the Project area to the sensitivities assessed by Marine Evidence based Sensitivity Assessment (“MarSEA”). This is appropriate for those biotopes that have been confirmed within the area and have species composition which reflects those characterising the biotopes. However the MMO has some further major comments on the conclusions on biotopes.</p>	<p>Noted.</p>	<p>N/a.</p>
<p>3.4.15: Some of the biotopes modelled using data from other developments close by have not been identified within the Hornsea 4 Project area. This has been highlighted for a sandy mud biotope characterised by <i>A. filiformis</i>, <i>Kurtiella bidentata</i> and <i>Abra nitida</i> and an impact assessment has not been carried out on that biotope (please refer to comments above regarding the absence of a biotope characterised by the</p>	<p>The Applicant notes the MMOs concern in relation to <i>A. filiformis</i> but clarifies that <i>A. filiformis</i> is considered in the assessment. In addition, the existing baseline and assessment consider biotopes present within nearby developments to determine the potential presence of these biotopes within the Hornsea Four Order Limits. All biotopes identified within the most recent sampling campaign have been considered in the assessment, in addition to any biotopes which may be present in the area.</p>	<p>The MMO notes the Applicants response that all biotopes (including modelled biotopes) have been included in the impact assessment.</p>



<p>most dominant species in the Array; <i>A. filiformis</i>), however others that were also not identified in the most recent sampling campaign have been taken forward for impact assessment. This is inconsistent.</p>		
<p>3.4.16: Table 2.16 and Table 2.18 of Chapter 2 highlight low confidence in the assessments for some biotopes but still assesses the overall significance of effect as slight rather than moderate. Confidence needs to be considered in the final assessments. If there is low confidence in the sensitivity assessments, then the final assessment should err on the side of caution.</p>	<p>The Applicant notes the MMO's comments and clarifies that the assessment confidence presented in Table 2.16 and Table 2.18 is based on the MarESA confidence assessment, which details whether the information is available in data or literature. Furthermore, the impact on benthic receptors could result in either a slight (not significant) or moderate (significant) effect. The overall significance is considered slight due to the widespread nature of the habitats within the wider region. The geographical spread of these habitats is considered in Section 2.7.1 of <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a></p>	<p>We note the Applicants response and appreciate the clarification regarding the confidence assessments.</p>
<p>3.4.17: Based on the comments above, the impact assessments will need to be included for some of the additional biotopes e.g. the suggested addition of SS.SBR.PoR.SspiMx, the inclusion of <i>A. filiformis</i> within the assessments.</p>	<p>See Applicant responses to RR-020-3.4.15 and RR-020-3.4.11.</p>	<p>The MMO notes that <i>A. filiformis</i> is included in a biotope that has been assessed for impacts, although the biotope has not been assigned to any stations within the Hornsea Four Order Limits. We agree that the biotope SS.SBR.PoR.SspiMx may not completely represent the habitats observed at EEC_17 to EEC_21, however the</p>



		<p>biotope currently assigned to these stations (<i>Flustra foliacea</i> and <i>Hydrallmania falcata</i> on tideswept circalittoral mixed sediment) does not represent the infauna present. An appropriate infaunal biotope needs to be assigned to these stations that represents the characteristic infaunal species e.g. <i>S. spinulosa</i>, and an impact assessment should be undertaken.</p>
<p>3.4.18: The assessment for spread of non-native invasive species (“NIS”) has predicted the magnitude as negligible based on the current scientific knowledge. The absence of information on species colonising the turbines makes predicting the presence and spread of NIS extremely difficult. This suggests that monitoring of the foundations should be undertaken to increase the knowledge base and to help provide more accurate assessments.</p>	<p>Noted. The Applicant highlights that Hornsea Four does not represent a new potential vector for invasive non-native species due to the presence of other existing offshore wind farms and the presence of oil and gas infrastructure and hard infrastructure within the immediate area. As detailed in Table 2.11 of <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a> and commitment Co111 of <a href="#">Volume A4, Annex 5.2: Commitments Register (APP-050)</a> ‘a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised’. When taking into consideration the designed-in measure Co111, the potential significance of the impact from Hornsea Four alone has been assessed as not significant. As such, the Applicant does not consider that additional monitoring of invasive non-native species is appropriate</p>	<p>We note the Applicants comments regarding non-native invasive species (NIS), however, Hornsea Four does represent a potential vector and stepping-stone to other offshore infrastructure and the coast. Whilst we recognise the commitment of a marine biosecurity plan to prevent introduction of NIS during construction and maintenance, this will not prevent NIS from colonising Hornsea Four turbines during the operation lifetime. As such, we advise monitoring of NIS is undertaken.</p>



<p>3.4.19: In relation to decommissioning it is not clear whether any gravel laid during seabed preparations will also be removed upon decommissioning. The removal of this substrate will determine the extent of seabed recovery as the majority of the Array area and cable route is sand. If removal is not possible then the benthic communities colonising the area will not be the same as found in the baseline environment. Please include the likelihood of removal of these base layers, and any consequences if removal is not possible, in the assessments.</p>	<p>As stated in <a href="#">Volume A1, Chapter 4: Project Description (APP-010)</a>, the Applicant confirms that at the end of the operational lifetime of Hornsea Four, it is anticipated that all structures above the seabed or ground level will be completely removed excluding scour and cable protection (which will remain in situ). Therefore, it is anticipated that any materials surrounding foundations (such as the gravel laid during seabed preparations) will be retained and is not proposed to be removed in accordance with the decommissioning plan and any best practice at the time of decommissioning. In relation to habitat loss, and as stated in paragraph 2.11.2.5 of <a href="#">Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a> this has been considered as the MDS in the assessment relating to a long-term or permanent change in seabed habitat. Correspondingly, in <a href="#">Section 2.11.3 of Volume A2, Chapter 2: Benthic and Intertidal Ecology (APP-014)</a>, the removal of the gravel layer is considered the MDS for decommissioning impacts such as habitat disturbance, increased suspended sediments and loss of introduced habitat. As such, the Applicant considers that appropriate MDS' have been adopted for each</p>	<p>The MMO notes the Applicants response in confirming that it is anticipated that the gravel laid during seabed preparations will be retained and is not proposed to be removed. We recognise that the permanent nature of this infrastructure has been acknowledged in paragraph 2.11.2.5 of the ES chapter (A2), however paragraph 2.11.2.11 of the ES chapter (A2) still states that '...the introduction of the Hornsea Four infrastructure and will be long term, lasting for the duration of the development.' We request that the Applicant changes 'long term' to 'permanent' based on the information provided in the response to comments and ensure that this is consistent throughout the chapters.</p>
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	<p>relevant impact and the assessment is robust and appropriate. Therefore, both eventualities of the gravel remaining in situ and being disturbed have been assessed. The Crown Estate agreement for lease (AfL) for Hornsea Four requires that the project is decommissioned at the end of its lifetime. Additionally, the Applicant highlights that the Energy Act (2004) requires that a decommissioning plan must be submitted to and approved by the Secretary of State for Business, Energy and Industrial Strategy. The Applicant notes that the decommissioning plan and programme will be updated during Hornsea Four's lifespan to take account of changing best practice and new technologies. The approach and methodologies employed at decommissioning will be compliant with the legislation and policy requirements at the time of decommissioning. The Applicant notes that all chapters identify that decommissioning should be agreed at the relevant time with the relevant consultees but a worst case approach is taken relevant to the impact being considered. This is considered to be appropriate.</p>	
<p>3.4.20: The surveys undertaken to characterise the benthic</p>	<p>Noted</p>	<p>N/a.</p>



<p>environment do not cover the entirety of the Array and ECC e.g. the acoustic survey was not 100% coverage and the benthic survey was not extensive. However, the MMO believes that the geophysical survey covered the areas where Wind Turbine Generators (“WTGs”) will be placed, and the benthic survey characterised those sediments that are dominant across the Project area.</p>		
<p>3.4.21: The biotope modelling was undertaken to fill in gaps where sampling was not undertaken, however some of the biotopes are unlikely to be as extensive in the Project area as predicted due to the sediment types present. The MMO advises another review of the models using the most recent data collected as this new inform</p>	<p>See Applicant response to RR-020-3.4.3.</p>	<p>We note the Applicants response referring to comment 3.4.3 and that site-specific data were prioritised over modelled data and have no further comment.</p>
<p>3.4.22: The analyses have not been presented as clearly as they should be. Much of the information that is needed to assess the results has not been brought through into the ES chapter which makes assessing the adequacy of the impact assessments extremely difficult. The technical report and ES chapter</p>	<p>The Applicant does not consider it appropriate or proportionate to replicate the significant detail across both the ES technical report and chapter documents.</p>	<p>The MMO agrees with the Applicants response regarding the replication of significant detail across both the ES chapter and ES technical report as not being proportionate or appropriate. However, there is some information, as alluded outlined in our Deadline 6 comments, that has not been brought across from the ES technical report. This information (mentioned</p>





needs to be reviewed as per previous comments and further information brought through into the main text.		above) should be provided in the ES chapter (A2) for consistency and transparency.
3.4.23: No significant adverse effects were identified; therefore, no mitigation is proposed. This is appropriate based on the benthic habitats present	Noted – the Applicant welcomes this confirmation.	N/a.
3.4.24: The methodology used to obtain and gather the data is appropriate in most cases and standard practices have been used.	Noted – the Applicant welcomes this confirmation.	N/a.
3.4.25: The MMO previously raised the potential issue of obtaining contaminant samples from a Hamon grab as this gear mixes the sediment. The MMO is not aware of any studies being undertaken to compare the results of using this gear type compared with those obtained using the standard gear type (Day grab) used for this purpose, nor know of the consequences of using this gear type on the concentrations of the contaminants. It would be beneficial to compare results with any other data nearby that has been collected using the correct gear, to provide confidence in the results.	A 0.1 m2 Mini-Hamon grab was used to collect the physio-chemical data due to the coarse nature of the sediment in the survey area, i.e., the sediment was too coarse to obtain success day grab samples. Sediments with a finer particle size, such as clays and muds, can act as adsorption surfaces for contaminants that may be released into the water column if the sediment is disturbed (Cefas, 2001). Sediments with larger particle sizes (e.g. sands) are not typically associated with elevated concentrations of anthropogenic contaminants. Hydrocarbons in particular are closely linked to the spatial distribution of sediment types. The concentrations of metals in sediments are generally	The MMO notes the Applicants response regarding contaminants and the need to use the Hamon grab due to the coarse nature of the sediments. We have no further comments.



	<p>higher in the coastal zone and around estuaries, decreasing offshore, indicating that river input and run-off from land are significant sources. As presented in Appendix A of <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>, Results of the chemical analyses revealed that hydrocarbon concentrations across the majority of the Hornsea Four survey area were within the expected United Kingdom Offshore Operators Association (UKOOA) (2001) background concentrations. Some elevation in total hydrocarbon (THC) concentrations was noted nearby existing infrastructure which was expected. Gas chromatography traces were typical of background levels of hydrocarbon inputs in areas of historical oil and gas exploration such as the North Sea (McDougall, 2000). Therefore, it is the Applicant's position that the surveys were sufficient for the purposes of characterisation for the purposes of EIA.</p>	
<p>3.4.26: The use of models to fill gaps in data collection is appropriate and has been employed for other OWF developments when data is scarce, however it is not clear how the</p>	<p>See Applicant response to RR-020-3.4.3.</p>	<p>The MMO notes the Applicants referral to comment 3.4.3 and are satisfied that the appropriate data were used and prioritised in the predictive models.</p>



<p>physical data collected has been used to refine the model outputs. Some of the biotopes predicted to be present do not fit well with the sediment recorded along the ECC and Array. Further validation of the models is required.</p>		
<p>3.4.27: Data was collected specifically for the project due to absence of historical data across much of the site. The models of predicted biotopes (based on historical data) were produced due to the absence of data at Preliminary Environmental Impact Report (“PEIR”). It is unclear how these have been updated using the site-specific data collected across the Project area as the some of the model outputs predicts the likelihood of some habitats being present where the sediment collected from the recent surveys does not corroborate. Section 7.2.2 of Annex 2 Benthic Report sets out how the recent survey data was applied to the model and states that the most recent data was prioritised over older data. However, this does not appear to come through in some of the model outputs.</p>	<p>See Applicant response to RR-020-3.4.3.</p>	<p>We note the Applicants referral to comment 3.4.3 and are satisfied that the appropriate data were used and prioritised in the predictive models.</p>

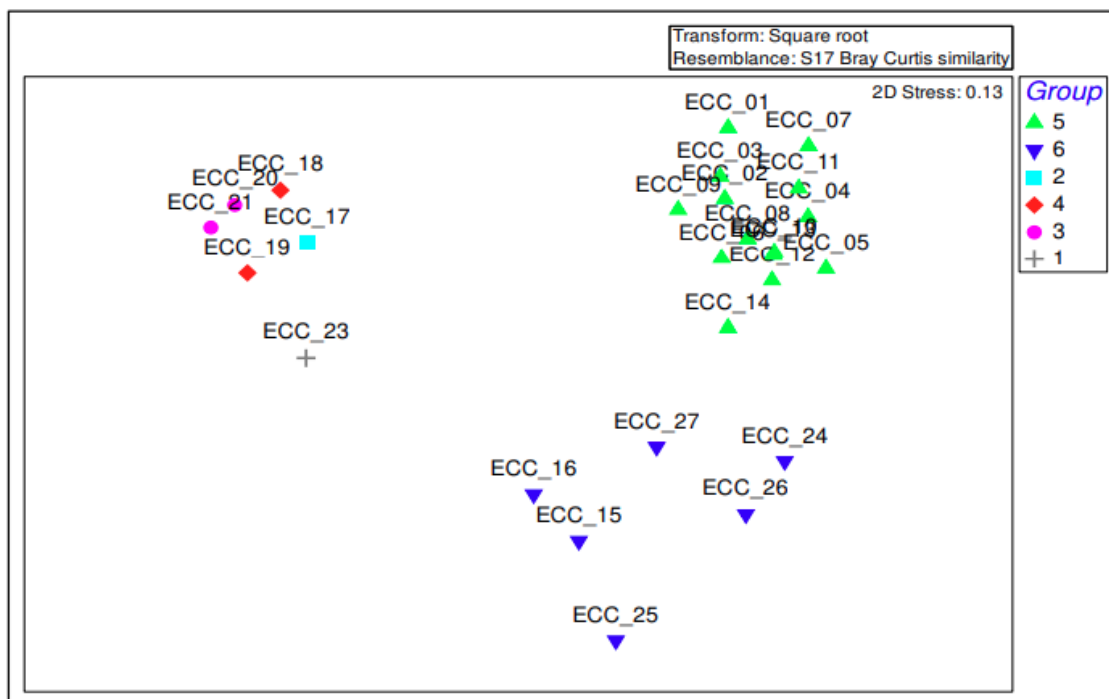


<p>3.4.28: It is not clear from the text in the reports whether an unbiased statistical accuracy assessment has been undertaken. The models use a combination of computational analysis and expert judgement; however, it would be beneficial to have a confidence element to the models due to the poor match, in some cases, to the physical data</p>	<p>As noted in <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>, confidence scores were assigned to all polygons to give an indication of their accuracy.</p>	<p>The MMO notes the Applicants response, however this appears to be related to the Annex I stony reef assessment undertaken by OceanEcology. There does not appear to be a similar confidence assessment of the predictive models. This should be considered in the future if predictive models are used.</p>
<p>3.4.29: <i>S. spinulosa</i> was identified at stations ECC17-21 in high numbers being the dominant species at these stations, however the biotope assigned did not include <i>S. spinulosa</i> as a characterising species and therefore does not reflect the faunal composition of those stations. Whilst the species was identified in high numbers, no reef was identified in the grab samples. However, the presence of this species and dominance at these stations should be mentioned in the ES chapter. It is not clear whether the geophysical data was interrogated at the stations to determine whether any reef signatures were apparent. The MMO</p>	<p>The presence of this species and dominance at these stations is recorded with <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>. Furthermore, the numbers of <i>S. spinulosa</i> identified within the surveys is not considered high enough to quantify as an Annex I reef habitat or a Sabellaria reef biotope. Moreover, as detailed in Section 1.2 of Appendix A, <a href="#">Volume A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (APP-068)</a>, grab samples targeted the range of different sediments and depths observed in the geophysical study. The Applicant will conduct biogenic and geogenic reef surveys as part of pre-construction survey efforts, to identify any biogenic reef features and to enable micro-siting around such features, if present</p>	<p>The MMO notes the Applicants response that the presence of this species is noted in the Benthic Technical Report (A5), however this information has not been translated to the ES Benthic Chapter (A2). Whilst the evidence provided (grab, DDV and acoustic) does not point towards the presence of reef, the presence of this species in high abundances should be mentioned in the main ES Benthic chapter (A2). We appreciate the inclusion of a pre-construction survey to identify any biogenic features for micro-siting and recommend EEC_17 to EEC_21 to be included in this survey.</p>



<p>requires clarification on this matter.</p>		
<p>3.4.30: A number of embedded mitigation commitments have been detailed in the commitments register and in Table 2.12 of Chapter 2 which are appropriate. There are two commitments (Co48 and Co84) to avoid any habitats of principle importance under the NERC Act 2006. The location of these will be informed through pre-construction surveys including micro siting where possible. The absence of <i>S. spinulosa</i> reef from the locations identified as containing high abundances of the species must therefore be confirmed.</p>	<p>The Applicant can confirm that in line with Co84 (<a href="#">Volume A4, Annex 5.2: Commitments Register (APP-050)</a>), foundations and cables will be micro-sited around habitats of principal importance wherever reasonably practicable (subject to agreement with the MMO). Additionally (and also in line with Co84), benthic monitoring will be undertaken at pre-construction phase of the proposed development in order to determine the location, extent and composition of any habitats of principal importance (Section 41 of the 2006 Natural Environmental and Rural Communities (NERC) Act). In the event that habitats of principal importance are identified in the pre-construction survey; post-construction monitoring will also be carried out with a focus on these identified habitats.</p>	<p>The MMO notes the Applicants response and appreciate the inclusion of a pre-construction survey to identify habitats of principle importance under section 41 of the NERC 2006 Act. The MMO encourages the inclusion of EEC_17 to EEC_21 within this survey.</p>





**Figure 3** – MDS ordination of infaunal data along the Export Cable Corridor (ECC) of Hornsea Four OWF (from Hornsea Four ES Vol A5, Annex 2.1: Benthic and Intertidal Ecology Technical Report (AS-009))

## 2.8 Updated version of the Draft Development Consent Order (DCO) [REP5a-002]

2.8.1 The MMO has noted the Applicant’s updated positions on the draft DMLs within the DCO. The MMO have reviewed the DCO and DMLs and provides the following latest positions on them:

2.8.2 **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 REP5-107 and section 2.1.1 to 2.1.3 of AS-031 for further details on this.

2.8.3 **DCO, Schedule 1, Part 3, Article 5(5).** Under section 2.5.3 of (REP5-107), the MMO requested that “unless otherwise agreed with the MMO” included “in writing” at the end. The MMO understands from the Applicant that they consider this amendment is not required due to the provisions within Article 29 of Part 3 of that Schedule (1), which requires all approvals, agreements or confirmations under that part to be provided in writing. Whilst the MMO maintains that the



addition would add clarity, we are content that this matter can be considered closed.

- 2.8.4 **DML Schedule 11, Part 1, Article 1.** The MMO notes the typographical error remains in footnote “c”, there should be no spaces between “c.” and “23”.
- 2.8.5 **DMLs Schedule 11 and 12, Part 1, Article 7.** The MMO maintains the request that this is removed, in line with the position to remove all reference to the MMO and the DMLs from DCO Article 5 (REP5-107).
- 2.8.6 **Schedules 11 & 12, Part 2, Article 3(2).** The MMO requests the insertion of “in writing” after “agreed” in the final line.
- 2.8.7 **DMLs Schedule 11 and 12, Part 2: Article 5(1).** The MMO maintains our comments from (REP5-107) and 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.
- 2.8.8 **DMLs Schedule 11 and 12, Part 2, Article 7(1)(b).** The MMO maintains our comments from (REP5-107) and notes whether “*confirmation form*” should be included under Part 1 Article 1(1)?
- 2.8.9 **DMLs Schedule 11 and 12, Part 2: Article 7(8)(b).** The MMO maintains our comments from (REP5-107) and 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.
- 2.8.10 **DMLs Schedule 11 and 12, Part 2, Article 7(7).** The MMO maintains our comments from (REP5-107) and 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.
- 2.8.11 **Schedules 11 & 12 Part 2, Article 7(9)&(10).** The MMO seeks clarification on “Local Notification”, and that if this is the same information provided at Article 7(8)a then there is a clear reference to that provision.
- 2.8.12 **Schedule 11 and 12: Part 2, Article 7(11).** The MMO maintains our comments from (REP5-107) and notes the Applicant has inserted “*within 5 days*”, the MMO reiterates the request that this should state “*within 24 hours of the notification*”.
- 2.8.13 **DMLs 11 and 12, Part 2, Article 11(10).** The MMO notes that the Applicant was asked by the Maritime Coastguard Agency (MCA) to include the following wording within the MMO’s MLDIR dropped object form for this project: “*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.*” The MMO are content with this addition. The Applicant has removed reference to timings within the conditions of



the DMLs to avoid any contradictions with the form. The MMO has reviewed the updated DML wording (REP5a-002), and the MCA's Deadline 5a Submission (REP5a-028) and confirms that we are happy with the new wording for Condition 11(10), and the associated MLDIR dropped object form.

- 2.8.14 **DMLs Schedule 11 and 12, Part 2, Article 12.** The MMO strongly maintains our comments from (REP5-107). The MMO reinforces its advice 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. This remains a major comment.
- 2.8.15 **DMLs Schedule 11 and 12, Part 2, Article 13(1)(h)(ii).** The MMO notes the Applicant's comments that they consider the term 'Chart Datum' to be a widely used and an understood term. Whilst the MMO considers that adding a definition would add clarity (REP5-107), it is content this is a minor point and can be considered closed.
- 2.8.16 **DMLs Schedule 11 and 12, Part 2, Article 13(1)(j).** The MMO requests the reference to 4 months is updated to 6 months within both the SIP and DMLs. The MMO further maintains the position that a standalone SIP condition would be preferable. The MMO also clarifies, in light of the comments within AS-036 that the intention of the SIP is to capture more accurate details of noise implications from projects, which is why a 6 month period is ideal, it is close enough to the proposed commencement of works to provide an accurate depiction of noise impacts (cumulative from other projects), but a long enough timescale to allow for the review period, and for the impacts to be considered accurately.
- 2.8.17 **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.
- 2.8.18 **Schedule 11 and 12, Part 2, Article 13(8).** The MMO maintains our comments from (REP5-107). *"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."*
- 2.8.19 **DMLs Schedule 11 and 12, Part 2, Article 14.** The MMO maintains our comments from (REP5-107). *"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"*





- 2.8.20 **DMLs Schedule 11 and 12, Part 2, Article 14 (3).** The MMO strongly maintains its position set out in 4.4.36 and 4.4.37 of Deadline 5 (REP5-107) regarding timescales and determination dates. The MMO notes that a decision on the application for a Development Consent Order for The Sizewell C Project was taken on 20 July 2022 and that this decision favoured the MMO's position on the removal of determination dates from the conditions of the DML's.
- 2.8.21 **DML Schedule 11, Part 2, Article 18(1)(b).** The MMO notes that the wording differs from the same provision in Schedule 12.
- 2.8.22 **DML Schedule 12, Part 2, Article 18(4).** The MMO notes that the wording differs from the same provision in Schedule 11.
- 2.8.23 **DMLs Schedule 11 and 12, Part 2, Article 18 (3).** The MMO is satisfied that the Applicant's wording for this condition is appropriate. The MMO considers this point closed.
- 2.8.24 **DMLs Schedule 11, Part 2, Article 23 & Schedule 12 Part 2 Article 25(4).** The MMO notes that a 4 month time scale has been included however the MMO requests a 6 month timescale.
- 2.8.25 **DMLs Schedule 12, Part 2, Article 23.** The MMO maintains the position that the restriction should be "*between 1st August and 31st October each year*".
- 2.9 **Deferred matters from MMO's Deadline 5 [REP5-107] and Deadline 5a [REP5a-027] (Comments on responses to ExQ2):**
- 2.9.1.1 DCO. 2.1: The MMO has reviewed the Applicant's response to this question within REP5-074 and have no comments.
- 2.9.1.2 MC. 2.7: The MMO has provided its updated comments on sediment sampling under Section 1.4.8 and 2.4 of this submission.
- 2.9.1.3 NVL. 2.1: The MMO has provided its updated comments on noise, vibration and Electromagnetic Fields under Section 2.1, 2.2 and 2.3 of this submission.

### 3 Progressed SoCGs and an updated Statement of Commonality of SoCGs

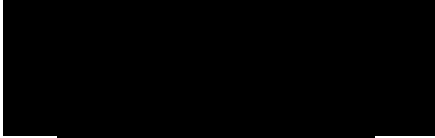
- 3.1 The MMO has worked with the Applicant on an updated SoCG, and believes it is due to be submitted at Deadline 6.

### 4 Any further information requested by the ExA under Rule 17 of the Examination Procedure Rules

- 4.1 The MMO notes the publication of the Rule 17 letter from the examining authority on July 25, 2022. The Action points from the Issue Specific Hearings have been addressed within section 1 of this written submission.



Yours Sincerely



Gregg Smith  
Marine Licencing Case Officer

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## References

Pye, K., Blott, S.J. and Pye, A.L. (2015) *East Riding Beach and Subtidal Sediments: A Preliminary Investigation of Sources and Transport Pathways Based on Multi-Element Composition*. Report to Ch2M Hill and East Riding of Yorkshire Council. KPAL Report EX19066, 16 December 2015.

Russell, F.S. 1976. *The eggs and planktonic stages of British marine fishes*, London: Academic Press. 524 pp.

