Chapter 8: Benthic Subtidal Ecology

Array EIA Report

2024

Version	Comments	Authored by	Reviewed by	Approved by
FINAL	Final	RPS	RPS	RPS

Approval for Issue		
For and on behalf of Ossian OWFL	Paul Darnbrough	28 June 2024

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8. BENTHIC SUBTIDAL ECOLOGY

8.1. INTRODUCTION

1. This chapter of the Array Environmental Impact Assessment (EIA) Report presents the assessment of the likely significant effects (LSE[1]) (as per the "EIA Regulations") on benthic subtidal ecology as a result of the Ossian Array, which is the subject of this application (hereafter referred to as "the Array"). Specifically, this chapter assesses the LSE[1] of the Array on offshore benthic subtidal ecology during the construction, operation and maintenance, and decommissioning phases.

2. Likely significant effect is a term used in both the EIA Regulations and the Habitat Regulations. Reference to LSE[1] in this Array EIA Report refers to LSE[1] as used by the EIA Regulations. This Array EIA Report is accompanied by a Report to Inform Appropriate Assessment (RIAA) (Ossian OWFL, 2024) which uses the term as defined by the Habitats Regulations (LSE[2]).

3. This chapter also summarises information contained within volume 3, appendix 8.1.

8.2. PURPOSE OF THE CHAPTER

4. The Array EIA Report provides the Scottish Ministers, statutory and non-statutory stakeholders with adequate information to determine the LSE[1] of the Array on the receiving environment. This is further outlined in volume 1, chapter 1.

5. The purpose of this benthic subtidal ecology Array EIA Report chapter is to:

- present the existing environmental baseline established from desk studies, site-specific surveys, numerical modelling studies, and consultation with stakeholders;
- identify any assumptions and limitations encountered in compiling the environmental information;
- present the environmental impacts on benthic subtidal ecology arising from the Array and reach a conclusion on the LSE[1] on benthic subtidal ecology, based on the information gathered and the analysis and assessments undertaken; and
- highlight any necessary monitoring and/or mitigation measures which are recommended to prevent, minimise, reduce or offset the likely significant adverse environmental effects of the Array on benthic subtidal ecology.

8.3. STUDY AREA

6. Figure 8.1 illustrates the two benthic subtidal ecology study areas which have been defined for the purpose of this assessment:

- the Array benthic subtidal ecology study area, which is defined as the area encompassed by the site boundary and one mean spring tidal excursion (Figure 8.1). This area is therefore appropriate for assessing impacts associated with the Array, which are highly localised. The site-specific benthic subtidal ecology surveys were undertaken within the site boundary, the results of which were used to inform the baseline characterisation and identify benthic receptors which could potentially be impacted by the Array; and
- the regional benthic subtidal ecology study area, which is defined as the area encompassing the wider North Sea (Figure 8.1). The boundaries for this regional benthic subtidal ecology study area were adapted from the Sectoral Marine Plan (SMP) Assessment region: East Region. The regional benthic subtidal ecology study area boundary to the south of the site boundary was extended to take account of feedback received during the pre-Scoping workshop (14 November 2022) (see Table 8.5) suggesting that the regional benthic subtidal ecology study area was not large enough to account for both direct and indirect effects. Desktop data sources have been used to characterise the regional benthic subtidal ecology study area, to provide wider context to the site-specific data collected within the Array benthic subtidal ecology study area.

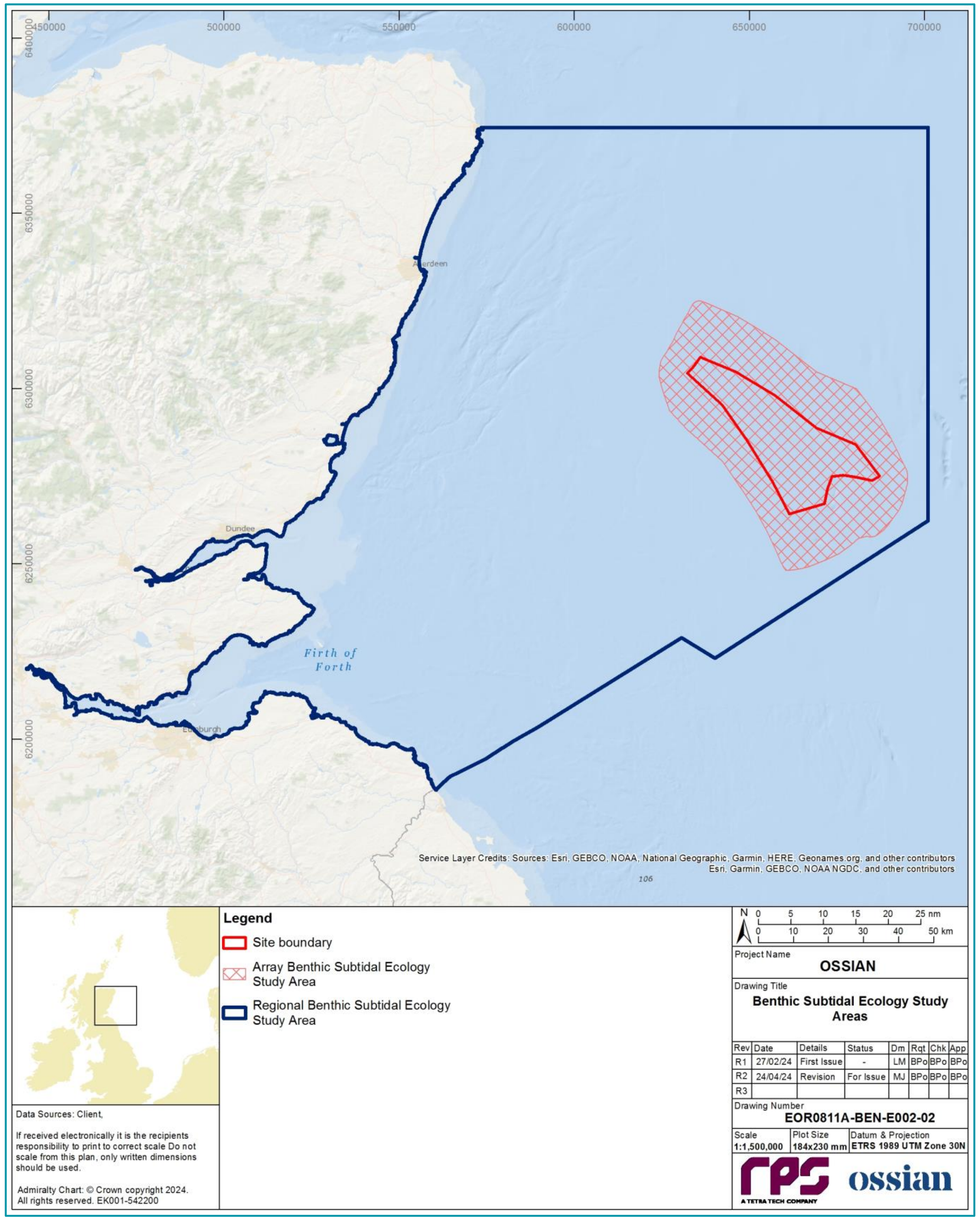


Figure 8.1: Benthic Subtidal Ecology Study Areas

8.4. POLICY AND LEGISLATIVE CONTEXT

7. Volume 1, chapter 2 of the Array EIA Report presents the policy and legislation of relevance to renewable energy infrastructure. Policy specifically in relation to benthic subtidal ecology is contained in the SMP for

Offshore Wind Energy (Scottish Government, 2020a)[1], the Scottish National Marine Plan (NMP) (Scottish Government, 2015), and the United Kingdom (UK) Marine Policy Statement (MPS) (UK Government, 2011). Table 8.1 presents a summary of the legislative provisions relevant to benthic subtidal ecology, with relevant policy provisions set out in Table 8.2 to Table 8.4.

8. Further detail is presented in volume 1, chapter 2.

Table 8.1: Summary of Habitat Regulations (Conservation of Offshore Marine Habitats and Species Regulations 2017and Conservation of Habitats and Species Regulations 2017) of Relevance to Benthic Subtidal Ecology

Summary of Relevant Legislation	How and Where Considered in the Array EIA Report
Designated Sites	
A competent authority must make an appropriate assessment of the implications of the Array (both alone and cumulatively with other plans and projects) upon European sites in view of the sites' conservation objectives. This must be done prior to deciding to undertake, or give consent, permission or other authorisation for a plan or project which is to be carried out in on or in any part of the water and/or seabed comprising the offshore marine area.	Relevant European sites have been considered in section 8.7.2, with their distances to the Array presented in Table 8.10. There are considerable distances between the Array and these identified sites, and thus no pathway to impact was identified. Section 8.9.3 provides justification on the decision to scope out the effect of the Array on designated sites with benthic subtidal qualifying features.

Table 8.2: Summary of the SMP for Offshore Wind Energy Relevant to Benthic Subtidal Ecology (Scottish Government, 2020a)

Summary of Relevant Policy	How and Where Considered in the Array EIA Report
Offshore Wind and Marine Renewable Energy Policy	
Regional cumulative effects should include the potential for adverse effects on benthic habitats, bird populations, cetaceans, navigational safety, seascape, landscape, and commercial fisheries. The SMP for Offshore Wind Energy includes measures to mitigate likely significant effects at various scales. (4.1)	This chapter includes a Cumulative Effects Assessment (CEA), which considers the impacts of the Array alongside other plans, projects, and activities (see section 8.12).

Table 8.3: Summary of the Scottish NMP Relevant to Benthic Subtidal Ecology (Scottish Government, 2015)

Summary of Relevant Policy	How and Where Considered in the Array EIA Report
General Policies	
Development and use of the marine environment must: • comply with legal requirements for protected areas and protected species (including designated sites); • not result in significant impacts on the national status of Scottish Priority Marine Features (PMFs); and • protect and enhance (where appropriate) the health of the marine area. (GEN 9)	Protected areas, species, and PMFs have been identified in Table 8.10 and Table 8.11. These have been included as Important Ecological Features (IEFs) in the assessment of significance for the Array alone (section 8.11) and cumulatively with other plans and projects (section 8.12).
The management requirement of protected sites must be met. These include Marine Protected Areas (MPAs) and Special Areas of Conservation (SACs), as well as former Natura 2000 sites and the marine components of Sites of Special Scientific Interest (SSSIs) and Ramsar sites. (4.41-4.50)	Protected sites relevant to benthic subtidal ecology have been considered in section 8.7.2, with distances to the Array presented in Table 8.10. There are considerable distances between the Array and these identified sites, and thus no pathway to impact was identified. Section 8.9.3 provides justification on the decision to scope out the effect of the Array on designated sites with benthic subtidal qualifying features.
The Marine Act requires all regulators to ensure that there is no significant risk of hindering the achievement of the conservation objectives of a MPA before giving consent to an activity, plan, or project. A management intervention will be required if an ongoing activity presents a significant risk of hindering the achievement of a MPAs conservation objectives. This intervention will be practical and proportionate, using the most appropriate statutory mechanism to reduce the risk. (4.47)	As per the row above, MPAs relevant to benthic subtidal ecology have been considered in section 8.7.2, with distances to the Array presented in Table 8.10. There are considerable distances between the Array and the identified MPA, and thus no pathway to impact was identified. Section 8.9.3 provides justification on the decision to scope out the effect of the Array on MPAs with benthic subtidal qualifying features.
Opportunities to reduce the risk of introduction of Invasive Non Native Species (INNS) to a minimum or proactively improve the practice of existing activities should be taken. (GEN 10)	The effects associated with INNS upon benthic subtidal ecology have been assessed in section 8.11. In addition, an INNS Management Plan (INNSMP) (volume 4, appendix 21, annex B) has been included as a designed in measure, which will detail actions to reduce the risk of introduction and spread of INNS during all phases of the Array as far as reasonably practicable (Table 8.17).
Cumulative impacts affecting the ecosystem of the marine plan area should be addressed as part of the decision making and plan implementation process. (GEN 21)	This chapter includes a CEA, which considers the impacts of the Array alongside other plans, projects, and activities (see section 8.12).
Offshore Wind and Marine Renewable Energy Policy	
Marine planners and decision makers should support the development of joint research and monitoring programmes for their offshore wind and marine renewable energy developments. (RENEWABLES 9)	The proposed need for monitoring is addressed in section 8.13.

[1] At the time of writing, the SMP is subject to an iterative review process, therefore, the information provided within this chapter is based upon the SMP published by the Scottish Government in 2020.

Table 8.4: Summary of the UK MPS Relevant to Benthic Subtidal Ecology (UK Government, 2011)

Summary of Relevant Policy	How and Where Considered in the Array EIA Report
General Policies	
Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species, and heritage assets. (Introduction)	The magnitude of impacts and the sensitivity of IEFs are assessed in section 8.11 to determine if impacts would represent significant change from the baseline and if the effect on the IEF is likely to be significant as a whole. The effect of a shifting baseline due to climate change in the absence of the Array is discussed in section 8.7.4. Designed in measures adopted as part of the Array are listed in Table 8.17, which aim to reduce impacts to benthic subtidal ecology as far as reasonably practicable.
Biodiversity is protected, conserved, and recovered (where appropriate), and biodiversity loss has been halted. (2.2)	As per the row above.

8.5. CONSULTATION

9. Table 8.5 presents a summary of the key issues raised during consultation activities undertaken to date specific to benthic subtidal ecology for the Array, including advice received in the Ossian Array Scoping Opinion (Marine Directorate – Licensing Operations Team (MD-LOT), 2023), along with how these have these have been considered in the development of this benthic subtidal ecology Array EIA Report chapter. Further detail is presented within volume 1, chapter 5.

Table 8.5: Summary of Issues Raised During Consultation and Scoping Opinion Representations Relevant to Benthic Subtidal Ecology

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Pre-Scoping Workshop			
November 2022	NatureScot, MD-LOT, Marine Directorate – Science, Evidence, Data and Digital (MD-SEDD) (formerly known as Marine Scotland Science (MSS) at the time of consultation)	Scoping out effects to benthic subtidal ecology due to Suspended Sediment Concentrations (SSCs) and associated deposition, changes to physical processes, and INNS were discussed. No objection was raised to scoping these out subject to presentation of the information within the Array EIA Scoping Report. Scoping out effects to benthic ecology due to Electromagnetic Fields (EMF) was also discussed, with further evidence to support this provided in Table 6.5 of the Array EIA Scoping Report.	Impacts to benthic ecology due to SSCs and associated deposition, INNS, and EMFs have since been scoped into the assessment due to responses to the Scoping Opinion (see rows below and Table 8.12). Impacts due to changes in physical processes continue to be scoped out (Table 8.13).
		Concern that the regional benthic subtidal ecology study area presented in the Array EIA Scoping Report was not large enough to account for both direct and indirect effects was raised.	The regional benthic subtidal ecology study area was extended southwards to accommodate direct and indirect effects (Figure 8.1).
Scoping Opinion (MD-LOT, 2023)			
June 2023	MD-LOT	*"The Scottish Ministers note that the Scoping Report only describes the offshore array components of the Proposed Development. The Scottish Ministers have considered the concerns raised in the representation from East Lothian Council regarding the appropriateness of considering the offshore array area separate to the offshore export cable works and onshore works and the intention by the Developer to submit separate Scoping Reports to assess these elements. However, the Scottish Ministers understand that due to the ongoing National Grid Holistic Network Design Follow Up Exercise and the potential for third party involvement, the grid connection for the Proposed Development is currently unknown. It therefore may not be possible to submit the onshore EIA, or the EIA for the offshore export cable infrastructure at the same time as the EIA for the Proposed Development. If this is the case, it is essential that sufficient information concerning proposed offshore export cable works and onshore works is included in the EIA Report to understand the cumulative impacts of the Proposed Development. This will ensure that as much information as possible relating to the project as a 'whole' is presented."*	The Proposed offshore export cable corridor(s) and Proposed onshore transmission infrastructure have been included as a Tier 1 project in the CEA (see section 8.12).
June 2023	MD-LOT	*"Any cable protection to be used to protect the inter-array cables must be assessed in the EIA Report including details on materials, quantities and location. In addition, any seabed levelling or removal of substances or objects from on or under the seabed, required for installation of inter-array cables will require consideration in the EIA Report and may require a marine licence. Should seabed preparation involve dredging, the EIA Report must identify the quantities of dredged material and identify the likely location for deposit. The Developer may also be required to submit pre-dredge sample analysis, this should include supporting characterisation of the new or existing deposit sites."*	Based on the results of the site-specific geophysical surveys, significant sand waves and bedforms were not recorded within the site boundary. It is expected that dredging will not be required as part of seabed preparation and so is not considered further within this chapter. The Project Description which includes reference to cable protection, seabed levelling and removal of substances or objects required for inter-array cable installation is provided in volume 1, chapter 3.
June 2023	Scottish Fishermen's Federation (SFF) Scoping Representation (April 2023)	*"Page 45, Table 6.2: "Potential Impacts Identified for Benthic Subtidal Ecology in the Absence of Designed In Measures", of the document fails to scope in the boulder relocation effects since the study show boulder exist in the project's site. The SFF recommend that boulder relocation should be scoped into the EIA report."*	Information on boulder clearance and relocation has been included in the Maximum Design Scenario (MDS) (Table 8.12). The Project Description is provided in volume 1, chapter 3.
	MD-LOT	*"The Scoping Report at Section 2.3.8 identifies that boulders may be present at the site of the Proposed Development. The EIA Report must provide the anticipated estimate of boulders to be cleared (including how much uncertainty may be associated with the figures presented). Clear narrative must be provided within the EIA Report to show how this has been estimated."*	

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
June 2023	NatureScot Scoping Representation (May 2023)	*"Wet storage could represent a very significant impact pathway with respect to floating wind. It is unclear from the Scoping Report if there are any plans for wet storage of assembled and/or component parts of floating turbines in the construction, and operation and maintenance phases, and what this would entail or potential locations identified. Consideration of wet storage, including potential impacts on receptors, needs to be addressed with the forthcoming EIA Report and HRA."*	The location of the final integration and marshalling port is currently unknown. Ossian OWFL (hereafter referred to as 'the Applicant') are currently developing a fabrication, delivery and integration strategy and engaging with a number of port and harbour operators to identify an optimised approach. In the absence of an integration and marshalling yard it is not possible, at this stage, to consider the potential site-specific impacts on relevant receptors. Enabling works, including integration, and marshalling activities, required within the final integration port to cover turbine pre-commissioning, testing and storage (if required) will be covered by the consenting requirements applying to them (including any requirements for environmental assessment) and will be managed by the port or harbour authority with support where appropriate from the Applicant. The Ossian construction programme will be managed to reduce the requirement for storage of integrated pre-commissioned turbines within port. A stock of floating foundations will be accumulated, and mooring lines and cables would be installed within the array in advance of turbine integration. The Applicant aims to minimise any wet storage requirements by towing integrated turbines to their final location within the array as soon as they are ready, subject to suitable weather conditions for transfer. Temporary offshore wet storage has been included in the MDS for applicable impacts (Table 8.12) and assessed where relevant. There is uncertainty over the location of the final integration port which makes meaningful assessment difficult.
	MD-LOT	*"Wet storage is also a potentially significant impact pathway in respect of the Proposed Development identified by NatureScot in its representation. The Scottish Ministers advise that, if there is potential for wet storage of floating wind turbines (whether fully assembled or in component parts), this must be detailed and consideration of impacts on receptors must be addressed within the EIA Report and HRA."*	
June 2023	MD-LOT	*"Matters are not scoped out unless specifically addressed and justified by the Developer and confirmed as being scoped out by the Scottish Ministers. The matters scoped out should be documented and an appropriate justification noted in the EIA report."*	Impacts scoped out are fully described in section 8.8.2.
June 2023	Scottish Environmental Protection Agency (SEPA) Scoping Representation (March 2023)	*"Many operations could potentially give rise to risk of pollution through silt mobilisation, silt suspension or chemical or oil spillages. To prevent pollution and safeguard marine ecology interests it is vital that good working practice is adopted, and appropriate steps taken to prevent water pollution and minimise disturbance to sensitive receptors. Measures need to be in place to minimise the release of sediment plumes and to contain and prevent construction and waste materials e.g. paint from falling from a structure into the water body beneath. Where appropriate, mitigation measures should be sought within method statements and onsite compliance should be confirmed through site visits."*	Designed in mitigation applicable to benthic subtidal ecology is detailed in section 8.10, and has been considered in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively).

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
June 2023	NatureScot Scoping Representation (May 2023)	*"We welcome the designed in measures described in section 6.1.5. We advise that the full range of mitigation measures and published guidance is considered and discussed in the EIA Report. This should specifically include Micro-siting of infrastructure around sensitive habitats (if any are subsequently found); Cable Plan and Cable Burial Risk Assessment for the inter-array cables; Scour Protection Management Plan (for the anchors, piles, rock placement, mattresses and any other infrastructure on the seabed)."* *"The EIA Report must clearly articulate those mitigation measures that are informed by the EIA (or HRA) and are necessary to avoid or reduce predicted significant adverse environmental effects of the proposed development. We advise that the full range of mitigation and monitoring measures, and published guidance, are considered and discussed in the EIA Report. "*	Designed in mitigation applicable to benthic subtidal ecology is detailed in section 8.10, and has been considered in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively). No additional mitigation measures are considered to be required, following the conclusion of these assessments.
June 2023	MD-LOT	*"The Developer has committed to several mitigation plans, including but not limited to a Vessel Management Plan, Fisheries Management and Mitigation Strategy, a Marine Pollution Contingency Plan, a Marine Mammal Mitigation Protocol and a mitigation commitment register as an appendix to the Scoping Report, summarising the mitigation commitments for each receptor. Any embedded mitigation relied upon for the purposes of the assessment should be clearly and accurately explained in detail within the EIA Report. The likely efficacy of the mitigation proposed should be explained with reference to residual effects. The EIA Report must identify and describe any proposed monitoring of significant adverse effects and how the results of such monitoring would be utilised to inform any necessary remedial actions."* *"The EIA Report must include a Table of mitigation which corresponds with the mitigation identified and discussed within the various chapters of the EIA Report and accounts for the representations and advice attached in Appendix I."*	Designed in mitigation applicable to benthic subtidal ecology is detailed in section 8.10, and has been considered in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively).
June 2023	SFF Scoping Representation (April 2023)	*"Specific emphasis should be given on scoping in the "Effects to benthic subtidal ecology due to accidental pollution" during all phases. In terms of "Effects to benthic subtidal ecology due to EMF" the SFF believe that this should be scoped in because there is no sufficient practical demonstration that there are no effects. The developer should provide ongoing monitoring of EMF effects to further the science."*	Effects to benthic ecology from EMFs, INNS, and increased SSCs were scoped back into the assessment (see Table 8.12). These impacts have been assessed qualitatively within section 8.11 in accordance with NS advice. With regards to increased SSC this has been scoped into the assessment for all project phases It should be noted that this approach differs to the assessment presented for physical processes (volume 2, chapter 7), wherein consultation only requested this impact to be considered in the operation and maintenance phase only. Boulder relocation is considered as part of seabed preparation activities for the impact of 'Temporary habitat loss and disturbance'. However, accidental pollution was not included due to low pathway for impact (given low sediment contamination levels within the Array) and due to the designed in mitigation to reduce the risk of accidental pollution. See Table 8.13 for further detail on the impacts scoped out of the assessment.
June 2023	NatureScot Scoping Representation (May 2023)	*"Table 6.4 summarises the impacts to be scoped into the benthic subtidal ecology assessment, and Table 6.5 the impacts proposed to be scoped out of assessment. We broadly support the proposed approach; however we do not support scoping out of: Increased SSCs and associated deposition; Increased risk of introduction and spread of INNS; and EMF."* *We highlighted these impact pathways in the relevant Scoping Workshop discussions and advised that these should be scoped in. For each pathway there is uncertainty around potential impacts on benthic species, including PMFs. In our view they should therefore be scoped into the assessment, even if this is through a qualitative assessment.*	
June 2023	MD-LOT	*"The Scottish Ministers disagree that 'Increase in SSCs and associated deposition due to operation and maintenance activities', 'Impacts to seasonal stratification due to the presence of infrastructure' and 'Impacts to the sediment transport and sediment transport pathways due to the presence of infrastructure' are scoped out of the EIA Report. These three impact pathways must be scoped in for further assessment. Any justification for scoping this receptor out, must be included within the EIA Report."*	

<table>
<tr><th>Date</th><th>Consultee and Type of Consultation</th><th>Issue(s) Raised</th><th>Response to Issue Raised and/or Where Considered in this Chapter</th></tr>
<tr><td rowspan="2"></td><td></td><td>"Table 6.4 of the Scoping Report summarises the impacts to be scoped into the EIA Report for the benthic subtidal ecology for each phase of the Proposed Development. The Scottish Ministers agree with the impacts scoped into the EIA Report, however, in line with NatureScot representation, advise that effects to benthic subtidal ecology due to electromagnetic fields, increased risk of introduction and spread of Invasive Non-Native Species ("INNS") and increased suspended sediment concentrations and associated deposition should be scoped into the EIA Report. The Scottish Ministers further advise that the representation from SFF regarding boulder relocation and accidental pollution must be fully considered by the Developer."</td><td rowspan="2"></td></tr>
<tr><td>MD-SEDD Scoping Representation (June 2023)</td><td>For the physical processes assessment, MD-SEDD advised to scope out 'increased SSCs and associated deposition' due to construction and decommissioning activities as the justification provided in the EIA Scoping Report was considered adequate. However, MD-SEDD advised to scope this impact in for the operation and maintenance phase for the physical processes assessment.</td></tr>
<tr><td rowspan="2">June 2023</td><td rowspan="2">NatureScot Scoping Representation (May 2023)</td><td>"We recommend that the assessment should quantify, where possible, the likely impacts to key benthic ecology PMFs. It should assess whether these could lead to a significant impact on the national status of the PMFs being considered."</td><td rowspan="2">PMFs have been identified in Table 8.11 and have been assessed in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively).</td></tr>
<tr><td>"We highlighted these impact pathways in the relevant pre-Scoping workshop discussions and advised that these should be scoped in. For each pathway there is uncertainty around potential impacts on benthic species, including PMFs. In our view they should therefore be scoped into the assessment, even if this is through a qualitative assessment."</td></tr>
<tr><td>June 2023</td><td>MD-LOT</td><td>"In regards to the approach to assessment, the Scottish Ministers advise that the assessment should quantify where possible the likely impacts to key Priority Marine Features ("PMFs") and consider whether this could lead to a significant impact on the national status of the PMFs being considered. This view is in line with NatureScot representation."</td><td>PMFs have been identified in Table 8.11 and have been assessed in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively).</td></tr>
<tr><td>June 2023</td><td>NatureScot Scoping Representation (May 2023)</td><td>"No specific monitoring for benthic subtidal ecology is mentioned in the Mitigation and Monitoring Commitments Register in the EIA Scoping Report (Appendix 2). Further information on proposed benthic subtidal ecology monitoring should be discussed in the EIA Report."</td><td>Designed in mitigation applicable to benthic subtidal ecology is detailed in section 8.10, and has been considered in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively). Proposed monitoring is provided in section 8.13.</td></tr>
<tr><td>June 2023</td><td>MD-LOT</td><td>"In regards to mitigation and monitoring, the full range of mitigation measures and published guidance should be considered within the EIA Report, including those specifically outlined by NatureScot in its representation. If any sensitive habitats are identified at a later date, micro-siting or other mitigation will be required. The Scottish Ministers further advise that monitoring should be discussed in the EIA Report, including consideration of EMF and INNS monitoring. Consideration should also be given to the SFF representation regarding habitat loss and disturbance."</td><td>Designed in mitigation applicable to benthic subtidal ecology is detailed in section 8.10, and has been considered in the assessment of significance for each effect in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively). Proposed monitoring is provided in section 8.13.</td></tr>
<tr><td>June 2023</td><td>NatureScot Scoping Representation (May 2023)</td><td>"We are broadly content with the proposed approach to cumulative assessment described in section 6.1.8. This section states that effects from the Array on benthic receptors are likely to be localised to within the footprint of the Array. Further consideration is needed on the potential for cumulative impacts to occur across a larger scale, even if the project alone impacts do not overlap spatially. For example, impacts from EMF are likely to be localised, however given the scale of potential wind farm development across this region each with associated dynamic and or inter array as well as interconnector and export cables it is possible that a 'network' or 'barrier' effect from EMF effects could impact migrating species. This requires further consideration."</td><td>A highly precautionary screening buffer of 50 km was used to identify relevant projects within the CEA (see section 8.12.1).</td></tr>
</table>

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
June 2023	MD-LOT	*"In regards to the cumulative impacts, the Scottish Ministers advise, in line with the NatureScot representation, that the Developer should give consideration in the EIA Report to the potential for cumulative impacts across a wider area than impacts which spatially overlap with those of the Proposed Development given wider offshore wind development across the region. This may include the potential for 'network' or 'barrier' effects to migrating species."*	
June 2023	NatureScot Scoping Representation (May 2023)	*"We recommend early consideration of potential Positive Effects for Biodiversity as well as nature inclusive design aspects at an early stage and following through into the EIA Report. We acknowledge that, whilst not policy, these aspects form part of our ability to address both the climate and biodiversity crises and as such we encourage developers to consider this as part of their application."*	Potential increases in biodiversity have been assessed in the impact of 'colonisation of hard structures' as part of the assessment of significance in the Array alone assessment and within the CEA (sections 8.11 and 8.12, respectively).
June 2023	NatureScot Scoping Representation (May 2023)	*"We recommend that this study area is re-defined as the site boundary plus one tidal excursion, as per the physical processes assessment. This will ensure that any impacts which range over this distance (e.g. sedimentation) are fully considered."* *"This study area sets the development into the context of the wider east-of Scotland. We note that this is a very large area, extending well beyond any likely impacts and suggest that a smaller area may be more appropriate."*	The Array benthic subtidal ecology study area has been extended to one mean spring tidal excursion as per the physical processes assessment (Figure 8.1). However, it should be noted that due to the lack of desktop data available within one tidal excursion, the baseline has largely been characterised by the results of the site-specific surveys (Table 8.7) and by data from the wider regional benthic subtidal ecology study area. As per a concern raised during the pre-Scoping workshop (see first rows in this table), the regional benthic subtidal ecology study area was increased southwards, in order to accommodate direct and indirect effects. Given the inclusion of the Proposed offshore export cable corridor(s) in Tier 1 of the CEA, a wider regional benthic subtidal ecology study area is more appropriate than if it was to be reduced.
June 2023	MD-LOT	*"The Scottish Ministers, in line with NatureScot representation, advise that the Array benthic subtidal ecology study area as described in section 6.1.2 of the Scoping Report is re-defined as the site boundary plus one tidal excursion and that consideration should also be given to narrowing the regional benthic ecology study area."*	
June 2023	NatureScot Scoping Representation (May 2023)	*"Appendix 8 section 8.3.4 focuses mainly on commercial shellfish species and should be updated to include other shellfish species that may be in the study area such as flame shell, etc, which are PMFs and will require consideration."*	Flame shell *Limaria hians* has not been considered within the assessment due to the distinct lack of records on the entire east coast of Scotland reported by Tyler-Walters *et al.* (2016) and on the National Biodiversity Network (NBN) Atlas (NBN Atlas, 2024). Further, no flame shells or flame shell beds were identified in the site-specific benthic survey. As such, this species has not been included in the assessment on benthic subtidal ecology or fish and shellfish ecology (volume 2, chapter 9).
June 2023	NatureScot Scoping Representation (May 2023)	*"We recommend the use of eDNA surveys within the offshore windfarm array area (and export cable corridor route) to help provide information on benthic subtidal ecology. This method may potentially offer significant benefits over traditional sampling methods that may be advantageous for the future of environmental monitoring. However, eDNA is still a relatively novel method of sampling with limited studies on its effectiveness."*	Site-specific environmental Deoxyribonucleic Acid (eDNA) sampling will be considered for the Proposed offshore export cable corridor(s) to inform its baseline. However, eDNA sampling will not be undertaken for the Array, as agreed upon with NatureScot on 24 January 2024 via email (see volume 3, appendix 5.1 annex A).
June 2023	MD-LOT	*"The Scottish Ministers are broadly content with the data sources used to characterise the baseline as listed by the Developer in Section 6.1.2 of the Scoping Report, however, highlight the representation from NatureScot and recommend the use of environmental DNA ("eDNA") surveys within the area of the Proposed Development to expand information on benthic subtidal ecology."*	

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Relevant Consultation to Date			
January 2024	NatureScot (email communication)	*We advise:* • *since the [eDNA] Technical Note was written, further papers have been published on the use of eDNA, including specifically Natural Power (2023);* • *in our view, this paper supports the use of eDNA in establishing a site-specific baseline for fish & shellfish ecology, when compared to traditional trawl sampling or historic fisheries data and as such we welcome and promote use of eDNA sampling for baseline characterisation efforts; however; in this instance, we accept the existing methods used to characterise the array area, and welcome consideration of eDNA sampling to help inform characterisation of the export cable corridor route."*	Site-specific eDNA sampling will be conducted for the Proposed offshore export cable corridor(s) and will be used to inform its baseline. However, eDNA sampling will not be undertaken for the Array, as agreed upon with NatureScot on 24 January 2024 via email (see volume 1, chapter 5, appendix 5.1 for all stakeholder engagement and consultation notes).

8.6. METHODOLOGY TO INFORM BASELINE

10. Topic specific information has been reviewed and analysed to inform this benthic subtidal ecology baseline. In addition, consultation with stakeholders and Statutory Nature Conservation Bodies (SNCBs) has been carried out to aid the collection of baseline information.

8.6.1. DESKTOP STUDY

11. Information on benthic subtidal ecology within the regional benthic subtidal ecology study area was collected through a detailed desktop review of existing studies and datasets which are summarised in Table 8.6.

12. Both the literature review of the reports and numerical modelling using the datasets were used to characterise the baseline. The benthic subtidal ecology technical report (volume 3, appendix 8.1) includes full details of the analysis undertaken to develop the benthic subtidal ecology baseline.

Table 8.6: Summary of Key Desktop Reports

Title	Source	Extent	Year	Author
European Marine Observation and Data Network (EMODnet) broad-scale seabed habitat map for Europe (EUSeaMap)	EMODnet – Seabed Habitats	2021	2023	EMODnet
MPA Mapper	Joint Nature Conservation Committee (JNCC)	2020	2023	JNCC
The Marine Scotland National Marine Plan Interactive (NMPi) maps	MSS/MD-SEDD	Not Applicable (N/A)	2023	NMPi
Berwick Bank Wind Farm Offshore EIA Report: Chapter 8 Benthic Subtidal and Intertidal Ecology	Berwick Bank Offshore Wind Farm	2020	2022	SSE Renewables
Environmental Statement – Neart na Gaoithe, Chapter 14 Benthic Ecology	Neart na Gaoithe Offshore Wind Farm	2009	2019	Mainstream Renewable Power
Offshore Environmental Statement, Volume 1B: Biological Environment, Chapter 12 Benthic Ecology	Inch Cape Offshore Wind Farm	2012	2018	Inch Cape Offshore Wind Limited
A big data approach to macrofaunal baseline assessment, monitoring and sustainable exploration of the seabed	Centre for Environment, Fisheries and Aquaculture Science (Cefas)	1969 to 2016	2017	Cooper and Barry
Kincardine Offshore Wind Farm – Environmental Statement	Kincardine Offshore Wind Farm	2013 to 2014	2016	Kincardine OWF Limited
Environmental Survey Report	Hywind Offshore Wind Farm	2013	2015	Statoil
Analysis of seabed imagery from the 2011 survey of the Firth of Forth Banks Complex, the 2011 International Bottom Trawl Survey (IBTS) Q4 survey and additional deep-water sites from MSS surveys	JNCC	2011	2014	Axelsson *et al.*
Mapping habitats and biotopes to strengthen the information base of Marine Protected Areas in Scottish waters, Phase 2 (Eastern Approaches to the Firth of Forth)	JNCC	2011	2014	Sotheran and Crawford-Avis
Biotope assignment of grab samples from four surveys undertaken in 2011 across Scotland's seas	JNCC	2011	2014	Pearce *et al.*
Mapping habitats and biotopes from acoustic datasets to strengthen the information base of Marine Protected Areas in Scottish Waters	JNCC	2011	2013	Sotheran and Crawford-Avis
Environmental Impact Statement. Volume 1, Chapter 11 Benthic Ecology and Intertidal Ecology	Seagreen 1 and Seagreen 1A	2011	2012	Seagreen Wind Energy Limited

8.6.2. IDENTIFICATION OF DESIGNATED SITES

13. A three-step process was used to identify all designated sites within the regional benthic subtidal ecology study area and qualifying interest features that could be affected by the construction, operation and maintenance, and decommissioning phases of the Array. This process is described below:

- Step 1: All designated sites of international, national, and local importance within the regional benthic subtidal ecology study area were identified using a number of sources. These sources included JNCC (2023) and NMPi (2023).
- Step 2: Information was compiled on the relevant benthic subtidal ecological features for each of these sites as follows: Firth of Forth Banks Complex MPA, Berwickshire and North Northumberland Coast SAC, Firth of Tay and Eden Estuary SAC, and Isle of May SAC.
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - a designated site directly overlaps with the Array and therefore has the potential to be directly affected by the Array; or
  - sites and associated features were located within the benthic subtidal ecology Zone of Influence (ZoI) for impacts associated with the Array. The ZoI varies for the different impacts scoped in for assessment and refers to the area in which benthic subtidal ecology could be impacted as a result. For all direct impacts, the ZoI is represented by the Array benthic subtidal ecology study area, and for indirect impacts associated with SSCs, the ZoI is represented by one tidal excursion. As dominant current direction of north/south is evident, a mean spring tidal excursion of 8 km has been determined for these directions, reducing to 4 km for the east/west tidal regime, thus representing the ZoI for this impact.

8.6.3. SITE-SPECIFIC SURVEYS

14. Site-specific surveys were undertaken, as agreed following consultation with MD-LOT and NatureScot, to inform the benthic subtidal ecology Array EIA Report chapter (see Table 8.5 for further details). A summary of the surveys undertaken used to inform the benthic subtidal ecology assessment of effects is outlined in Table 8.7.

Table 8.7: Summary of Site-Specific Survey Data Collected

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
Geophysical survey	Array benthic subtidal ecology study area	Geophysical survey to characterise the benthic environment (including sediment classification, bathymetry, etc.), and superficial geology within the Array benthic subtidal ecology study area	Ocean Infinity	2022	Volume 3, appendix 8.1, annex A
Environmental survey	Array benthic subtidal ecology study area	Benthic subtidal survey to characterise the benthic environment within the Array benthic subtidal ecology study area. Involves grab sampling, Drop Down Video (DDV), and epibenthic beam trawling.	Ocean Infinity	2022	Volume 3, appendix 8.1, annex A

8.7. BASELINE ENVIRONMENT

8.7.1. OVERVIEW OF BASELINE ENVIRONMENT

15. The following sections provide a summary of the benthic subtidal ecology baseline environment. The benthic subtidal ecology technical report, volume 3, appendix 8.1, includes full details of the analysis undertaken to develop the baseline and information on benthic subtidal ecology.

Regional Benthic Subtidal Ecology Study Area

16. The regional benthic subtidal ecology study area was characterised through a desktop review of key literature sources (presented in Table 8.6). Broadscale seabed substrate data indicates that, in terms of EMODnet sediment classifications, the regional benthic subtidal ecology study area is dominated by deep circalittoral sand (A5.27) and is interspersed with deep circalittoral coarse sediment (A5.15), which is characteristic of the North Sea (EMODnet, 2023) (Figure 8.2). Other low energy habitats, such as deep circalittoral mud and circalittoral mixed sediments are recorded along the coast and within the Firth of Forth (EMODnet, 2023). Finer sediments, moderate energy circalittoral rock, circalittoral mixed sediments, and circalittoral sandy mud were recorded further inshore (EMODnet, 2023).

17. There were a diverse range of benthic species and communities identified within the regional benthic subtidal ecology study area by Axelsson *et al.* (2014), Pearce *et al.* (2014), Sotheran and Crawford-Avis (2013), Sotheran and Crawford-Avis (2014) and Cooper and Barry (2017), and from site-specific surveys undertaken for other offshore wind farms (see volume 3, appendix 8.1 for a full account and Table 8.8 for a summary). However, it should be noted that these datasets were based on areas further inshore and with more heterogenous sediment composition than that of the Array benthic subtidal ecology study area. Species and communities identified in the data sources listed in Table 8.6 and in the site-specific survey for the Array include polychaetes (particularly bristleworm *Spiophanes bombyx*), dead man's fingers *Alcyonium digitatum*, and various echinoderms and bryozoans (such as hornwrack *Flustra foliacea*). A brief summary of the results of the site-specific surveys for the Array is provided in the paragraph 18 to 24.

Table 8.8: Overview of Benthic Subtidal Communities from other Projects within the Regional Benthic Subtidal Ecology Study Area

Project	Minimum Distance to Array Benthic Subtidal Ecology Study Area (km)	Community Overview	Source
Seagreen Alpha and Seagreen Bravo (now referred to as Seagreen 1 Offshore Wind Farm and Seagreen 1A Project, respectively)	50.72	**Seagreen 1 Offshore Wind Farm:** The sabellid polychaetes 'dense Chone' and 'sparse Chone', dominate the central and eastern regions. Sabellaria sp., 'sparse polychaetes and bivalves', and 'faunal turf' present in the western area. **Seagreen 1A Project:** 'Dense Chone' and 'rich polychaetes' present in the eastern area. Sabellaria sp., 'rich polychaetes and bivalves', and 'epifauna with polychaetes' present in the western area.	Seagreen Wind Energy Limited (2012)
Berwick Bank Offshore Wind Farm	56.77	Northern areas dominated by pea urchin *Echinocyamus pusillus*, polychaete and bivalve communities and patches of super-abundant brittle star *Amphiura filiformis.* Bivalves dominated the central and eastern areas and a patch in the west. Polychaete-rich deep *Venus* communities were present in the western area.	SSE Renewables (2022)
Kincardine Offshore Wind Farm	61.60	Offshore deep circalittoral habitats with fine sands or non-cohesive muddy sands throughout the study area. Frequently observed species were the coral *A. digitatum,* the common starfish *Asterias rubens*, and bryozoans (such as *F. foliacea*).	Kincardine OWF Limited (2016)
Hywind Offshore Wind Farm	72.00	Fauna at the wind turbine site area were mainly associated with sandy habitats (offshore circalittoral sand: SS.SSa.OSa). Three different Annex I reef habitats were recorded: stony reefs, bedrock reefs, and Ross worm *Sabellaria spinulosa* reefs.	Statoil (2015)
Inch Cape Offshore Wind Farm	86.90	Circalittoral sands and gravelly sands with areas of mixed sediment, with species typical of these sediments, such as *A. digitatum, F. foliacea*, echinoderms *Ophiothrix fragilis* and *A. rubens,* hydroids (e.g. *Hydrallmania falcata*), and the keel worm *Spirobranchus triqueter.* The dominating biotype was *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.MysThyMx), which covered 65% of the area. Offshore circalittoral coarse sediment (SS.SCS.OCS) covered 31% and *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel (SS.SCS.MedLumVen) covering 4%. Several *Sabellaria* spp., individuals were reported, but no evidence of Annex I reefs was observed.	Inch Cape Offshore Limited (2018)

Project	Minimum Distance to Array Benthic Subtidal Ecology Study Area (km)	Community Overview	Source
Neart na Gaoithe Offshore Wind Farm	105.00	The offshore area was characterised by circalittoral sandy mud (SS.SMu.CSaMu), with species such as seapens *Virgularia mirabilis*, brittle stars *A. filiformis*, polychaetes *S. bombyx*, and bivalves *K. bidentata, Abra* spp., and *Ennucula tenuis*. The biotope *A. filiformis* and *E. tenuis* in circalittoral and offshore sandy mud (SS.SMu.CSaMu.AfilEten) and mosaics of circalittoral coarse sediment (SS.SCS.CCS) and SS.SSa.OSa were also abundant. Soft polychaete tubes, megafauna burrows, and seapens were observed over soft sediments, while *O. fragilis, A. digitatum*, and *Spirobranchus* spp., were observed over coarse mixed sediment.	Mainstream Renewable Power (2019)

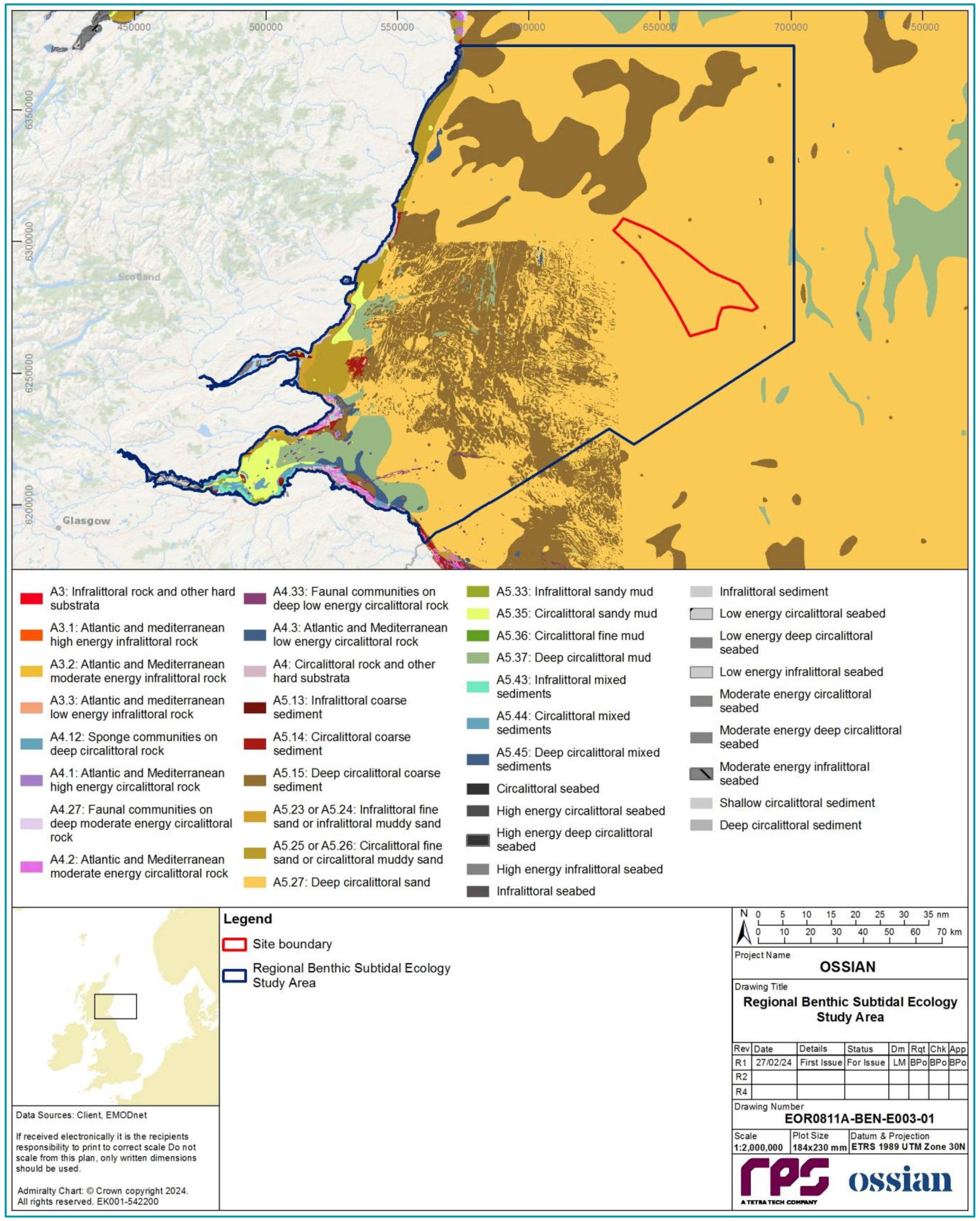


Figure 8.2: Subtidal Sediments within the Regional Benthic Subtidal Ecology Study Area (Source: EMODnet (2023))

Array Benthic Subtidal Ecology Study Area

18. Overall, the results from the site-specific geophysical and environmental surveys (see Table 8.7 of this chapter and volume 3, appendix 8.1, annex A) concluded that the Array benthic subtidal ecology study area was dominated by sand, classified as MC521 – Faunal communities of Atlantic circalittoral sand. Mixed sediments were present predominantly in the north-west and were classified as MC421 – Faunal communities of Atlantic circalittoral mixed sediment. This MC421 habitat decreased in abundance towards the south-east, only occurring occasionally and often associated with ripple features. The majority of sampling sites shared components of MC521 and MC421, albeit to a varying degree. Higher mud content, gravel and diamicton were observed in the central and south-eastern sections, however the Array benthic subtidal ecology study area was largely homogenous. The widespread presence of megaripples and sand waves indicated some sediment mobility, while occasional furrows, mainly in the west, were indicative of erosion. These results are in line with the EUSeaMap broadscale substrate data, which indicate that the Array benthic subtidal ecology study area is significantly dominated by deep circalittoral sand (A5.27) (Figure 8.2).

19. Regarding sediment contamination, levels of Polychlorinated Biphenyls (PCBs) and organotins within the Array benthic ecology subtidal study area were below the limit of detection at all sampled sites. Similarly, metals were generally low, except for arsenic at sample site S002 (located at the northernmost tip of the Array benthic subtidal ecology study area). This value marginally exceeded the Norwegian Environment Agency (NEA) Good 2 threshold and the Canadian Environmental Quality Guidelines (CEQGs) threshold but was within the various other thresholds tested (such as the Cefas action levels) therefore is not considered of concern. Total Hydrocarbon Content (THC) varied across the Array benthic subtidal ecology study area and was generally higher in the southern and eastern areas. THC did not exceed any of the Dutch Rijksinstituut voor Volksgezondheid en Milieu (RIVM) intervention levels at any of the sampling sites and were lower than Oslo Paris Convention (OSPAR) background levels for the North Sea. Similarly, Polycyclic Aromatic Hydrocarbon (PAH) concentrations were low overall, with concentrations higher in the southern and eastern areas in the same trend as THC. There were no threshold values exceeded for individual PAHs but the sum of the Environmental Protection Agency (EPA) 16 compounds exceeded the lower threshold value for NEA Good 2 at sampling site S051 (located at the southernmost tip of the Array benthic subtidal ecology study area).

20. Biomass between grab sampling sites was varied, with six major phyla identified: Echinodermata, Mollusca, Annelida, Arthropoda, Cnidaria and Bryozoa. Echinoderms comprised the majority of the biomass within the grab samples (65%), which is largely due to the purple heart urchin *Spatangus purpureus* and sea potato *Echinocardium cordatum* occurring at several grab sampling sites. The phyletic composition was dominated by annelids, mainly sand mason worm *Lanice conchilega* and *S. bombyx*. The phyletic composition of sessile colonial fauna was dominated by cnidarians and bryozoans, with cnidarians representing the highest number of taxa and bryozoans the highest number of colonies.

21. The most abundant non-colonial fauna identified in the DDV and photography survey were annelids and cnidarians, representing 39% and 28% of total abundance, respectively. Cnidarians covered the largest surface area within the imagery, with a total contribution of 48%, followed by bryozoans and bryozoans/cnidarians at 47% and 5%, respectively.

22. Within the trawl samples, arthropods dominated the phyletic composition of non-colonial fauna, and cnidarians represented the highest number of individuals and colonies of the sessile colonial fauna. The total faunal biomass was dominated by chordates, with the most abundant chordate being the long rough dab *Hippoglossoides platessoides* (discussed further in the volume 3, appendix 9.1).

23. Species richness, diversity, and evenness were relatively low across grab sampling sites, which could be explained by the limited variation in sediment composition. The number of taxa and the number of individuals ranged between 14 to 34 taxa and 28 to 143 individuals per 0.1 m^2. There were two statistical groups produced in the Similarity Proofing Algorithm (SIMPROF) analysis on untransformed macrofaunal data, with the majority of grab samples sites within group b (Figure 8.3). The similarity explored in the Non-Metric Multidimensional Scaling (NMDS) plot presented a stress value of 0.21 (Figure 8.3). The SIMPROF analysis conducted with a square root transformation resulted in five statistically distinct groups, with the majority of sample sites in group e, and a stress value of 0.27 (Figure 8.4). These results were indicative of homogeneity between sampling sites, with the gravel and mud proportions being the main driver for faunal community diversity. The results of the Biota-Environment Matching and Stepwise Test (BEST) indicated that mud and gravel were the variables that best explained the spatial distribution of fauna (rho = 0.29, P = 0.01), and were statistically significant variables.

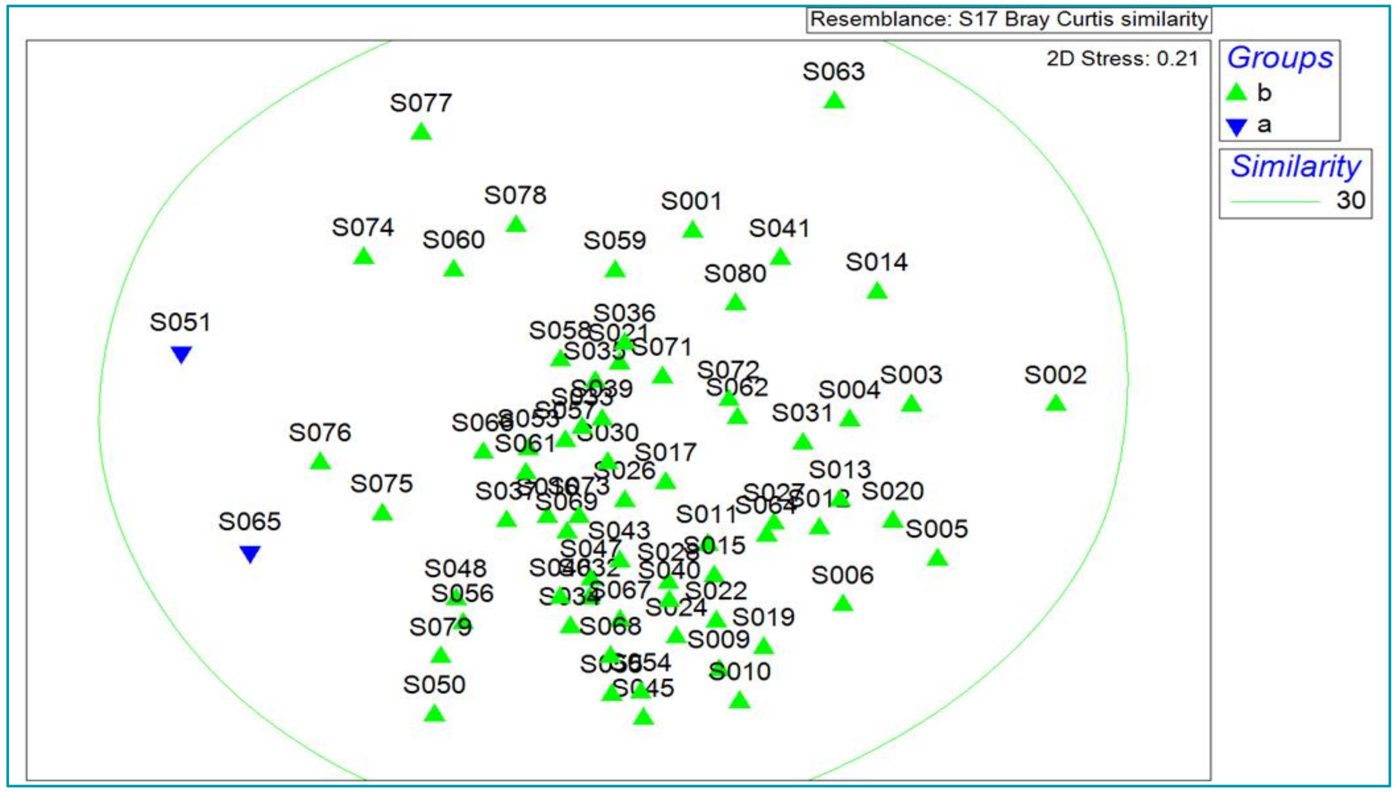


Figure 8.3: NMDS Plot Based on Untransformed Non-Colonial Faunal Composition from Macrofaunal Grab Sampling Sites within the Array Benthic Subtidal Ecology Study Area

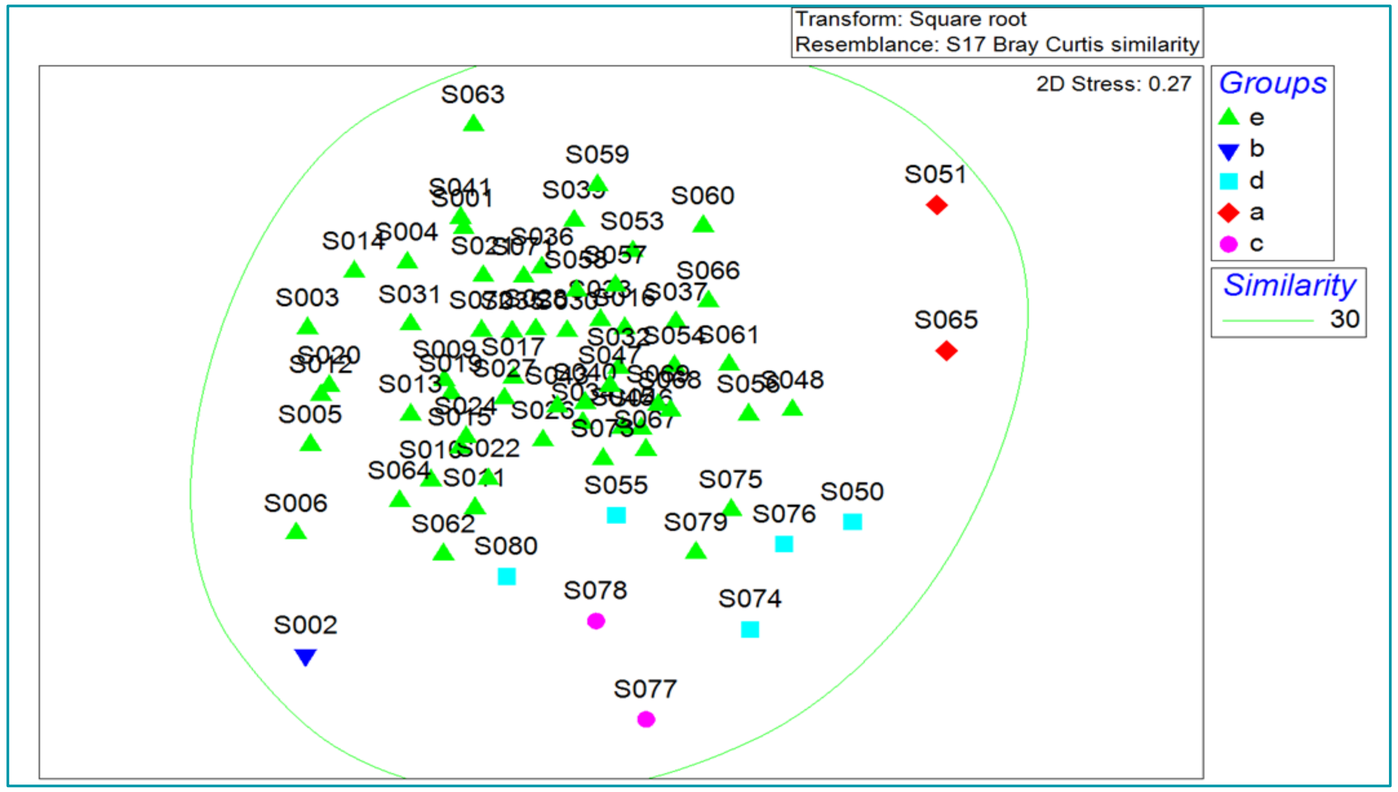


Figure 8.4: NMDS Plot Based on Square Root Transformed Non-Colonial Faunal Composition from Macrofaunal Grab Sampling Sites within the Array Benthic Subtidal Ecology Study Area

24. There were no Annex I habitats identified within the site-specific survey, however there were several habitats and species of conservation interest recorded, which are summarised in Table 8.9. These include two habitats and various species, such as horse mussel *Modiolus modiolus,* sea tamarisk *Tamarisca tamarisca,* ocean quahog *Arctica islandica,* dead man's fingers, and phosphorescent sea pen *Pennatula phosphorea.* These habitats and species of conservation interest are further discussed in section 8.7.3, where they have been carried forward as IEFs for the assessment.

Table 8.9: Benthic Habitats and Species of Conservation Importance Identified during the Site-Specific Environmental Survey

Habitat or Species	Location Identified
Offshore subtidal sands and gravels	Identified across most of the survey area and grab sample sites.
Subtidal sand and gravels	Identified across most of the survey area and grab sample sites.
Dead man's fingers	This species was identified in DDV and photographs from sites S005, S008, S014, S018, S022, S023, S025, S027, S029, S030, S037, S040, S042, S048, S050, S055, S057, S066, S070, and S080.
Horse mussel	Individual adult horse mussel were identified in DDV and photographs at sites S038, S055, S056, S070, and S080 and from the trawl transect BT005. These observations were scattered across the south-east and at the outer most boundary. However, no horse mussel beds (reefs) were identified.
Ocean quahog	Adults were identified across the entire Array benthic subtidal ecology study area, in the grab samples S013, S071, S077, while juveniles were identified in S003, S048, S051, S055, S061, S066, S067, S073, and S076. Adult shell fragments were also recorded in S065.
Phosphorescent sea pen	Individuals were identified in DDV and photographs from sites S051-S053, S056, S057, S059-S063, S065-S068, and S070-S080. They are characteristic of burrowing megafauna and burrowed mud habitats listed as Oslo Paris Convention (OSPAR) priority habitats and Scottish PMF habitats. However, the absence of frequent burrows or mounds and other key species, such as Norway lobster *Nephrops norvegicus*, and the overall sandy composition of the seabed indicated that these habitats of conservation interest were not present.
Sea tamarisk	Identified in the grab sample at S008.

8.7.2. DESIGNATED SITES

25. Designated sites and relevant qualifying interest features identified for the benthic subtidal ecology Array EIA Report chapter are described in Table 8.10 and presented in Figure 8.5. These include an MPA and three SACs. SSSIs have not been listed here due to their distance from the Array benthic subtidal ecology study area and their intertidal features which would not be impacted by the Array. For example, the closest SSSIs with benthic ecological designations are the Tayport Tentsmuir Coast SSSI (124 km), Berwickshire Coast Intertidal SSSI (126 km), and the Firth of Forth SSSI (127 km), which are designated for various intertidal habitats, such as mudflats, saline lagoons and rocky shores. These SSSIs are therefore all outside potential ZoIs for impacts associated with the Array.

26. None of the four designated sites within the regional benthic subtidal ecology study area overlap with the Array benthic subtidal ecology study area (see Figure 8.5). For example, the closest designated site with qualifying benthic ecological features is the Firth of Forth Banks Complex MPA, which is located a minimum of 25 km from the Array benthic subtidal ecology study area. Due to this large distance and the lack of mobile qualifying interest features, this MPA is unlikely to be affected by the Array. Using this logic, the remaining three designated sites are also unlikely to be impacted by the Array, especially considering their increased distance from the Array and any potential ZoIs (see Table 8.10). In addition, two of the qualifying interest features of the Firth of Forth Banks Complex MPA have already been included as IEFs: the ocean quahog and Offshore subtidal sands and gravels, and have therefore been included as part of the assessment (Table 8.11).

Table 8.10: Designated Sites and Relevant Qualifying Interest Features for the Benthic Subtidal Ecology Array EIA Report Chapter

Designated Site	Closest Distance to Array (km)	Relevant Qualifying Interest Feature(s)[2]
Firth of Forth Banks Complex MPA	25	• ocean quahog; • offshore subtidal sands and gravels; • shelf banks and mounds; and • moraines representative of the Wee Bankie Key Geodiversity Area.
Berwickshire and North Northumberland Coast SAC	114	• Annex I mudflats and sandflats not covered by seawater at low tide (1140); • Annex I large shallow inlets and bays (1160); • Annex I reefs (1170); and • Annex I submerged or partially submerged sea caves.
Firth of Tay and Eden Estuary SAC	121	• Annex I Estuaries (1130); • Annex I sandbanks which are slightly covered by sea water all the time (1110); and • Annex I mudflats and sandflats not covered by seawater at low tide (1140).
Isle of May SAC	129	• Annex I reefs (1170)

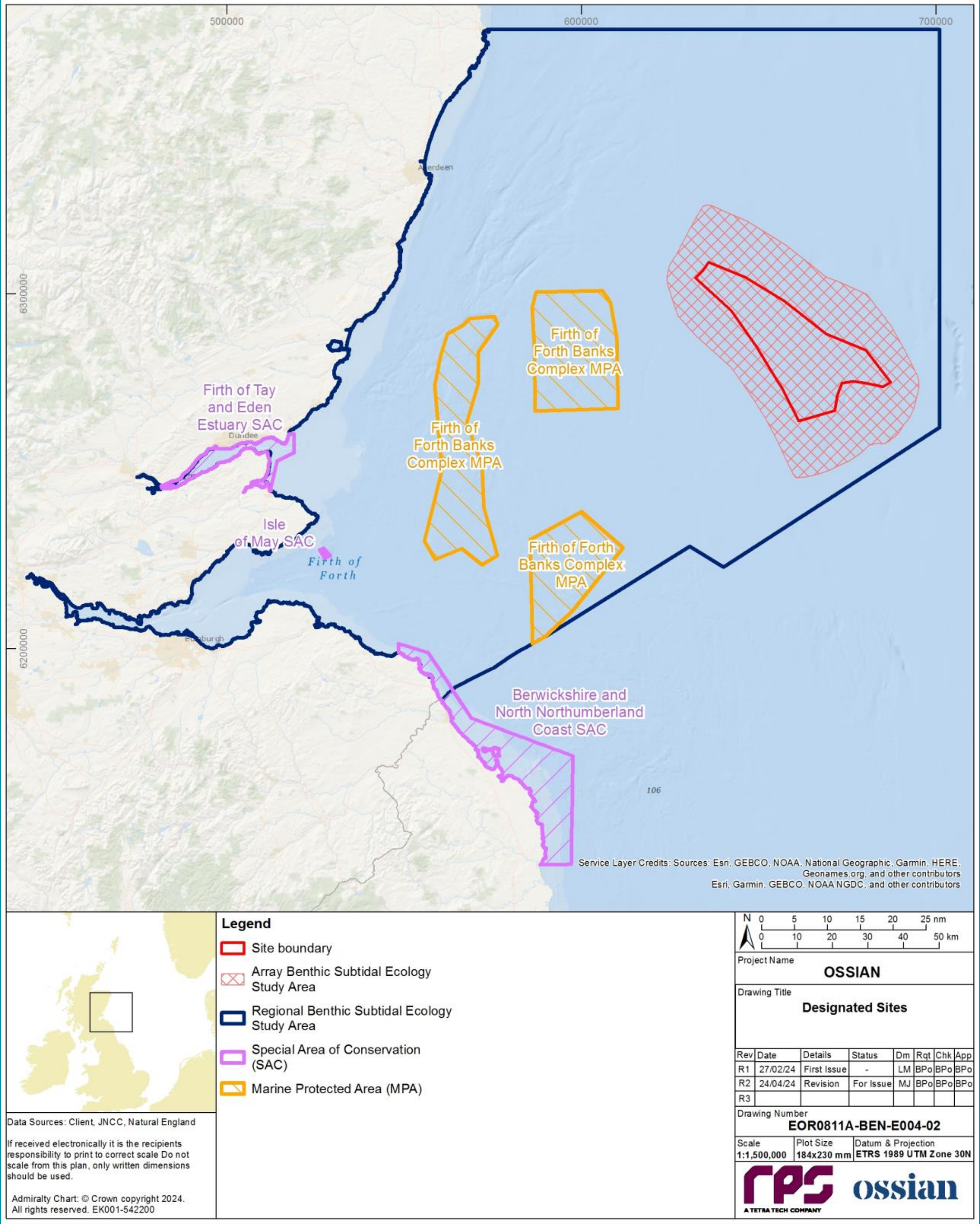


Figure 8.5: Designated Sites Relevant to Benthic Subtidal Ecology

[2] As per JNCC Habitat Classification list

8.7.3. IMPORTANT ECOLOGICAL FEATURES

27. For the purposes of the benthic subtidal ecology EIA, IEFs have been identified using best practice guidelines provided by the Chartered Institute for Ecology and Environmental Management (CIEEM) (2022). The potential impacts of the Array which have been scoped into the assessment (see section 8.8) have been assessed against the IEFs The IEFs assessed are those that are considered to be important and potentially impacted by the Array. Importance may be assigned due to quality or extent of habitats, habitat or species rarity, or the extent to which they are threatened (CIEEM, 2022). For a species or habitat to be considered an IEF, they must have a specific biodiversity importance recognised through international or national legislation or through local, regional, or national conservation plans e.g. Annex I habitats under the Habitats Directive, OSPAR protected habitats and species, National Biodiversity Plan or the Marine Strategy Framework Directive, UK Biodiversity Action Plan (BAP), Scottish PMFs, and the Scottish Biodiversity List (SBL).

28. As highlighted in Table 8.9, individual horse mussels were identified across the survey, however no horse mussel beds were recorded. Therefore, as only the horse mussel beds themselves are of conservation importance (PMF, SBL and OSPAR habitats), this species will not be carried forward in the IEF evaluation. Similarly, *P. phosphorea* (SBL) was identified in multiple sampling sites, however the closely associated sea-pen and burrowing megafauna (OSPAR) and burrowed mud (PMF) habitats were not identified. Thus, only the SBL designation for the *P. phosphorea* itself will be taken forward in the IEF evaluation.

29. Table 8.11 lists all the IEFs within the Array benthic subtidal ecology study area. The main habitats identified throughout the Array benthic subtidal ecology study area comprise of Offshore subtidal sands and gravels and Subtidal sands and gravels.

Table 8.11: IEFs within the Array Benthic Subtidal Ecology Study Area

IEF	Description and Representative Biotopes	Protection Status	Conservation Interest	Importance within the Array Benthic Subtidal Ecology Study Area
Offshore subtidal sands and gravels	Despite its PMF status, this habitat is one of the most abundant offshore habitats in UK and Irish waters, often comprising communities of tube building polychaetes, burrowing brittle stars, bivalves, polychaetes, pea urchins, amphipods and hooded shrimps (Marine Scotland, 2016). The following biotopes are associated with this habitat and were identified during the site-specific surveys within the Array benthic subtidal ecology study area: • *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri); and • *Abra prismatica, Bathyporeia elegans*, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo) (Marine Scotland, 2016, Tyler-Walters *et al.*, 2016).	None	PMF	Regional
Subtidal sands and gravels	As above, this is one of the most abundant habitats in inshore and offshore UK and Irish waters, with the sands and gravels in the North Sea largely derived from rock material (Maddock, 2011). As above for Offshore subtidal sands and gravels, the following biotopes are associated with this habitat and were identified during the site-specific surveys within the Array benthic subtidal ecology study area: • *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri); and • *Abra prismatica, Bathyporeia. elegans*, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo).	None	SBL, UK BAP Priority Habitat	Regional
Dead man's fingers *Alcyonium digitatum*	A colonial coral which forms thick, fleshy masses of finger-like lobes. Found on all UK and Irish coasts (Budd, 2008).	None	SBL	Regional
Ocean quahog *Arctica islandica*	The longest living mollusc in the world and can live for over 400 years. Found in sandy and muddy sediments all around Scotland and the UK (Tyler-Walters and Sabatini, 2017).	OSPAR protected species	PMF	National
Phosphorescent sea pen *Pennatula phosphorea*	Colonial cnidarian found in Scotland, particularly in the North Sea, and the Irish Sea, but not in southern England (Jones, 2008).	None	SBL	Regional
Sea tamarisk *Tamarisca tamarisca*	A colonial hydroid with a straggly appearance of alternate branches widely spaced along its stem. Found on all UK and Irish coasts (Wilson, 2002).	None	SBL	Regional

8.7.4. FUTURE BASELINE SCENARIO

30. The EIA Regulations require that a *"a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort, on the basis of the availability of environmental information and scientific knowledge"* is included within the Array EIA Report.

31. If the Array does not come forward, the 'without development' future baseline conditions are described within this section.

32. In addition to the effects of climate change on the marine environment, variability and long term changes in physical processes may cause direct and indirect effects to benthic habitats and communities in the mid to long term future (Department of Energy and Climate Change (DECC), 2016). The best evidence indicates that long term changes to benthic ecology may be related to long term changes in the climate or in nutrients (DECC, 2016), with shifts in abundances and species composition being driven by climatic processes. Benthic communities are also influenced by anthropogenic activities, such as pollution, contamination, and seabed disturbing activities such as dredging, commercial fishing, and development. A scientific review by the Marine Climate Change Impacts Partnership (MCCIP) concluded that climatic processes both directly (e.g. winter mortality), and indirectly (e.g. via hydrographic conditions), influence the abundance and species composition of seabed communities (MCCIP, 2020). In turn, alteration to seabed communities could impact rates and timing of processes such as nutrient cycling, planktonic larval supply, and organic waste assimilation (MCCIP, 2020). Recently, the Department for Environment, Food,

and Rural Affairs (DEFRA) has centred their focus on the risk of climate change to ecosystem services on the following topics:

- INNS and their likely detriment to native communities and ecosystems;
- the increased risk to species of disease from new pathogens as their distributions shift; and
- the impacts on areas of high biodiversity value in the coastal zone from increased storms and erosion (HM Government, 2022).

33. Overall, localised changes in community assemblage may occur due to pollution, contamination, and anthropogenic seabed disturbance and erosion (DECC, 2016, HM Government, 2022). DEFRA also highlighted that the risks associated with INNS, ocean acidification, and higher water temperatures are linked to climatic changes (HM Government, 2022), which could also have impacts on benthic subtidal ecology on a wider scale. However, the potential pressures described are unlikely to result in any significant changes to substrate type, which is a key driver of species assemblages and biotope classification. Nonetheless, it is difficult to define, for certain, how the baseline will evolve in the future, particularly at the species-level.

8.7.5. DATA LIMITATIONS AND ASSUMPTIONS

34. The data sources used in this chapter are detailed in Table 8.6 and volume 3, appendix 8.1. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. Data that have been collected are based on existing literature and have been informed through consultation with stakeholders.

35. Site-specific surveys were undertaken to characterise the benthic subtidal ecology baseline (see Table 8.7). However, it should be noted that there is a small possibility for the benthic communities to have developed and evolved in the intervening period since the site-specific surveys were carried out in 2022. Nonetheless, as the surveys were conducted less than five years prior to submission of this EIA Report, the results are considered to be fully valid. The sampling design and data collection have provided robust data on the benthic communities within the Array benthic subtidal ecology study area, however, interpreting these data has its limitations. It is often difficult to interpolate data collected from discrete sample locations to cover a very extensive area and define the precise extent of each biotope. Benthic communities generally show a transition from one biotope to another and therefore boundaries indicate where communities grade into one another rather than where one ends, and another begins. The classification of the community data into biotopes is not always straightforward, as some communities do not readily fit the available descriptions in the biotope classification system. However, this site-specific study does provide a suitable baseline characterisation which describes the main habitats and communities within the Array benthic subtidal ecology study area.

8.8. KEY PARAMETERS FOR ASSESSMENT

8.8.1. MAXIMUM DESIGN SCENARIO

36. The MDSs identified in Table 8.12 are those expected to have the potential to result in the greatest impact on benthic subtidal ecology. These scenarios have been selected from the details provided in volume 1, chapter 3 of the Array EIA Report. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Description (volume 1, chapter 3) (e.g. different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

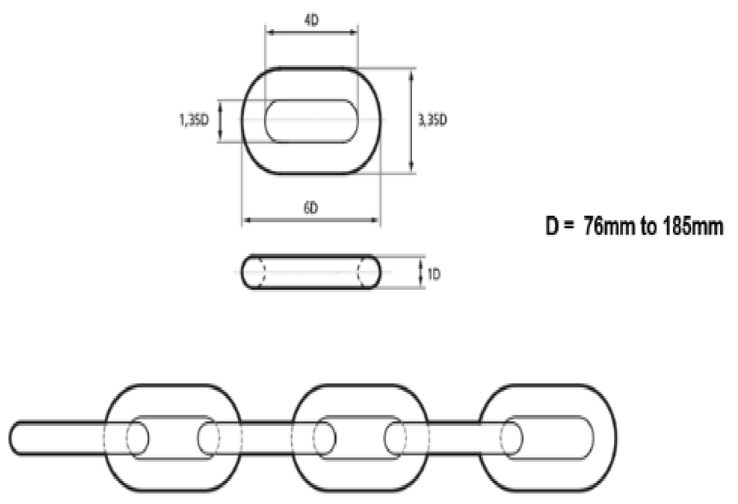
37. The impact of increased SSCs and associated deposition has been informed by the assessment presented in volume 2, chapter 7.

Table 8.12: Maximum Design Scenario Considered for Each Potential Impact as Part of the Assessment of LSE[1] on Benthic Subtidal Ecology

Potential Impact	Phase[3] C	O	D	Maximum Design Scenario	Justification
Temporary habitat loss and disturbance	✓	✓	✓	**Site Preparation and Construction Phases** A total of up to 49,948,548 m^2 (49.95 km^2) of temporary subtidal habitat loss and/or disturbance due to: • a footprint area of 14,723,348 m^2 due to boulder clearance and relocation and sand wave clearance; • a footprint area of 9,540,000 m^2 due to disturbance due to Drag Embedment Anchor (DEA) installation; • a footprint area of 25,392,000 m^2 due to disturbance caused by the installation of 1,261 km of inter-array cables and 236 km of interconnector cables; • a footprint area of up to 250,000 m^2 for temporary offshore wet storage; and • a footprint area of 43,200 m^2 due to jack up vessel use for Offshore Substation Platform (OSP) installation. This represents 5.82% of the total site boundary. In addition, up to 5,190 m^2 of temporary habitat loss could occur due to crater formation from the clearance of Unexploded Ordnance (UXO). This value has not been included in the total of 49,948,548 m^2 as it has not been derived from the Project Description (volume 1, chapter 3). Instead, it has been calculated based on appropriate crater sizes from other projects, and applied to the 15 potential UXOs that may require clearance during the construction of the Array (Ordtek, 2018, Royal HaskoningDHV, 2022) (see paragraph 58). **Operation and Maintenance Phase** A total of up to 51,411,500 m^2 (51.41 km^2) of temporary habitat loss and/or disturbance over the 35 year lifecycle of the Array due to: • a footprint area of 367,500 m^2 due to jack up vessel usage for operation and maintenance activities (10,500 m^2 per year over the 35 year lifecycle); and • a footprint area of 51,044,000 m^2 due to disturbance caused by reburial of inter-array and interconnector cables (1,222,400 m^2 and 236,000 m^2, respectively per year). This represents 5.99% of the total site boundary. **Decommissioning Phase** A total of up to 43,200 m^2 of temporary habitat loss and/or disturbance due to the footprint area of jack up vessel use for decommissioning activities. This represents 0.01% of the total site boundary.	The MDS for this impact considers the maximum seabed footprint of temporary habitat loss and/or disturbance during the construction, operation and maintenance and decommissioning phases of the Array.

[3] C = Construction, O = Operation and maintenance, D = Decommissioning

Potential Impact	Phase[3] C	O	D	Maximum Design Scenario	Justification
Long term habitat loss and disturbance	✓	✓	✓	**Construction and Operation and Maintenance Phases** Up to 19,270,958 m^2 (19.27 km^2) of long term subtidal habitat loss to infrastructure installed in the construction phase, which will persist into the operation and maintenance phase. This is due to: • a total footprint area of 12,416,305 m^2 due to mooring lines on the seabed. Mooring lines on the seabed will cover a maximum total footprint of 46,854 m^2 per foundation (n = 265) based on wind turbines installed on semi-submersible floating foundations and moored to seabed anchors using catenary moorings. Some of this cable will be buried and therefore not associated with long term habitat loss or disturbance, although the proportion that will be buried is not yet finalised; • a total footprint area of 25,288 m^2 due to anchors on the seabed (265 foundations with an anchor footprint of 95 m^2 each); • a footprint area of 632,196 m^2 due to scour protection for moorings and anchors; • a footprint area of 2,163 m^2 due to OSP jacket foundations (3 large OSPs with an area of 382 m^2 each and 12 small OSPs at 85 m^2 each); • a footprint area of 94,814 m^2 due to scour protection for all OSP jacket foundations; • a footprint area of 4,889,600 m^2 due to all inter-array cable protection and 944,000 m^2 of interconnector cable protection; • a footprint area of 24,000 m^2 due to all inter-array and interconnector cable crossing protection; • a total footprint area of 41,040 m^2 due to subsea junction boxes (228 boxes with a footprint area of 180 m^2 each); and • a footprint area of 201,552 m^2 due to scour protection for all subsea junction boxes. This represents 2.25% of the total site boundary. In addition, up to 778,464 m^2 of long term seabed disturbance may occur due to dynamic cabling and mooring lines at the touch down transition, which is subject to intermittent movement (therefore, repeated seabed disturbance). This value has been derived from a maximum disturbance footprint of 2,937.6 m^2 from mooring lines for each foundation (n=265 total). This footprint of repeated disturbance equates to 0.09% of the total area of the site boundary. Finally, up to 10% of piles may require drilling, with a volume of 636 m^3 of drill arisings associated with each pile (total volume of 101,151 m^3 for the Array). **Decommissioning Phase** Up to 6,786,162 m^2 (6.79 km^2) of long term subtidal habitat loss due to infrastructure left *in situ* during the decommissioning of the Array (all scour protection and cable protection). This is comprised of: • a total footprint area of 4,901,600 m^2 due to all inter-array cable protection (4,889,600 m^2) and cable crossing protection (12,000 m^2); • a total footprint area of 956,000 m^2 due to all interconnector cable protection (944,000 m^2) and cable crossing protection (12,000 m^2); and • a total footprint area of 928,562 m^2 due to scour protection for moorings and anchors (632,196 m^2), subsea junction boxes (201,552 m^2), and OSP jackets (94,814 m^2). This represents 0.79% of the site boundary.	The MDS for this impact accounts for the maximum seabed footprint of infrastructure installed during the construction phase which will result in the greatest extent of long term subtidal habitat loss in the operation and maintenance phase. In the decommissioning phase, the MDS accounts for the maximum seabed footprint of infrastructure that will remain *in situ.* It should be noted that the decommissioning strategy is not yet fully defined and is being assessed on an individual impact basis. The MDS for removal of infrastructure differs between impacts (e.g. increased SSCs and associated deposition). Currently, it is proposed that all scour protection and cable protection are to be left *in situ.* All inter-array and interconnector cables are also proposed to be left *in situ;* however, these will be buried to a minimum target burial depth of 0.4 m (subject to a Cable Burial Risk Assessment (CBRA)) and therefore do not represent a source of long term subtidal habitat loss.

Increased SSCs and associated deposition	✓	✓	✓	**Site Preparation and Construction Phases** There is potential for increased SSCs and associated deposition to occur as a result of the following activities: • boulder clearance, wherein a clearance width of up to 24 m will be used for an estimated 25% of inter-array cables (315.25 km) and interconnector cables (59 km); • sand waves may be cleared to a width of 24 m along inter-array cables, interconnector cables, and scour protection for OSP foundations. The maximum volume of cleared material is 5,867,520 m^3 at inter-array cables, 1,133 m^3 at interconnector cables, and 104,295 m^3 at OSP foundations (total 11,841,602 m^3 of cleared material); • installation of up to 1,590 DEAs, which may be dragged up to 60 m each along the seabed; and • installation of 1,261 km of inter-array cables and 236 km of interconnector cables. **Operation and Maintenance Phase** Project lifetime of 35 years. Mooring line chain thickness is 185 mm, and the horizontal diameter is 620 mm, as shown below:  There are two potential MDSs associated with this impact for benthic subtidal ecology, 130 turbines with up to 9 catenary mooring lines each, or 265 turbines with up to 6 catenary mooring lines each. Justification for the inclusion of both is provided in the next column. <u>130 turbine MDS:</u> Mooring lines – movement around touchdown points on the seabed of up to 9 catenary mooring lines per semi-submersible foundation, of which there are up to 130, at a minimum spacing of 1.4 km. The maximum length of each mooring line in contact with the seabed during operation is: • 680 m: which amounts to 6,120 m per foundation and up to a total of 795,600 m of mooring line with the potential to be in contact with the seabed. <u>265 turbine MDS:</u> Mooring lines – movement around touchdown points on the seabed of up to 6 catenary mooring lines per semi-submersible foundation, of which there are up to 265, at a minimum spacing of 1 km. The maximum length of each mooring line in contact with the seabed during operation is: • 680 m: which amounts to 4,080 m per foundation and up to a total of 1,081,200 m of mooring line with the potential to be in contact with the seabed. **Decommissioning Phase**	In the construction and decommissioning phases, the MDS for this impact is associated with the activities that may result in increased SSCs and associated deposition. As this impact was not scoped in for assessment in these phases in the physical processes chapter (volume 2, chapter 7), and in line with the advice received from NS (See Table 8.5), these are assessed highly qualitatively in section 8.11. Where available in the Project Description (volume 1, chapter 3), volumes of cleared material and/or arisings are presented (e.g. for sand wave clearance and drilling). Inter-array and interconnector cable burial methodology will be confirmed at the final design stage (post-consent), however cable plough, jet trencher, mass flow excavator, and mechanical cutter may be used to achieve cable burial depths (volume 1, chapter 3). Within the Project Description (volume 1, chapter 3), the removal of all scour protection, inter-array cables, interconnector cables, and cable protection in the decommissioning phase is to be assessed on an individual impact basis as the MDS will differ between impacts. The MDS for this impact therefore considers the removal of all infrastructure, as this represents the largest potential for increased SSCs and associated deposition. It should be noted that the decommissioning strategy is not defined, and cables, cable protection, and scour protection may potentially be left *in situ* where removal could result in greater environmental effects. If some infrastructure remains *in situ*, the MDS presented here will be an overestimation, and SSCs will be lower as a result. In the operation and maintenance phase, increased SSCs may arise due to mooring lines or cables making contact with and moving on the seabed, disturbing seabed materials and causing scouring and increased SSCs within the water column. This may lead to associated deposition of these materials, although the potential for blockage to the overall sediment transport regime in the area is unlikely. There is the potential impact to benthic subtidal features within the Array benthic subtidal ecology study area from the increase in SSCs during this phase. The greatest potential for the increase in SSCs is from catenary moorings which would have the greatest length of mooring line that will move on the seabed around the touch down points compared to semi-taut, taut, and tendons. Two scenarios have been considered when assessing this impact for benthic subtidal ecology. Whilst MDS values are based on the maximum length of moorings lines on the seabed, in practice only a small proportion of the length of these mooring lines will move. Mooring lines on the windward side of the turbine would be expected to lift, whilst the mooring lines on the leeward side would be expected to slacken and drop to the seabed. In extreme weather conditions a greater proportion of mooring line would be expected to rise on the windward side. Mooring systems will be designed to minimise movement as far as practicable. Impacts from increased SSC are expected to be extremely localised with deposition expected quickly and in close proximity to mooring lines of each turbine with limited interaction between plumes from adjacent turbines. The 130 turbine scenario has been assessed as this results in the greatest concentration of suspended sediment within a single turbine footprint. Consideration of impacts associated with the 265 turbine scenario is also considered on the basis that this results in a greater overall footprint for deposition within the site boundary, albeit at a lower concentration.

Potential Impact	Phase[3] C	O	D	Maximum Design Scenario	Justification
				Up to 19,270,958 m² (19.27 km²) of hard substrate on the seabed will be removed in the decommissioning of the Array. SSC levels are expected to be similar or of a lower extent to the construction phase (given the absence of site preparation activities in the decommissioning phase).	In the operation and maintenance phase, movement on the seabed by inter-array cables will be limited to a small area between their touchdown point and the point where the cable becomes static. Movement of the inter-array cables between the touchdown point and where it becomes static will be reduced as far as practicable through the use of buoyancy modules and clump weights where appropriate (and subject to engineering design). Movement of the cable will therefore be limited to small sections of the dynamic cable and would result in minor increases to SSCs in the vicinity of the touchdown point only. Static inter-array and interconnector cables on the seabed will be buried or fixed with cable protection, where target burial depths cannot be achieved.
Effects to benthic subtidal ecology due to EMF from subsea electrical cabling	×	✓	×	**Operation and Maintenance Phase** Presence of inter-array and interconnector cables: • up to 1,261 km of 66 kV inter-array cables with maximum 116 km in the water column, with the rest buried to a minimum target depth of 0.4 m (subject to CBRA); • up to 236 km of 275 kV Alternating Current (AC) or 525 kV Direct Current (DC) interconnector cables with a minimum target burial depth of 0.4 m (subject to CBRA); • up to 20% of inter-array and interconnector cables may require cable protection; • cables will also require cable protection at asset crossings (up to 12 crossings for inter-array cables and up to 12 crossings for interconnector cables); and; • up to 228 junction boxes will be required for inter-array cables. The operation and maintenance phase will be up to 35 years.	The MDS for this impact is based on the greatest cable length proposed, both in the water column and buried in the seabed.
Colonisation of hard substrates	×	✓	×	**Operation and Maintenance Phase** Up to 19,270,958 m² (19.27 km²) of hard substrate will be installed on the seabed during the construction phase (see 'Long term subtidal habitat loss' above) which could be colonised by benthic species in the operation and maintenance phase. As stated above, this represents up to 2.25% of the total seabed area of the site boundary. In addition, the floating wind turbine foundations, dynamic cables, and anchor mooring lines represent hard substrate introduced into the water column. Given the complexity of calculating a footprint of hard substrate associated with mooring lines, dynamic cabling and steel tubulars associated with a semi-submersible foundation and the uncertainty around final foundation design it is not possible to calculate an area available for colonisation of organisms. In addition, marine growth may periodically be removed from the floating wind turbine foundations, as it could inhibit buoyancy. Therefore, the MDS for this impact is represented by up to 19.27 km² of hard substrate installed on the seabed and an unquantified area installed in the water column.	The MDS for this impact considers the maximum footprint area of hard substrate that will be installed in the construction phase, comprising of mooring lines, cable protection, cable crossing protection, and scour protection. This impact also qualitatively considers hard substrate that will be installed within the water column, which could potentially also be colonised.

Potential Impact	Phase[3] C	O	D	Maximum Design Scenario	Justification
Effects to benthic subtidal ecology due to removal of hard substrates	×	×	✓	**Decommissioning Phase** Up to 19,270,958 m^2 (19.27 km^2) of hard substrate on the seabed will be removed in the decommissioning of the Array. This comprises: • footprint areas of 12,416,305 m^2 and 25,288 m^2 due to mooring lines and anchors on the seabed, respectively; • a footprint area of 632,196 m^2 due to scour protection for moorings and anchors; • a footprint area of 2,163 m^2 due to OSP jacket foundations (3 large OSPs with an area of 382 m^2 each and 12 small OSPs at 85 m^2 each); • a footprint area of 94,814 m^2 due to scour protection for all OSP jacket foundations; • a footprint area of 4,901,600 m^2 due to all inter-array and interconnector cable protection; • a footprint area of 24,000 m^2 due to all inter-array and interconnector cable crossing protection; • a total footprint area of 41,040 m^2 due to subsea junction boxes (228 boxes with a footprint area of 180 m^2 each); and • a footprint area of 201,552 m^2 due to scour protection for all subsea junction boxes. In addition, floating wind turbine foundations, dynamic cables, and anchor mooring lines represent hard substrate in the water column (see 'Colonisation of hard substrates' above). These will be removed during the decommissioning phase, and therefore, represent the MDS for this impact within the water column.	Within the current Project Description (volume 1, chapter 3), the removal of all scour protection, inter-array cables, interconnector cables, and cable protection is to be assessed on an individual impact basis as the MDS will differ between impacts. The MDS for this impact therefore considers the removal of all infrastructure, as this represents the largest potential impact. It should be noted that the decommissioning strategy is not defined, and cables, cable protection, and scour protection may potentially be left *in situ*. In reality, if some infrastructure remains *in situ,* the MDS presented here will be an overestimation in the area of hard substrates removed.
Increased risk of introduction or spread of INNS	✓	✓	✓	**Site Preparation and Construction Phases** • up to 7,902 vessel round trips may occur over the site preparation and construction phases of the Array. These include, but are not limited to, jack up vessels, cargo barges, support vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels, and site preparation vessels (sand wave clearance and UXO clearance); • up to 97 vessels may be on site at any one time during the site preparation and construction phases; and • towing of up to 265 turbines (maximum three turbines towed at one time) to the site boundary. **Operation and Maintenance Phase** • up to 19,270,958 m^2 (19.27 km^2) of hard substrate will be installed on the seabed during the construction phase (see 'Long term subtidal habitat loss' above) which could be colonised by INNS during the operation and maintenance phase. As stated above, this represents up to 2.25% of the total site boundary; • hard substrate will be present within the water column due to the presence of floating wind turbine foundations, dynamic cables, and anchor mooring lines (see 'Colonisation of hard substrates' above) which could be colonised by INNS during the operation and maintenance phase; and • in addition, up to 17,780 vessel round trips may occur over the 35 year lifecycle of the Array (508 round trips per year), with up to 31 vessels on site at any one time. **Decommissioning Phase** • up to 6,786,162 m^2 (6.79 km^2) of infrastructure is proposed to be left *in situ* during the decommissioning phase. As per 'Long term subtidal habitat loss and disturbance' above, this comprises all cable protection and scour protection; and • information on vessel movements in the decommissioning phase are not defined at this stage. However, it can be assumed that will be of an equal or lower extent to that of the construction phase and are likely to be lower.	As above for 'Colonisation of hard structures', the MDS for this impact considers the maximum footprint area of hard substrate that will be installed in the construction phase and persist into the operation and maintenance and decommissioning phases. This MDS for this impact also considers the total number of vessel round trips in each phase, as these represent pathways for introduction of INNS. Within the current Project Description (volume 1, chapter 3), the removal of all scour protection, inter-array cables, interconnector cables, and cable protection is not yet finalised, and these structures may be left *in situ.* The removal of these structures is to be assessed on an individual impact basis as the MDS will differ between impacts. The MDS for this impact therefore considers leaving all scour protection and cable protection *in situ* as this represents the largest potential area of hard substrate present for INNS to continue to colonise after the decommissioning phase.

8.8.2. IMPACTS SCOPED OUT OF THE ASSESSMENT

38. The benthic subtidal ecology pre-Scoping workshop (see Table 8.5) was used to facilitate stakeholder engagement on topics to be scoped out of the assessment.

39. On the basis of the baseline environment and the Project Description outlined in volume 1, chapter 3 of the Array EIA Report, a number of impacts were proposed to be scoped out of the assessment for benthic subtidal ecology. This was either agreed with key stakeholders through consultation as discussed in volume 1, chapter 5, or otherwise, the impact was proposed to be scoped out in the Ossian Array EIA Scoping Report (Ossian OWFL, 2023) and agreement was confirmed through the EIA scoping consultation and subsequent Scoping Opinion (MD-LOT, 2023).

40. These impacts are outlined, together with justifications for scoping them out, in Table 8.13.

Table 8.13: Impacts Scoped Out of the Assessment for Benthic Subtidal Ecology (Tick Confirms the Impact is Scoped Out

Potential Impact	Phase[4] C	O	D	Justification
Effects to benthic subtidal ecology due to accidental pollution	✓	✓	✓	Pollution could potentially be accidentally released during all three phases of the Array from sources such as vessels, vehicles, equipment, and machinery. However, the potential risk of accidental release of pollutants is reduced as far as reasonably practicable by designed in measures, such as the development of, and adherence to, an appropriate EMP which includes Marine Pollution Contingency Plan (MPCP) (see section 8.10; volume 3, appendix 21, annex A). These designed in measures include planning for accidental spills, outline all potential contaminants that could be released, and include key emergency contact details. They will also outline good industry practice and OSPAR, International Marine Organisation (IMO), and International Convention for the Prevention of Pollution from Ships (MARPOL) guidelines for preventing pollution at sea. Due to these measures, the likelihood of an accidental spill is very low, and the magnitude will be reduced as far as reasonably practicable in the unlikely event that it does occur, leading to no LSE[1]. Based on this reasoning and feedback received on the Array EIA Scoping Report (Ossian OWFL, 2023) and consultation with SNCBs, this impact is scoped out of the assessment for benthic subtidal ecology.
Effects to benthic subtidal ecology due to the release of sediment bound contaminants	✓	×	×	If sediment bound contaminants are present within Array benthic subtidal ecology study area, there is potential for these to be released into the water column during the construction phase due to the installation of infrastructure. However, due to the low levels of contaminants recorded during site-specific surveys (i.e. all contaminants were below Cefas Action Level 1 or below limit of detection at all locations; see volume 3, appendix 8.1 and 'Array Benthic Subtidal Ecology Study Area'), there is no potential for significant effects on benthic ecology from this impact. Based on this reasoning and feedback received on the Array EIA Scoping Report (Ossian OWFL, 2023) and consultation with SNCBs, this impact is scoped out of the assessment for benthic subtidal ecology.
Effects to benthic subtidal ecology due to changes in physical processes	×	✓	×	This impact was proposed to be scoped out on the basis that there would be no significant effect upon benthic subtidal ecology in EIA terms. As concluded in the Physical Processes assessment, there were no significant impacts identified (see volume 2 chapter 7), therefore further supporting the conclusion that adverse effects to benthic subtidal ecology are unlikely to occur as a result of this impact. Furthermore, the Feature Activity Sensitivity Tool (FeAST) and Marine Evidence Based Sensitivity Assessment (MarESA) were used to assess the sensitivities of the biotopes present within the Array to changes in local water flow (i.e. tidal current). Using FeAST, the biotopes 'continental shelf coarse sediments', 'continental shelf mixed sediments', and 'continental shelf sands' were determined as having low sensitivity to changes in local water flow. These biotopes were chosen, as they were representative of the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs. Similarly, using MarESA, the biotopes '*Abra prismatica, Bathyporea elegans,* and polychaetes in circalittoral fine sand' and '*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand' were assessed as being not sensitive to changes in local water flow. Based on this reasoning and feedback received on the Array EIA Scoping Report (Ossian OWFL, 2023) and consultation with SNCBs, this impact is scoped out of the assessment for benthic subtidal ecology.

[4] C = Construction, O = Operation and maintenance, D = Decommissioning

8.9. METHODOLOGY FOR ASSESSMENT OF EFFECTS

8.9.1. OVERVIEW

41. The benthic subtidal ecology assessment of effects has followed the methodology set out in volume 1, chapter 6 of the Array EIA Report. Specific to the benthic subtidal ecology EIA, the following guidance documents have also been considered:

- Guidelines for Ecological Impact Assessment (EcIA) in the UK and Ireland (CIEEM, 2022);
- Advances in Assessing *Sabellaria spinulosa* Reefs for Ongoing Monitoring (Jenkins *et al.*, 2018);
- Marine Evidence Based Sensitivity Assessment – A Guide (Tyler-Walters *et al.*, 2018);
- Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Judd, 2012);
- Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland – Volume 5: Benthic Habitats (Saunders *et al.*, 2011);
- Best Methods for Identifying and Evaluating *Sabellaria spinulosa* and Cobble Reef (Limpenny *et al.*, 2010);
- Identification of the Main Characteristics of Stony Reef Habitats under the Habitats Directive (Irving, 2009);
- Guidance on Environmental Considerations for Offshore Windfarm Development (OSPAR Commission, 2008a); and
- Defining and Managing *Sabellaria spinulosa* Reefs (Gubbay, 2007).

8.9.2. CRITERIA FOR ASSESSMENT OF EFFECTS

42. When determining the significance of effects, a two stage process is used which involves defining the magnitude of the potential impacts and the sensitivity of each receptor. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivities of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 1, chapter 6 of the Array EIA Report.

43. The criteria for defining magnitude in this chapter are outlined in Table 8.14. Each assessment considered the spatial extent, duration, frequency and reversibility of impact when determining magnitude, which are outlined within the magnitude section of each impact assessment (e.g. a duration of hours or days would be considered for most receptors to be of short term duration, which is likely to result in a low magnitude of impact).

Table 8.14: Definition of Terms Relating to the Magnitude of an Impact

Magnitude of Impact	Definition
High	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse)
	Large scale or major improvement or resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial)
Medium	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics, features or elements (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial)
Low	Some measurable change in attributes, quality or vulnerability, minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse)
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial)
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse)
	Very minor benefit to, or positive addition of one or more characteristics, features or elements (Beneficial)

44. The MarESA has been used to define the sensitivity of benthic subtidal ecology IEFs. MarESA involves the likelihood for damage (thus vulnerability) due to defined pressures and the rate of recovery (i.e. recoverability) once said pressure is removed. Vulnerability is defined as the level at which a receptor can absorb disturbance or stress without changing character. Recoverability is defined as the ability of the habitat or species to return to the state that it existed in prior to the impact which caused the change. However, full recovery does not necessarily mean that every species component of a habitat or population has recovered to its prior condition, abundance, and/or extent. Instead, full recovery is reached if the relevant functional components are present, and the habitat and/or population is structurally and functionally recognisable as it was prior to the change.

45. MarESA is a database developed through the Marine Life Information Network (MarLIN) of Britain and Ireland and maintained by the Marine Biological Association (MBA). The MarESA database consists of a detailed review of available evidence on the effects of pressures on marine species and habitats. It also contains a scoring of sensitivity against a standard list of pressures, and their benchmark levels of effect. The MarESA evidence base is peer reviewed and is the largest review undertaken to date on the effects of human activities and natural events on marine species and habitats. It is one of the best available sources of evidence regarding the recovery of seabed species and habitats.

46. The MarESA sensitivity assessment correlates vulnerability and recoverability in order to characterise sensitivity of benthic receptors. This has been used to inform the sensitivity of the benthic subtidal ecology IEFs within the assessment of significance and the CEA (sections 8.11 and 8.12, respectively). The criteria for defining sensitivity in this chapter are outlined in Table 8.15.

47. FeAST provides sensitivity assessments for various species and habitats using the same methodology and approach as the MarESA. However, only the ocean quahog IEF had a specific FeAST assessment, with none available for dead man's fingers, sea tamarisk, or phosphorescent sea pen. The FeAST contained an assessment on the broad seabed habitats 'continental shelf coarse sediments', 'continental shelf mixed sediments', and 'continental shelf sands', which could be used to assess the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, however the FeAST assessment does not contain information specific to the representative biotopes identified for these IEFs in Table 8.11. Therefore, for the assessment of significance and the CEA, the FeAST was not used, only the MarESA and other available background literature.

48. As noted in section 8.11, there was no MarESA available for sea tamarisk or phosphorescent sea pen, the sensitivities of these IEFs have been assessed using the available literature throughout. For the dead man's fingers IEF, only the outdated MarLIN sensitivity assessment is available, which was superseded in 2014 by the MarESA for the remaining IEFs. Given that the same representative biotopes were identified within the Array benthic subtidal ecology study area for both the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF (see Table 8.11) these two IEFs have been assessed in-combination throughout.

Table 8.15: Definition of Terms Relating to the Sensitivity of the Receptor

Value (Sensitivity of the Receptor)	Description
Very High	Very high importance and rarity, international receptor with no potential or very limited potential for recovery
High	High importance and rarity, international and/or national receptor and limited potential for recovery
Medium	High or medium importance and rarity, regional receptor, and potential for recovery
Low	Low or medium importance and rarity, local receptor and high potential for recovery
Negligible	Very low importance and rarity, local receptor and very high potential for recovery

49. The magnitude of the impact and the sensitivity of the receptor are combined when determining the significance of the effect upon benthic subtidal ecology. The particular method employed for this assessment is presented in Table 8.16.

50. Where a range is suggested for the significance of effect, for example, minor to moderate, it is possible that this may span the significance threshold. The technical specialist's professional judgement was applied to determine which outcome defines the most likely effect, which takes in to account the sensitivity of the receptor and the magnitude of impact. Where professional judgement is applied to quantify final significance from a range, the assessment hsa set out the factors that result in the final assessment of significance. These factors may include the likelihood that an effect will occur, data certainty and relevant information about the wider environmental context.

51. For the purposes of this assessment:

- a level of residual effect of moderate or more will be considered a 'significant' effect in terms of the EIA Regulations; and
- a level of residual effect of minor or less will be considered 'not significant' in terms of the EIA Regulations.

52. Effects of moderate significance or above are therefore considered important in the decision-making process, whilst effects of minor significance or less warrant little, if any, weight in the decision-making process.

Table 8.16: Matrix Used for the Assessment of the Significance of the Effect

		Magnitude of Impact			
		Negligible	**Low**	**Medium**	**High**
Sensitivity of Receptor	**Negligible**	Negligible	Negligible to Minor	Negligible to Minor	Minor
	Low	Negligible to Minor	Negligible to Minor	Minor	Minor to Moderate
	Medium	Negligible to Minor	Minor	Moderate	Moderate to Major
	High	Minor	Minor to Moderate	Moderate to Major	Major
	Very High	Minor	Moderate to Major	Major	Major

8.9.3. DESIGNATED SITES

53. As per the conclusions provided in section 8.7.2, this Array EIA Report no LSE[1] in EIA terms are predicted on the qualifying interest feature(s) of MPAs, Natura 2000 sites (i.e. nature conservation sites in Europe designated under the Habitats or Birds Directives[5]) and/or sites in the UK that comprise the National Site Network (collectively termed 'European sites'). This is due to the distance from the Array of designated sites with qualifying interest features relevant to benthic subtidal ecology and the non-mobile nature of their respective qualifying features. These factors result in a lack of potential impact upon these designated sites due to the Array.

8.10. MEASURES ADOPTED AS PART OF THE ARRAY

54. As part of the Array design process, a number of designed in measures have been proposed to reduce the potential for impacts on benthic subtidal ecology (see Table 8.17). They are considered inherently part of the design of the Array and, as there is a commitment to implementing these measures, these have been considered in the assessment presented in section 8.11 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These designed in measures are considered standard industry practice for this type of development.

Table 8.17: Designed In Measures Adopted as Part of the Array

Designed In Measures Adopted as Part of the Array	Justification
Development of, and adherence to an Environmental Management Plan (EMP) (volume 4, appendix 21).	To ensure adequate environmental controls are in place across the project to manage and mitigate any potential risk to the environment. Measures will cover all aspects of environmental management including environmental awareness training, auditing, environmental reporting and waste management. It is anticipated that the Marine Pollution Contingency Plan (MPCP) and Invasive Non-Native Species Management Plan (INNSMP) will be appendices to the overarching EMP.
Development of, and adherence to a Marine Pollution Contingency Plan *(*MPCP) (volume 4, appendix 21, annex A).	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and maintenance and decommissioning plant is reduced so far as reasonably practicable. These will likely include designated areas for refuelling where spillages can be easily contained, storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, double skinning of pipes containing hazardous substances, and storage of these substances in impenetrable bunds. All vessels associated with the Array will be required to comply with the standards set out by International Convention for the Prevention of Pollution from Ships (MARPOL).
Development of, and adherence to a Scour Protection Management Plan *(*SPMP) (volume 4, appendix 25).	To set out the approach to scour protection installation and monitoring to ensure asset integrity is not compromised whilst reducing scour requirements as far as practicable during the project lifecycle.
Development of, and adherence to an INNSMP (volume 4, appendix 21, annex B).	To reduce the risk of introduction and spread of Invasive and Non-Native Species (INNS) during all phase of the Array as far as reasonably possible.
Development of, and adherence to a CBRA.	The CBRA will determine the risks arising from cable burial, such as scour, erosion, and dropped objects, and any measures to address them, in order to limit disturbance to the seabed as far as reasonably practicable.
Development of, and adherence to, a Decommissioning Programme (DP[2])	The aim of this plan is to adhere to the existing UK and international legislation and guidance (at the time of writing) during the decommissioning phase. This will reduce the amount of long-term disturbance to the environment as far as reasonably practicable. While this measure has been committed to as part of the Array, the MDS for the decommissioning phase has been considered in each of the assessments of effects presented in section 8.8.

[5] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

8.11. ASSESSMENT OF SIGNIFICANCE

55. Table 8.12 summarises the potential impacts arising from the construction, operation and maintenance and decommissioning phases of the Array, as well as the MDS against which each impact has been assessed. An assessment of the likely significance of the effects of the Array on the benthic subtidal ecology receptors caused by each identified impact is given below.

TEMPORARY HABITAT LOSS AND DISTURBANCE

56. Temporary habitat loss and disturbance will occur during the construction, operation and maintenance, and decommissioning phases of the Array. The MDS for this impact is summarised in Table 8.12. The relevant MarESA pressures and their benchmarks which have used to inform this impact assessment are:

- Habitat structure changes – removal of substratum (extraction): the benchmark for which is the extraction of substratum to 30 cm. This pressure is considered to be analogous to the impacts associated with sand wave and boulder clearance/relocation and UXO clearance.
- Abrasion/disturbance at the surface of the substratum or seabed: the benchmark for which is damage to surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the impacts associated with jack-up vessel operations, cable installation, and any infrastructure temporarily placed on the seabed.
- Penetration and/or disturbance of the substratum subsurface: the benchmark for which is damage to sub-surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the impacts associated with cable and DEA installation, sand wave clearance, UXO clearance, and jack-up vessel operations.
- Smothering and siltation rate changes (heavy): the benchmark for which is heavy deposition of up to 30 cm of fine material added to the habitat in a single discrete event. This pressure corresponds to impacts associated with sand wave clearance and cable installation.

Construction phase

Magnitude of impact

57. The MDS accounts for up to a total of 49.95 km^2 of temporary habitat loss and disturbance during the construction phase (Table 8.12). The represents 5.82 % of the total Array benthic subtidal ecology study area. The MDS has been based on the total temporary habitat loss and disturbance as a result of the following activities in the site preparation and construction phases:

- sand wave and boulder clearance/relocation and UXO clearance;
- installation of inter-array and interconnector cables;
- footprint of temporary offshore wet storage;
- footprint of jack up vessels used for OSP installation; and
- installation of DEAs.

58. Seabed preparation activities (sand wave and boulder clearance and relocation) will account for up to 14.72 km^2 of temporary habitat loss and disturbance (Table 8.12). Any mounds of cleared material will erode over time and displaced material will re-join the natural sedimentary environment, gradually reducing the size of the mounds. As the sediment type deposited on the seabed will be similar to that of the surrounding areas (and largely sandy, see section 8.7.1), displaced benthic communities would be expected to recolonise these areas (see 'Sensitivity of the receptors' below). Further, based on the site-specific bathymetry data, broadscale sand wave clearance is unlikely to be required. Bedforms recorded in the site-specific surveys were relatively low (volume 2, chapter 7). In addition, up to 15 UXOs may require clearance during site preparation activities, which could result in the formation of craters (Table 8.12). Information on potential crater dimensions is challenging to predict for the Array at this stage, and there is limited information on this impact available in the literature. However, two recent studies assessed seabed disturbance from UXO clearance at southern North Sea wind farms (Ordtek, 2018, Royal HaskoningDHV, 2022). Modelling suggested that craters of up to 21 m in diameter could be created from UXO detonation, giving an area of approximately 346 m^2 per crater (Ordtek, 2018, Royal HaskoningDHV, 2022). Using these calculations, if 15 UXOs require clearance during site preparation for the Array, a total of up to 5,190 m^2 of temporary habitat loss could occur due to crater formation (i.e. 346 m^2 x 15 craters). However, it should be noted that this is only a precautionary estimation, and these parameters and calculations will be refined at a later stage. As previously mentioned for sand wave and boulder clearance and relocation, it is expected that the craters will erode and infill overtime, and displaced material will re-join the natural sedimentary environment.

59. Inter-array and interconnector cable installation will result in 25.39 km^2 of temporary habitat loss and disturbance within the construction phase (Table 8.12). This will include the installation of 1,261 km of inter-array cables (of which 116 km will be dynamic) and 236 km of interconnector cables on the seabed, with a 20 m width of disturbance from the installation tool. For the purposes the MDS, the total footprint of affected seabed has been calculated, assuming a mound of uniform thickness of 0.5 m height. However, it should be noted that, mounds may be taller and more unevenly distributed. Any mounds of cleared material will, however, erode over time and displaced material will re-join the natural sedimentary environment, gradually reducing the size of the mounds and so this estimate can be considered suitably precautionary.

60. A recent study by RPS (2019) reviewed the effects of cable installation on subtidal sediments and habitats, drawing on monitoring reports from over 20 UK offshore wind farms. Following cable installation, sandy sediments were shown to recover quickly, with little to no evidence of disturbance in the years following cable installation (RPS, 2019). Although there was some evidence that remnant cable trenches in coarse and mixed sediments were conspicuous for several years after installation, these shallow depressions were of limited depth (i.e. tens of centimetres) relative to the surrounding seabed, and spread over a horizontal distance of several metres and therefore did not represent a large shift from the baseline environment (RPS, 2019). In muddy and muddy sand seabed habitats, remnant trenches were observed years following cable installation, although these were relatively shallow (i.e. a few tens of centimetres) (RPS, 2019). Given that the seabed sediments within the Array benthic subtidal ecology study area are dominated by sands and sandy gravels (see section 8.7.1), the results of the RPS (2019) study suggest that disturbance to these sediments is likely to be reversible. In addition, post-construction monitoring of the Block Island Offshore Wind Farm (off the coast of Rhode Island, United States of America (USA)) demonstrated that 62% of the trench formed during export cable installation had recovered within four months, and the remainder was partially recovered (Bureau of Ocean Energy Management (BOEM), 2020), further highlighting the reversibility of this impact.

61. Temporary habitat loss and disturbance will occur as a result of depressions formed by jack up vessels used to install OSPs. The MDS accounts for a total area of up to 43,200 m^2 (Table 8.12) across the Array benthic subtidal ecology study area due to jack up vessel footprints. The MDS is derived from up to three large OSPs and 12 small OSPs requiring installation using jack up vessels, with up to two jack up events per OSP, and up to 1,440 m^2 of disturbance per jack up usage. Depressions in the seabed caused by jack up vessel usage could last for up to a year or more. For example, monitoring studies at Barrow Offshore Wind Farm (Irish Sea) demonstrated that depressions were almost entirely infilled 12 months post construction (Barrow Offshore Windfarm Ltd, 2008). Similarly, post-construction seafloor disturbance monitoring at the Block Island Wind Farm suggested that depressions from the spud cans of jack up vessels were expected to fully recover (BOEM, 2020).

62. The maximum footprint of temporary offshore wet storage is up to 250,000 m^2 (Table 8.12). At this stage of the Application, the wet storage requirements of the Array are uncertain, however they are temporary in nature, and benthic habitats are expected to recover in the same manner as described in paragraphs 58 to 61. Wet storage may be used to optimise delivery schedules during installation of mooring and anchors. Anchors or mooring components may be offloaded from the delivery vessel at or close to the final installation location to allow the delivery vessel to leave site. The installation vessels will then complete the final installation of the anchors and mooring lines at the turbine location. It is not anticipated that wet storage will be required for prolonged periods of time. Mooring lines and dynamic cables following

installation may also be left on the seabed at the final locations, whilst awaiting hook up of the floating turbine.

63. Finally, if DEAs are selected as an anchoring method for floating foundations (see Anchoring Option 2 and 3 in the Project Description, volume 1, chapter 3), these will be lifted from the installation vessel using a crane and positioned on the seabed. The DEAs will then be pulled using an anchor handling tug, or similar, in order to embed the anchor in the seabed. It is anticipated that based on the ground conditions at site, that the anchor will be pulled between 30 to 60 m during the installation process, subject to further ground investigations and anchor design. This process will be undertaken in a controlled manner to ensure that DEAs are installed at the correct position and to appropriate depth. There will be up to 1,590 DEAs installed in this manner in total, resulting in a maximum footprint of up to 9,540,000 m^2 (Table 8.12).

64. The maximum duration of the offshore construction phase for the Array is up to eight years (2031 to 2038 inclusive). Within this maximum construction phase, construction activities are anticipated to occur intermittently. They will be spread out across the full allotted timeframe with only a small proportion of the MDS footprint for this impact being affected at any one time.

65. The impact is predicted to be of local spatial extent (5.82% of the Array benthic subtidal ecology study area), medium term duration (up to eight years), intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

66. The sensitivity of the IEFs to temporary habitat loss and disturbance are presented in Table 8.18. These sensitivities are based on the MarESA (where available).

67. The two representative biotopes for the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs were both concluded, overall, to be of medium sensitivity to this impact based on the four MarESA pressures (Table 8.18) (Tillin, 2016a; Tillin, 2016b). They have medium to high vulnerability to the pressure 'Habitat structure changes – removal of substratum (extraction)' as the benthic species associated with these biotopes are shallowly buried and extraction will remove them. However, these biotopes have medium resilience as they are characterised by opportunistic species that can rapidly colonise disturbed habitats or species that are larger and longer living and may present in established and mature assemblages (Table 8.18) (Tillin, 2016a; Tillin, 2016b). These two biotopes also have medium sensitivity to the pressure 'Smothering and siltation rate changes (heavy)' as the characteristic species may not be able to migrate through heavy smothering (up to 30 cm of sediment in a single event) (Tillin, 2016a, Tillin, 2016b). The biotopes have low sensitivity to the pressures 'Abrasion/disturbance of the surface of the substratum or seabed' and 'Penetration or disturbance of the substratum subsurface' (Table 8.18). While abrasion and penetration of the subsurface are likely to damage a proportion of the characteristic species at the surface of the substratum, resilience and recovery is high due to their opportunistic nature, resulting in a low sensitivity (Tillin, 2016a; Tillin, 2016b). Overall, the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs are deemed to be of medium vulnerability, medium to high recoverability and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

68. The ocean quahog IEF was concluded to be of high sensitivity to this impact based on the MarESA pressures (Table 8.18) (Tyler-Walters and Sabatini, 2017). They have low to no resistance to the removal of substratum or abrasion and penetration of the substratum surface (Table 8.18) (Tyler-Walters and Sabatini, 2017). This is because the ocean quahog feeds at the surface of the substratum, and burrows to several centimetres and down to depths of 14 cm periodically (Morton, 2011, Strahl *et al.*, 2011). Therefore, these pressures would result in removal and/or damage to the substratum that individuals occupy alongside removal and damage to any individuals present (Tyler-Walters and Sabatini, 2017). Furthermore, ocean quahog are vulnerable to disturbance given their long lifespan (hundreds of years), slow growth rate, and high age of sexual maturity (from ten years old) (Thorarinsdóttir *et al.*, 2010; Thorarinsdóttir and Jacobson, 2005). For example, the effects of hydraulic dredging on the benthic community in a bay in Iceland reported a 93% decreased in ocean quahog abundance, with recovery in only 7% to 26% of dredge channels within five years (Ragnarsson *et al.*, 2015). Although ocean quahog have low vulnerability and high resistance to smothering (therefore a low sensitivity) (Table 8.18), this species is still assessed as high sensitivity to the impact of temporary habitat loss and disturbance, due to its high sensitivity to the other three MarESA pressures. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivities of the receptors are, therefore, considered to be high.

69. The dead man's fingers IEFs was concluded to be of medium sensitivity to this impact based on the MarLIN assessment (Table 8.18) (Budd, 2008). Sensitivity was assessed as medium to the pressure of 'substratum loss' (named differently in the MarLIN than the MarESA pressures for the other IEFs) (Table 8.18) (Budd, 2008). This is because the species is permanently attached to the substratum, and therefore has a high vulnerability to removal. However, given suitable substrate remains or is deposited (which would be the case for the construction activities associated with this impact), potential for recovery is high (Budd, 2008). Recoverability for dead man's fingers is high in general, given its broadcast reproduction strategy of long-lived larvae, which increases population resilience (Budd, 2008). Dead man's fingers has a low overall sensitivity to the pressures of 'Abrasion and physical disturbance' and 'Smothering' associated with temporary habitat loss and disturbance (Table 8.18) (Budd, 2008). The species has a medium vulnerability to abrasion and physical disturbance, which has been inferred from consistent reports of damage caused by abrasive fishing gear (Hartnoll, 1999, Hinz *et al.*, 2011), and medium to high recoverability (Budd, 2008). The species has a medium vulnerability to smothering as it is permanently attached to the substratum, however, colonies can be large (up to 20 cm in height), and thus recovery is likely (Budd, 2008). Overall, the dead man's fingers IEF is deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

70. As stated in paragraph 48, no MarESA was available for phosphorescent sea pen or sea tamarisk IEFs, so they have been assessed using the best available literature. Both of these IEFs are colonial species, which live attached to their substrate. The phosphorescent sea pen is embedded into the seabed by its peduncle (i.e. stalk, or anchoring structure), while the sea tamarisk is attached to bedrock, stable rocks, or shells (Jones, 2008, Wilson, 2002). Therefore, they are likely to be highly vulnerable to removal of substratum, and abrasion, penetration, and disturbance of the substratum subsurface. For phosphorescent sea pen, this has been inferred from observations of fishing gear and dredging removing entire sea pens from the substratum (Kenchington *et al.*, 2011; Tuck *et al.*, 1998). However, the phosphorescent sea pen can retreat into its burrow, which can be up to 25 cm deep (Greathead *et al.*, 2007; Jones, 2008), and may be able to avoid removal, abrasion, disturbance or penetration of the first few centimetres of substratum as a result (Hill and Tyler-Walters, 2018). Furthermore, sea pens have been observed to be able to reinsert themselves into the sediment if the peduncle is in contact with the seabed (Eno *et al.*, 2001). The phosphorescent sea pen is not likely to be vulnerable to heavy smothering and siltation rate changes given that it can readily retreat deep into its burrow until the sediments have been redispersed (Hill and Tyler-Walters, 2018). Recoverability is therefore considered to be high. Although the sea tamarisk cannot retreat into the sediment, it forms large colonies (over 15 cm) and its stem is supported by a non-living, protein-chitinous structure (Wilson, 2002). As this species naturally lives in turbid environments with moderate to strong tidal streams, it is likely to be adapted to smothering and surface disturbance. Further, colonial hydroids in general are known to be resilient taxa, given their modular body organisation and high environmental plasticity (Di Camillo *et al.*, 2017; Gili and Hughes, 1995). Overall, the phosphorescent sea pen and sea tamarisk IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Table 8.18: Sensitivity of the IEFs to Temporary Habitat Loss and Disturbance

IEF	Representative Biotopes	Sensitivity to Defined MarESA Pressure				Overall Sensitivity
		Habitat Structure Changes – Removal of Substratum (Extraction)	Abrasion/disturbance of the Surface of the Substratum or Seabed	Penetration or Disturbance of the Substratum Subsurface	Smothering and Siltation Rate Changes (Heavy)	
Offshore subtidal sands and gravels and Subtidal sands and gravels	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri)	Medium	Low	Low	Medium	Medium
	Abra prismatica, Bathyporeia elegans, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo)	Medium	Low	Low	Medium	Medium
Dead man's fingers*	N/A	Medium (referred to as 'Substratum loss' in the MarLIN assessment available)	Low (Referred to as 'Abrasion and physical disturbance' in the MarLIN assessment available)	Not assessed in the MarLIN assessment	Low (Referred to as 'Smothering' in the MarLIN assessment available)	Medium
Ocean quahog	N/A	High	High	High	Not sensitive	High
Phosphorescent sea pen	N/A	No MarESA available, sensitivities to the defined pressures are discussed in paragraph 70 from the best available literature.				Medium
Sea tamarisk	N/A					Medium
*It should be noted that there is no MarESA available for dead man's fingers. For this IEF, only the MarLIN sensitivity assessment was available, which was superseded by the MarESA for the other IEFs in 2014. The naming of the pressures therefore vary slightly but are still comparable with the MarESA used for the other IEFs, however 'Penetration or disturbance of the substratum subsurface' was not assessed in the MarLIN assessment.						

Significance of the effect

71. Overall, for the ocean quahog IEF, the magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to both the Array benthic subtidal ecology study area and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

72. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

73. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

74. The MDS accounts for up to a total of 51.41 km^2 of temporary habitat loss and disturbance during the 35 year operation and maintenance phase (Table 8.12). This represents 5.99% of the total Array benthic subtidal ecology study area. However, it should be noted that only a small proportion of the total temporary habitat loss and disturbance is likely to occur at any one time, with the MDS for this impact calculated over the 35 year lifecycle of the Array. There may be up to 1.47 km^2 of temporary habitat loss and disturbance per year. Therefore, individual maintenance activities will be small scale and intermittent events. The MDS has been based on the total temporary habitat loss and disturbance as a result of the following activities in the operation and maintenance phase:

- footprint of jack up vessels used for operation and maintenance activities; and
- disturbance caused by reburial of inter-array and interconnector cables.

75. The impacts of jack up vessel activities will be similar to those identified for the construction phase above and will be restricted to the immediate area where the spud cans are placed on the seabed, with recovery occurring following removal of spud cans. The footprint of temporary habitat loss and disturbance due to jack up vessel use has been calculated as up to 10,500 m^2 per year. The impacts of inter-array and interconnector cable reburial will be similar to those identified for cable installation in the construction phase above but will only impact up to 1.22 km^2 and 0.23 km^2, respectively, per year.

76. The spatial extent of this impact in the operation and maintenance phase is small in relation to the whole Array benthic subtidal ecology study area, although there is the potential for repeated disturbance to the habitats in the immediate vicinity of the infrastructure because of these activities. However, these effects are expected to be similar to the construction phase, but of a much lower magnitude.

77. The impact is predicted to be of local spatial extent (5.99% of the Array benthic subtidal ecology study area), long term duration, intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

78. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phase (see Table 8.18 and paragraphs 66 to 70) and have not been repeated here.

Significance of the effect

79. Overall, for the ocean quahog IEF, the magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to both the Array benthic subtidal ecology study area and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

80. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

81. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

82. The MDS accounts for up to a total of 43,200 m^2 of temporary habitat loss and disturbance during the decommissioning phase (Table 8.12). The represents 0.01% of the total Array benthic subtidal ecology study area. The MDS has been based on the total temporary habitat loss and disturbance as a result of the footprint of jack up vessels used for decommissioning activities. The impacts of these jack up vessel activities will be similar to those identified for the construction phase above and will be restricted to the immediate area where the spud cans are placed on the seabed, with recovery occurring following removal of spud cans.

83. The impact is predicted to be of local spatial extent (0.01% of the Array benthic subtidal ecology study area), short term duration, intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

84. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phase (see Table 8.18 and paragraphs 66 to 70) and have not been repeated here.

Significance of the effect

85. Overall, for the ocean quahog IEF, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

86. For all other IEFs, the magnitude of the impact is deemed to be negligible, and the sensitivities of the receptors are considered to be medium. As per Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

87. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

LONG TERM HABITAT LOSS AND DISTURBANCE

88. Long term habitat loss and disturbance will occur during the construction, operation and maintenance, and decommissioning phases of the Array. The MDS for this impact is summarised in Table 8.12. The impact of long term habitat loss does not represent a complete removal of habitat, but rather a physical change from a predominantly sandy sedimentary habitat to a hard, artificial substratum. The relevant MarESA pressure and its benchmark which has used to inform this impact assessment is:

- Physical change (to another seabed type): the benchmark for which is change in sediment type from sedimentary or soft rock substrata to hard rock or artificial substrate or vice-versa.

89. The effects of long term habitat loss and disturbance are assessed here, however the potential for colonisation of the hard structures installed has been assessed below in 'Colonisation of hard structures'. Further, while the long term habitat loss and disturbance will occur in the decommissioning phase through infrastructure that is left *in situ,* the potential effects to benthic subtidal ecology due to the removal of other infrastructure in the decommissioning phase has been assessed separately in 'Effects to benthic subtidal ecology due to removal of hard substrates' below.

Construction and operation and maintenance phases

Magnitude of impact

90. The MDS accounts for up to a total of 19.27 km^2 of long term habitat loss and disturbance as infrastructure is installed during the construction phase, which will persist into the operation and maintenance phase (Table 8.12). The represents 2.25% of the total Array benthic subtidal ecology study area. The MDS has been based on the total long term habitat loss and disturbance as a result of the installation of the following infrastructure:

- mooring lines and anchors on the seabed;
- OSP foundations;
- inter-array and interconnector cable protection and cable crossing protection;
- subsea junction boxes; and
- scour protection for mooring lines, anchors, OSP foundations, and subsea junction boxes.

91. In addition, the MDS accounts for up to 778,464 m^2 of long term seabed disturbance due to the persistent frequent and intermittent movement of dynamic cabling and mooring lines on the seabed (Table 8.12). The represents 0.09% of the total Array benthic subtidal ecology study area over the 35 year lifecycle of the Array. Finally, the MDS includes drilling at up to 10% of piles, with up to 636 m^3 of drill arisings associated with each.

92. The installation of mooring lines and anchors on the seabed will result in up to 12.41 km^2 and 25,288 m^2 of long term habitat loss, respectively, with their associated scour protection accounting for up to 632,196 m^2 (Table 8.12). The installation of up to three large OSPs and 12 small OSPs will result in a maximum footprint of 2,163 m^2, with up to 94,814 m^2 of associated scour protection (Table 8.12). Up to 4.89 km^2 and 0.94 km^2 of cable protection will be installed on the seabed for the inter-array and interconnector cables, respectively, with up to 24,000 m^2 of cable protection in addition (Table 8.12). Finally, the installation of up to 228 junction boxes and their scour protection accounts for 41,040 m^2 and 201,552 m^2 of long term habitat loss, respectfully (Table 8.12).

93. The impact is predicted to be of local spatial extent (2.25% of the Array benthic subtidal ecology study area), long term duration, continuous, and of low reversibility during the construction and operation and maintenance phases. It is predicted that the impact will affect the receptors directly. This impact presents some measurable, but minor long term loss of and alteration to areas of seabed within the Array benthic subtidal ecology study area, but not in the regional benthic subtidal ecology study area. The magnitude is therefore considered to be low.

Sensitivity of the receptor

94. The sensitivity of the IEFs to long term habitat loss and disturbance are presented in Table 8.19. These sensitivities are based on the MarESA (where available).

95. The two representative biotopes of the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF are both characterised by their sedimentary habitats (circalittoral fine sand) (Tillin, 2016a, Tillin, 2016b). Therefore, a change to an artificial or rock substratum would alter the characteristics of the biotopes, and result in a loss of the characteristic species (such as *E. pusillus, O. borealis, A. prismatica, B. elegans,* and other polychaetes and bivalves) that live buried within sandy sediments (Tillin, 2016a, Tillin, 2016b). Overall, the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs are deemed to be of high vulnerability, low recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be high (Table 8.19).

96. Similarly, the ocean quahog IEF and phosphorescent sea pen IEF also require a soft sedimentary habitat, and physical change to hard artificial or rock substratum would represent habitat loss for individuals affected. These species are therefore highly vulnerable to this impact (Hill and Tyler-Walters, 2018, Tyler-Walters and Sabatini, 2017). Overall, the ocean quahog and phosphorescent sea pen IEFs are deemed to be of high vulnerability, low recoverability, and national and regional value, respectively. The sensitivities of the receptors are, therefore, considered to be high (Table 8.19).

97. In contrast however, dead man's fingers and sea tamarisk naturally live on hard substrates, including bedrock, rocks, boulders, shells, and man-made artificial hard structures (Budd, 2008, Wilson, 2002). Therefore, this impact does not represent a change from a preferred habitat to an unsuitable one for these IEFs, in comparison to the others. In addition, hydroids (such as sea tamarisk) are typically one of the first taxa to colonise new substrates (Boero, 1984). Therefore, the dead man's fingers IEF and the sea tamarisk IEF are deemed to be of low vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low (Table 8.19).

Table 8.19: Sensitivity of the IEFs to Long Term Habitat Loss and Disturbance

IEF	Representative Biotopes	Sensitivity to Defined MarESA Pressure Physical Change (to Another Seabed Type)	Overall Sensitivity
Offshore subtidal sands and gravels and Subtidal sands and gravels	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri)	High	High
	Abra prismatica, Bathyporeia elegans, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo)	High	High
Dead man's fingers*	N/A	Not assessed	Low
Ocean quahog	N/A	High	High
Phosphorescent sea pen	N/A	No MarESA available, sensitivities to the defined pressures are discussed in paragraph 97 from the best available literature.	High
Sea tamarisk	N/A		Low
*It should be noted that there is no MarESA available for dead man's fingers. For this IEF, only the MarLIN sensitivity assessment was available, which was superseded by the MarESA for the other IEFs in 2014. The pressure 'Physical change (to another seabed type)' was not assessed in the MarLIN assessment.			

Significance of the effect

98. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

99. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of long term habitat loss and disturbance with respect to both the Array benthic subtidal ecology study area and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

100. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

101. The MDS accounts for up to a total of 6.79 km^2 of long term habitat loss and disturbance in the decommissioning phase (Table 8.12). The represents 0.79% of the total Array benthic subtidal ecology study area. The MDS has been based on the total long term habitat loss and disturbance as a result of the following infrastructure remaining *in situ* during the decommissioning of the Array:

- anchors where they are embedded deep in the seabed;
- inter-array and interconnector cable protection and cable crossing protection; and
- scour protection for moorings, anchors, subsea junction boxes and OSP foundations.

102. All other infrastructure on the seabed mentioned in paragraph 90, will be removed, with only cable protection (5.83 km^2), cable crossing protection (24,000 m^2), and scour protection remaining (928,562 m^2) (Table 8.12). Anchors will be removed where they can be easily recovered without major excavation of the seabed and where it is safe to do so. For piles that are embedded deep in the seabed, e.g. piles, or DAEs that are installed at depth within the seabed these will be cut at or below the seabed and left in-situ.

103. The impact is predicted to be of local spatial extent (0.79% of the Array benthic subtidal ecology study area), long term duration, continuous, and of low reversibility during the decommissioning phase. It is predicted that the impact will affect the receptors directly. This impact presents some measurable and minor long term loss of and alteration to the affected areas of seabed within the entire Array benthic subtidal ecology study area but less so within the regional benthic subtidal ecology study area. The magnitude is therefore considered to be low.

Sensitivity of the receptor

104. The sensitivities of all IEFs are considered to be as previously described for the construction and operation and maintenance phases (see Table 8.19 and paragraphs 94 to 97) and have not been repeated here.

Significance of the effect

105. Overall, for the dead man's fingers IEF and the sea tamarisk IEF, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

106. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of long term habitat loss and disturbance with respect to both the Array benthic subtidal ecology study area and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

107. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

INCREASED SSCS AND ASSOCIATED DEPOSITION

108. Increased SSCs and associated deposition may arise in all phases of the Array. Indirect impacts of this on benthic subtidal ecology include increased turbidity and smothering. In the operation and maintenance phase, this impact has been informed by the qualitative assessments undertaken for physical processes (see volume 3, appendix 7.1, and volume 2, chapter 7). In the construction and decommissioning phases, this impact has been assessed qualitatively, however not informed by the physical processes assessment, as it was not scoped in for these phases for physical processes. The benchmarks for the relevant MarESA pressures which have been used to inform this impact assessment are:

- Changes in suspended solids (water clarity): the benchmark for which is a change in one rank on the Water Framework Directive (WFD) scale (e.g. from clear to intermediate for one year, caused by activities disturbing sediment or organic particulate material and mobilising it into the water column).

- Smothering and siltation rate changes (light): the benchmark for light sediment deposition is up to 5 cm of fine material added to the habitat in a single discrete event.

Site preparation and construction phase

Magnitude of impact

109. The site preparation activities and installation of infrastructure associated with the Array may lead to increases in SSCs and associated deposition. The following activities have been considered:

- seabed preparation activities: boulder and sand wave clearance;
- DEA installation; and
- inter-array and interconnector cable installation and burial (Table 8.12).

110. A qualitative assessment of increased SSC has been undertaken with reference to other quantitative modelling undertaken on other offshore wind projects in the regional benthic subtidal ecology study area to inform the assessment.

111. Boulder clearance may be required for up to 25% of the length of inter-array and interconnector cables, a total of 315.25 km and 59 km respectively. A clearance width of up to 24 m will be required. Similarly, sand wave clearance will also require a clearance width of up to 24 m, with a total of 11,841,602 m^3 of cleared material presented in the Project Description (volume 1, chapter 3) (Table 8.12). The modelling conducted for Berwick Bank Wind Farm considered a clearance width of 25 m for site preparation activities, such as sand wave clearance (SSE Renewables, 2022). This modelling showed that the resulting sediment plume would be very small, with SSCs of <100 mg/l. SSCs were predicted to peak during the deposition of cleared material, with concentrations reaching 2,500 mg/l at the release site, but the plume was predicted to be at its most extensive during the redistribution of the deposited material on successive tides (SSE Renewables, 2022). Under these circumstances, concentrations of 100 mg/l to 250 mg/l were predicted with average values <100 mg/l extending out to one tidal excursion (SSE Renewables, 2022). Sedimentation of deposited material was focussed within 100 m of the site of release with a maximum depth 0.5 m to 0.75 m, whilst the finer sediment fractions were distributed in the vicinity at much smaller depths (circa 5 mm to 10 mm) over a maximum distance of one tidal excursion (SSE Renewables, 2022). As the seabed sediments at Berwick Bank are coarser than those of the Array benthic subtidal ecology study area (which comprises largely deep circalittoral sand; Figure 8.2), the smaller sedimentation depths associated with finer sediment fractions (5 mm to 10 mm; (SSE Renewables, 2022)) are more likely to be associated with site preparation activities for the Array.

112. Furthermore, modelling conducted for the Seagreen 1 and 1A Wind Farms suggested that material released from seabed preparation activities will mostly fall to the seabed as part of a dynamic plume or a passive plume (Seagreen Wind Energy Limited, 2012). Any material released as a passive plume will be in low concentrations and remain for a relatively short duration, before becoming widely dispersed in the area of tidal currents (Seagreen Wind Energy Limited, 2012). Whilst the overall total of potentially released sediments at Seagreen 1 and 1A was considered to be high, it will take place on a foundation by foundation basis over the course of the construction phase, with a maximum of two foundations being installed at any one time (Seagreen Wind Energy Limited, 2012). The modelling concluded that dispersal of sediment is likely to occur along the main axis of tidal current flow with elevated SSCs being relatively low compared to background values, and of a short term duration (Seagreen Wind Energy Limited, 2012). A low magnitude of impact was concluded for site preparation activities at Berwick Bank and Seagreen 1 and 1A (Seagreen Wind Energy Limited, 2012, SSE Renewables, 2022).

113. As described in paragraph 63, up to 1,590 DEAs may be pulled up to 60 m along the seabed during the construction phase. This process will be undertaken in a controlled manner to ensure that DEAs are installed at the correct position and to appropriate depth. DEAs were not assessed in any publicly available EIAs for projects within the regional benthic subtidal ecology study area, however they are discussed in a recent study on the environmental effects of wind turbine foundations (Horwath *et al.*, 2020). This study concluded that floating foundations that use embedded anchors may have similar bottom-disturbing activities during installation when compared to monopiles, depending on the size of the anchors and method of installation (Horwath *et al.*, 2020). The study noted that the extent that anchors drag along the seabed due to the forces on floating foundations is unknown but is likely to produce some additional SSCs (Horwath *et al.*, 2020). Therefore, the low magnitude of impact associated with foundation installation at Berwick Bank Wind Farm, could be applied to the use of DEAs at the Array. Modelling of SSCs associated with foundation installation at Berwick Bank Wind Farm predicted plumes to have peak concentrations of <5 mg/l, with average values typically less than one fifth of this, and dropping to 1 mg/l to 2 mg/l within a very short distance, typically less than 500 m of the installation activity (SSE Renewables, 2022). The sediment plumes were expected to be temporary, returning to background levels within a few tidal cycles (SSE Renewables, 2022). The average sedimentation depth was predicted to be typically 0.05 mm to 0.1 mm during pile installation, with that maximum dropping to <0.003 mm one day following cessation of operations (SSE Renewables, 2022). This suggests that associated deposition would be imperceptible from the background sediment transport activity, with plotted sediment depths less than typical grain diameters (SSE Renewables, 2022). As per the Array, drill arisings will result from foundation installation at Berwick Bank Wind Farm. The assessment for these however, is considered under long term habitat loss and disturbance (paragraphs 90 *et seq.*) as this material will be deposited on the seabed in the same area which will be occupied by scour protection and is unlikely to be redistributed as a result of hydrodynamic processes.

114. Finally, cable installation and burial have the potential to result in increased SSCs and associated deposition. The MDS considers up to 1,261 km of inter-array cables and 236 km of interconnector cables (noting that up to 116 km of the total inter-array cables will be dynamic, and not buried at the seabed) (Table 8.12). As described in the Project Description (volume 1, chapter 3), cable installation methods are not currently defined, and will be identified at the final design stage (post-consent), however cable plough, jet trencher, mass flow excavator, and mechanical cutter are potential options. At the Berwick Bank Wind Farm, jet trenching was assumed for the modelling, which predicted peak increases in SSCs of 100 mg/l in the immediate vicinity of the cable installation, with the sediment subsequently re-suspended and dispersed on subsequent tides, giving rise to concentrations of up to 500 mg/l (SSE Renewables, 2022). The material was predicted to settle during slack water and then be resuspended to form an amalgamated plume. Sedimentation was predicted to be greatest at the location of the trenching and up to 30 mm in depth one day following cessation of inter-array cable installation (SSE Renewables, 2022). Levels of sedimentation were predicted to reduce significantly, down to single figures, within close proximity (i.e. 100 m) of the trench (SSE Renewables, 2022).

115. Similarly, modelling conducted for the Seagreen 1 and 1A Wind Farms considered jetting as the installation technique, which will fluidise or liquefy the seabed sediments, which will therefore remain near to the bed (Seagreen Wind Energy Limited, 2012). The assessment noted that much of the sediment released by jetting was likely to settle back in the immediate vicinity of its release due to its relatively coarse grain size at Seagreen 1 and 1A (Seagreen Wind Energy Limited, 2012). Any sediment that remained suspended would become dispersed by the prevailing tidal currents in low concentrations, and the magnitude of impact was concluded to be low for this project (Seagreen Wind Energy Limited, 2012).

116. Based on the qualitative assessment provided here and drawing on the low magnitudes of impact assessed for similar offshore wind projects in the regional benthic subtidal ecology study area, this impact is predicted to be of local spatial extent, short term duration, intermittent, and of high reversibility. The magnitude is therefore considered to be low.

Sensitivity of the receptor

117. The sensitivity of the IEFs to increased SSCs and associated deposition are presented in Table 8.20. These sensitivities are based on the MarESA (where available).

118. The two representative biotopes of the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF were both assessed as having a medium vulnerability and high recoverability to both the MarESA pressures associated with this impact (Tillin, 2016a; Tillin, 2016b) (Table 8.20). This is because

the characteristic species, such as bivalves, are expected to be regularly exposed to, and tolerant of, short term increases in SSCs (Tillin, 2016a, Tillin, 2016b). Overall, the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs are deemed to be of medium vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low (Table 8.20).

119. Similarly, ocean quahog and phosphorescent sea pen both inhabit silty and sandy substrates, where the surface of the sediment is naturally regularly mobilised (Hill and Tyler-Walters, 2018, Tyler-Walters and Sabatini, 2017). Furthermore, the ocean quahog can burrow through deposited sediments to allow its feeding siphons to reach the surface; this has been demonstrated in several studies which illustrated the species could burrow through approximately 40 cm of sediment, at speeds of up to 3.89 cm per day (Powilleit *et al.*, 2009, Powilleit *et al.*, 2006). As detailed above in paragraph 70, the phosphorescent sea pen can retreat into its burrow, which can be up to 25 cm deep (Greathead *et al.*, 2007, Jones, 2008). The phosphorescent sea pen is not likely to be vulnerable to light smothering and siltation rate changes given that it can readily retreat deep into its burrow until the sediments have been redispersed (Hill and Tyler-Walters, 2018). Overall, the ocean quahog and phosphorescent sea pen IEFs are deemed to be of low vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low (Table 8.20).

120. Dead man's fingers has a medium vulnerability to smothering as it is permanently attached to the substratum, however, colonies can be large (up to 20 cm in height), and thus recovery is likely (Budd, 2008). The species has been shown to be tolerant of high levels of suspended sediment, for example, Hill *et al.* (1997) demonstrated that the species sloughed off settled particles with a large amount of mucous. Siltation is normally only a problem in sheltered areas, and the slope of the rock that the species is attached to is also important as little silt will settle on vertical surfaces and overhangs (Budd, 2008). Similarly, sea tamarisk colonies can be over 15 cm in height, and have widely spaced branches (Wilson, 2002). Given the colony size and that hydroids are adapted to live in turbid waters with medium to strong tidal streams (Boero, 1984, Wilson, 2002), it is likely that they will be tolerant of changes to suspended solids, light smothering and siltation rate changes. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

Table 8.20: Sensitivity of the IEFs to Increased SSCs and Associated Deposition

IEF	Representative Biotopes	Sensitivity to Defined MarESA Pressure		Overall Sensitivity
		Changes in Suspended Solids (Water Clarity)	Smothering and Siltation Rate Changes (Light)	
Offshore subtidal sands and gravels and Subtidal sands and gravels	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri)	Low	Low	Low
	Abra prismatica, Bathyporeia elegans, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo)	Low	Low	Low
Dead man's fingers*	N/A	Very low (referred to as 'Increase in suspended sediment' in the MarLIN assessment)	Low (referred to as 'Smothering' in the MarLIN assessment)	Low
Ocean quahog	N/A	Not sensitive	Not sensitive	Low
Phosphorescent sea pen	N/A	No MarESA available, sensitivities to the defined pressures are discussed in paragraphs 119 and 120 from the best available literature.		Low
Sea tamarisk	N/A			Low
*It should be noted that there is no MarESA available for dead man's fingers. For this IEF, only the MarLIN sensitivity assessment was available, which was superseded by the MarESA for the other IEFs in 2014.				

Significance of the effect

121. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

122. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

123. A large proportion of the length of each mooring line will remain largely static on the seabed during operation and maintenance with movement predominately around the touchdown point. The greatest potential for the increase in SSCs due to mooring lines will be from catenary moorings which have the greatest length in contact with the seabed. Two approaches to the MDS were considered in the assessment of benthic subtidal ecology, in contrast to one considered in the physical processes assessment (volume 2, chapter 7). In line with the physical processes assessment, the first MDS was considered to be the number of foundations with the greatest length of mooring line on the seabed per foundation as this has the potential to result in the greatest increase in SSC within the radius of the mooring footprint of a single turbine mooring footprint. The effects are considered to be very localised, with no interactions in plumes or deposition between adjacent turbine locations. This was assumed as up to 130 semi-submersible turbine foundations with up to 9 catenary mooring lines each (Table 8.12). This first MDS is hereafter referred to as the '130 turbine MDS' for clarity. The second MDS considered was based on up to 265 semi-submersible turbine foundations with up to 6 catenary mooring lines each (Table 8.12) and is hereafter referred to as the '265 turbine MDS' for clarity. This was included in the assessment for benthic subtidal ecology as the 130 turbine MDS represents a potentially higher impact to benthic IEFs and habitats at a localised level (due to a higher number of mooring lines per foundation), but it does not consider the overall footprint of impact over the Array benthic subtidal ecology study area as a whole. Thus, the 265 turbine MDS represents a higher overall length of mooring lines, and therefore area of deposition from increased SSC over the Array benthic subtidal ecology study area as a whole, but a lower potential for impact associated with benthic IEFs and habitats in the immediate vicinity of individual turbines.

124. The mooring line radius for both MDSs is 700 m, with a touchdown distance of between 25 m and 150 m from the foundation, and overall length of 750 m. During operation, approximately 680 m of the catenary mooring line will be in contact with the seabed which amounts to up to 6,120 m per foundation for the 130 turbine MDS and up to 4,080 m per foundation for the 265 turbine MDS (Table 8.12). Overall, up to 795,600 m of mooring line may be in contact with the seabed under the 130 turbine MDS, and up to 1,081,200 m under the 265 turbine MDS (Table 8.12). The tidal range at the Array benthic subtidal ecology study area is less than 4 m, therefore it is not anticipated that tidal movements will result in substantial horizontal and vertical movements of floating substructures. As a result, the mooring lines are not considered to notably increase the SSCs under standard operating conditions for both the MDSs.

125. Under harsher weather conditions, the dynamic interaction between the mooring lines and the seabed will increase with intensity and direction of the storm. Horizontal movement of the floating foundations may result in the lifting of the mooring lines located on the windward side of the turbine, as tension on these mooring lines increases. Mooring lines on the leeward side would experience the opposite effect, whereby the length of mooring line in contact with the seabed increases as they slacken, up to a maximum of 710 m for some mooring lines in the most extreme storm conditions. The length where disturbance is likely to occur will be less, as this will be greater closer to the touchdown point and negligible towards the anchor

point. Furthermore, the dimensions of the mooring lines are considered to be small, with a chain thickness of 185 mm, and horizontal diameter of 620 mm, which will limit the volumes of seabed material they have the potential to disturb, even if they were to become completely embedded.

126. Movement on the seabed by inter-array cables will be limited to a small section between the touch down point and the point where the cable becomes static, resulting in minor increases to SSCs in the vicinity of the touchdown point only. With regard to inter-array cables, the total length of the dynamic inter-array cables will be 116 km with a maximum external cable diameter of 300 mm for both MDSs considered. Movement of the inter-array cables may be reduced through the use of buoyancy modules and clump weights (subject to engineering design) thus limiting movement on the seabed to a very small proportion of the total dynamic cable length between the touchdown point and where it transitions to a static cable. Static inter-array and interconnector cables on the seabed will be buried or fixed with cable protection where target burial depths cannot be achieved. Thus, the potential disturbance area is restricted to small areas in the vicinity of up to two dynamic cable touchdown points per turbine. Increased SSCs would therefore be spatially limited, smaller, and adjacent to any disturbance resulting from the mooring lines.

127. The spacing between the floating foundations is a minimum 1.4 km for the 130 turbine MDS and a minimum of 1 km for the 265 turbine MDS (Table 8.12). These spacings are large enough for any impacts to SSCs to be considered as isolated, considering the low current speeds and sediment transport rates in the physical processes study area. Any dynamic interactions between the seabed and mooring lines or dynamic cables will likely be experienced similarly at adjacent foundations under tidal and storm conditions, with the foundations moving in the same direction and orientated the same way as their neighbouring foundations. Thus, storm conditions will not impact upon minimum foundation spacing and seabed disturbance areas from mooring lines are considered sufficiently far apart to be isolated even under storm conditions for both MDSs considered.

128. Variation in seabed composition is limited across the Array benthic subtidal ecology study area, with sand accounting for most of the seabed substrate, with small amounts of mud and gravel. Disturbed materials are more likely to move along the seabed, rather than becoming fully suspended in the water column and due to the low nearbed current speeds, will not be transported for any significant distance before being re-deposited on the seabed. The baseline dominant current direction within the site boundary is to the south or south-south-west, with dominant wind directions also from the south-west. Therefore, disturbed sediments from mooring lines and cabling are likely to move towards the north-east, however, there may also be some effect from littoral currents produced by the dominant wave direction from the north.

129. As discussed within the physical processes technical report (volume 3, appendix 7.1), movement would only occur during a small proportion of the tidal cycle, due to the reduction in current speeds, therefore material will settle within a few minutes to hours, depending on tidal state and be deposited close to the area of disturbance. Therefore, the potential for changes to the overall sediment transport regime in the Array benthic subtidal ecology study area is unlikely, particularly considering the small quantities of material with potential to be disturbed. There is a low potential to directly impact benthic subtidal ecology from the increase in SSCs, however due to the isolated volumes of potential materials to be disturbed and the low sediment transport rates in the area, the impact can be considered to be relevant within the Array benthic subtidal ecology study area only. For both MDSs considered, direct impact would occur intermittently for short durations of the tidal cycle and would be greatest during storm conditions. Baseline Total Suspended Sediment (TSS) levels were assessed as likely below 10 mg/l during a winter storm, and any increase as a result of the mooring lines and cabling are not expected to exceed this. Seabed scouring from movement of mooring lines and cabling on the seabed during storm events will be limited due to the ongoing sediment transport processes.

130. Overall, for all IEFs, impact is predicted to be of local spatial extent, short term duration, intermittent, and of high reversibility. The magnitude is therefore considered to be low.

Sensitivity of the receptor

131. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phases (see Table 8.20 and paragraphs 117 to 120) and have not been repeated here.

Significance of the effect

132. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

133. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

134. Decommissioning of infrastructure associated with the Array may lead to increases in SSCs and associated deposition. The MDS is represented by the removal of all infrastructure, as this represents the largest potential for increased SSCs and associated deposition (Table 8.12). It should be noted that the decommissioning strategy is not defined, and cables, cable protection, and scour protection may potentially be left *in situ*. In reality, if some infrastructure remains *in situ*, the MDS presented here will be an overestimation, and SSCs will be lower as a result.

135. Decommissioning activities are assumed to result in increased SSCs and associated deposition that are lesser than or equal to those produced during construction. The impacts of decommissioning activities are therefore predicted to be no greater than those presented in paragraphs 109 *et seq.* for the site preparation and construction activities. In actuality, the release of sediment in the decommissioning phase will be lower as it does not include activities such as seabed preparation and DEA installation.

136. Therefore, this impact is predicted to be of local spatial extent, short term duration, intermittent, and of high reversibility. The magnitude is therefore considered to be low.

Sensitivity of the receptor

137. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phases (see Table 8.20 and paragraphs 117 to 120) and have not been repeated here.

Significance of the effect

138. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

139. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

EFFECTS TO BENTHIC SUBTIDAL ECOLOGY FROM EMF FROM SUBSEA ELECTRICAL CABLING

140. There is potential for EMFs to be produced by the subsea electrical cabling throughout the 35 year lifetime of the Array. There were no relevant MarESA pressures and benchmarks available to inform the assessment on any of the IEFs, due to the limited available information on the impacts of EMFs on benthic species (Tillin and Tyler-Walters, 2014a, Tillin and Tyler-Walters, 2014b).

Operation and maintenance phase

Magnitude of impact

141. The MDS accounts for up to 1,261 km of 66 kV inter-array cables, with up to 116 km within the water column (i.e. 'dynamic cables') and the rest buried at a minimum target depth of 0.4 m (Table 8.12). There will also be up to 236 km of interconnector cables buried to a minimum target depth of 0.4 m (Table 8.12). Final cable burial depths will be subject to a Cable Burial Risk Assessment (CBRA). It has been estimated in the MDS that up to 20% of these buried cables will require cable protection, with up to 24 cable crossings also requiring protection.

142. EMFs comprise both the electrical fields, measured in volts per metre (V/m), and the magnetic fields, measured in microtesla (µT), millitesla (mT), or milligauss (mG). Within the North Sea, background magnetic field measurements field are approximately 50 µT, and background electric field measurements are approximately 25 µV/m (Tasker *et al.*, 2010). Subsea cables are constructed using magnetic outer sheathing materials, which can partially block the direct electrical field (E-field), meaning that the only EMFs that are emitted into the marine environment are the magnetic field (B-field) and the resultant induced electrical field (iE-field). Dynamic cables are typically double armoured to increase stability and manage weight, which may inadvertently reduce losses of EMFs (Hervé, 2021). By design, alternating current (AC) and direct current (DC) cables typically contain three and two conductor bundles, respectively, which are superimposed and twisted around each other. This design feature creates partial self-cancellation of the total B-field (CSA Ocean Sciences Inc and Exponent, 2019, Hervé, 2021). At the seabed, cable burial and cable protection are common industry practice measures, which can reduce EMF levels at the seabed surface (Chapman *et al.*, 2023, CSA Ocean Sciences Inc and Exponent, 2019, Gill *et al.*, 2005, Gill *et al.*, 2009). Overall, EMF levels in the vicinity of subsea cables are influenced by a variety of design and installation factors, including distance between cables, cable sheathing, number of conductors, and internal cable configuration.

143. Although there will be up to 116 km of dynamic cabling, a large portion of this will be higher within the water column itself, and the length of cabling in the vicinity of the seabed will be much lower. At this stage of the Array design, it is not possible to refine this value further. However, the intensity of EMF from subsea cables decreases at approximately the inverse square/power of the distance away from the cable (Hutchison *et al.*, 2021). This attenuation is the same for buried, unburied, and dynamic cables (Hutchison *et al.*, 2021). Therefore, this impact is likely to be highly localised to the vicinity of dynamic cabling and therefore only the portion of cable close to the seabed will potentially impact benthic species.

144. The impact is predicted to be of local spatial extent, long term duration, continuous, and of high reversibility (as cables will be removed after the operation and maintenance phase). It is predicted that the impact will affect the receptors directly. This impact presents some measurable, long term minor loss of and alteration to the affected areas of seabed within the Array benthic subtidal ecology study area. The magnitude is therefore considered to be low.

Sensitivity of the receptor

145. While there is a growing evidence base on the impacts of EMFs on fish species (Armstrong *et al.*, 2015, Cresci *et al.*, 2022, CSA Ocean Sciences Inc and Exponent, 2019, Gill *et al.*, 2009, Gill and Taylor, 2001, Hutchison *et al.*, 2018, Normandeau Associates Inc *et al.*, 2011, Orpwood *et al.*, 2015, Snyder *et al.*, 2019), studies on benthic invertebrates are limited, with research primarily focussing on crustaceans (Harsanyi *et al.*, 2022, Hutchison *et al.*, 2020b, Hutchison *et al.*, 2018, Scott *et al.*, 2021, Scott *et al.*, 2018). Therefore, there is a knowledge gap surrounding the ability of benthic species to detect EMFs and any associated physiological or behavioural impacts (Albert *et al.*, 2020). As a result, there was no MarESA available for any of the benthic IEFs identified within this assessment to impacts associated with EMFs (Tillin and Tyler-Walters, 2014a, Tillin and Tyler-Walters, 2014b).

146. Recently, Chapman *et al.* (2023) presented the findings of a study on the behavioural and physiological responses of two echinoderms (common starfish and common sea urchin *Echinus esculentus*), velvet swimming crab *Necora puber,* and common periwinkle *Littorina littorea* to EMFs from subsea power cables. This represents the first study on the effects of EMF on common sea urchin, although previous studies have demonstrated developmental delay in the embryos of painted urchin *Lytechinus pictus* and purple urchin *Strongylocentrotus purpuratus* due to EMF exposure between 10 µT to 100,000 µT (Cameron *et al.*, 1993, Levin and Ernst, 1997, Zimmerman *et al.*, 1990). Chapman *et al.* (2023) exposed common starfish, common sea urchin, velvet swimming crab, and common periwinkle to EMFs of 500 µT for 24 hours and reported no significant behavioural or physiological responses in any of the species (Chapman *et al.*, 2023). Similarly, Bochert and Zettler (2006) found that an artificial static EMF of approximately 2,700 µT had no effect on common starfish distribution in laboratory settings over 22 hours. Bochert and Zettler (2006) also exposed ragworm *Hediste diversicolor* and the isopod crustacean *Saduria entomon* to the same environmental conditions, with ragworm distribution unaffected by the EMF levels, as per their results on common starfish. However, only one third of *S. entomon* individuals were recorded in the vicinity of the EMF source after 22 hours, while the control group population was equally distributed in the enclosure, suggesting a potential avoidance to EMFs in this species (Bochert and Zettler, 2006).

147. Effects of EMF on ragworm were also investigated by Jakubowska *et al.* (2019) and Stankevičiūtė *et al.* (2019). The former study assessed the effect of EMF levels of 1 mT from a cable of 50 Hz for eight days on the avoidance behaviour, burrowing, and physiology (food consumption, respiration, and extraction of ammonia) of ragworm (Jakubowska *et al.*, 2019). No avoidance or attraction behaviour to the EMF source was reported, and there were no changes in food consumption and respiration rates (Jakubowska *et al.*, 2019). Similarly, Albert *et al.* (2022) observed no alteration in feeding behaviour of blue mussels *Mytilus edulis* exposed to artificial B-field treatment of 300 µT. However, ragworm burrowing activity increased and ammonia excretion was significantly lower when exposed to the EMF conditions, although the mechanisms behind these observations remain unclear (Jakubowska *et al.*, 2019). In addition, genotoxic and cytotoxic effects of 50 Hz 1 mT EMFs over 12 days were investigated for ragworm and the Baltic tellin *Macoma balthica* (i.e. effects which could cause DNA and cellular damage, respectively) (Stankevičiūtė *et al.*, 2019). Exposure to EMF did not induce any significant cytotoxic responses in ragworm, however a significant elevation in frequencies of cells with 8-shaped nuclei, apoptotic cells, and binucleated cells was recorded for Baltic tellin, which suggest cytotoxic effects (Stankevičiūtė *et al.*, 2019). Both ragworm and Baltic tellin displayed genotoxic effects as a result of EMF exposure, measured by increased formation of micronuclei and nuclear buds, which are markers of DNA damage such as chromosomal loss and mitotic disruption (Stankevičiūtė *et al.*, 2019).

148. Although there are no studies to date on ocean quahog sensitivity to EMF, the results above for the Baltic tellin could be applicable, given that both species are North Sea burrowing bivalves. Further, Jakubowska-Lehrmann *et al.* (2022) assessed the effects of 50 Hz 1 mT EMFs over eight days on another bivalve, the lagoon cockle *Cerastoderma glaucum.* As recorded for ragworm (Jakubowska *et al.*, 2019), there were no changes in respiration rate of the lagoon cockle, but significantly lower ammonia excretion was recorded after EMF exposure (Jakubowska-Lehrmann *et al.*, 2022). Lagoon cockle showed no changes in antioxidant enzyme activity or lipid peroxidation (indicators of oxidative stress), however increased protein carbonylation and inhibition of acetylcholinesterase activity were observed after EMF exposure (indictors of oxidative stress and neurotoxicity) (Jakubowska-Lehrmann *et al.*, 2022). The latter finding suggests that

EMF exposure could have oxidative and neurotoxic impacts on lagoon cockle (i.e. damage to cells, proteins, DNA, and the nervous system) (Jakubowska-Lehrmann *et al.*, 2022). Furthermore, increased oxidative stress was recorded in the mollusc *Elysia leucolegnote* after exposure to EMFs in laboratory conditions (Fei *et al.*, 2023), although it should be noted that *E. leucolegnote* is a species of sea slug, only recorded in Hong Kong, thus not be representative of the IEFs defined in this assessment.

149. Overall, there is limited literature available on the potential impacts of EMF on benthic invertebrates (Albert *et al.*, 2020, Hervé, 2021) and none of the existing studies described in paragraphs 145 to 148 include any of the IEFs defined as part of this assessment. While echinoderms, bivalves, and polychaetes are key components of the representative biotopes of the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, impacts of IEFs on these taxa are varied throughout the literature (as described in paragraphs 146 to 148). To date, there have been no studies on the impact of EMFs on hydroids (such as sea tamarisk) or anthozoans (such as dead man's fingers or phosphorescent sea pen), and assessing sensitivity is challenging as a result. There have been several recent studies on the impact of EMFs on bivalves (Albert *et al.*, 2020, Jakubowska-Lehrmann *et al.*, 2022, Jakubowska *et al.*, 2019, Stankevičiūtė *et al.*, 2019). The results are varied, but cytotoxic, genotoxic, and neurotoxic impacts of EMFs were recorded, which could also occur in the ocean quahog, given its relative taxonomic similarity to the bivalve species assessed. However, it should be noted that these studies recorded results at considerably higher levels than would be expected to occur several metres away from subsea power cables: 300 µT (Albert *et al.*, 2022) and 1 mT (Jakubowska-Lehrmann *et al.*, 2022, Jakubowska *et al.*, 2019, Stankevičiūtė *et al.*, 2019).

150. Overall, on a precautionary basis, all IEFs are deemed to be of medium vulnerability, medium recoverability, and regional to national value. In reality, this is likely to be over precautionary, based on the results of the literature summarised in the preceding paragraphs, which largely suggests minimal impacts at EMF levels likely to be present at the cables associated with the Array. Further, the literature typically considers EMF levels which are much higher than those that would be associated within several metres of the cables associated with the Array. Further, the results of some studies (such as Chapman *et al.* (2023) and Bochert and Zettler (2006)) found little to no impact of EMF on the species in their assessments. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of the effect

151. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptor are considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

152. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

COLONISATION OF HARD SUBSTRATES

153. The introduction of the hard substrates on the seabed and the foundations of floating, mooring lines and dynamic cables of wind turbines within the water column may potentially affect the established benthic community by providing new habitat and ecosystem function. These hard substrates include:

- mooring lines and anchors on the seabed;
- OSP foundations;
- inter-array and interconnector cable protection and cable crossing protection;
- subsea junction boxes;
- scour protection for mooring lines, anchors, OSP foundations, and subsea junction boxes; and
- floating wind turbine foundations in the water column.

154. These artificial hard structures are expected to be colonised by a range of organisms, which could lead to local biodiversity increases. The relevant MarESA pressure associated with this impact is the same as assessed above for 'Long term habitat loss and disturbance':

- Physical change (to another seabed type): the benchmark for which is change in sediment type from sedimentary or soft rock substrata to hard rock or artificial substrate or vice-versa.

Operation and maintenance phase

Magnitude of impact

155. The MDS for this impact is similar to as described above for 'Long term habitat loss and disturbance' which assumes that up to 19.27 km^2 of artificial hard substrate will be installed on the seabed within the Array benthic subtidal ecology study area (2.25% of the entire area) (Table 8.12). This comprises mooring lines and anchors on the seabed, OSP foundations, inter-array and interconnector cable protection and cable crossing protection, subsea junction boxes, and scour protection for mooring lines, anchors, OSP foundations, and subsea junction boxes. In addition, the presence of floating wind turbine foundations, anchor mooring lines, and dynamic cables represent hard substrate which may be colonised within the water column (Table 8.12).

156. It is expected that these artificial hard structures will be colonised by epifaunal species local to the Array benthic subtidal ecology study area. However, this impact will represent a shift in the baseline seabed conditions from soft to hard substrate in the areas where the infrastructure is installed. This could result in beneficial effects. For example, a 12 year monitoring study on the artificial foundations installed at the Lysekil research site in Sweden reported increased biodiversity, abundance of reef species, and total number of species over time (Bender *et al.*, 2020). Colonising communities on offshore installations are typically dominated by mussels, macroalgae, and barnacles near the water surface, which essentially creates a new intertidal zone, while the community is dominated by filter feeding arthropods at intermediate depths, and by anemones in deeper locations (De Mesel *et al.*, 2015, Karlsson *et al.*, 2022). Colonisation of the hard substrates associated with the Array is therefore likely to result in an increase in biodiversity and a change compared to the baseline if no hard substrates were present (Lindeboom *et al.*, 2011). In addition, the structural complexity of artificial substrates such as OSP foundations and floating wind turbine foundations may provide refuge as well as increasing feeding opportunities for larger and more mobile species. For example, Mavraki *et al.* (2020), demonstrated higher food web complexity associated with zones which had high accumulation of organic material (such as soft substrate or scour protection), suggesting potential reef effect benefits from the presence of artificial hard structures.

157. Although this impact is expected to be beneficial in terms of increasing biodiversity and enhancing reef effects, the installation of hard structures will result in habitat loss for the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF. However, given the wide availability of both of these habitats over the Array benthic subtidal ecology study area and regional benthic subtidal ecology study area, and the localised nature of this impact (2.25% of the Array benthic subtidal ecology study area), this impact is only expected to result in minor loss or alteration to the soft bottom sediments of these IEFs as a whole.

158. Overall, for all IEFs, the impact is predicted to be of local spatial extent (2.25% of the Array benthic subtidal ecology study area), long term duration, continuous, and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

159. Introduction of hard structures within the Array benthic subtidal ecology study area will represent a shift in seabed type and species assemblage. In terms of the MarESA, the sensitivity of the IEFs to this impact are as previously described for physical change (to another seabed type) in the assessment of 'Long term

habitat loss and disturbance' (see Table 8.19 and paragraphs 94 to 97). The MarESA sensitivities were high for all IEFs except dead man's fingers and sea tamarisk, which were assessed as low.

160. Colonisation of hard structures may have indirect adverse effects on the baseline communities and habitats identified within the Array benthic subtidal ecology study area due to increased predation on and competition for the existing soft sediment species. Nonetheless, these effects are difficult to predict on large scales and timelines, especially as monitoring to date has focussed on the colonisation and aggregation of species close to wind turbine foundations rather than broad scale studies. Introducing hard structures on the seabed not only creates new habitat but also modifies or removes existing, sandy and soft bottom habitats. Often it replaces an essentially two-dimensional sedimentary seabed with a complex three-dimensional structure, thereby increasing surface area, surface complexity and number of niches Dannheim *et al.* (2020). Increased biodiversity and connectivity of populations is dependent on suitable artificial hard substrates being created at the right location and distances from source populations (Chase, 2015). Substrates may also only be suitable for colonisation after being suitably weathered, through the loss of any surface contaminants, the production of biofilms, and the sequence of development of the community after settlement (Chase, 2015; Thompson *et al.*, 1998). Rougher textures may facilitate greater microhabitat diversity than smoother ones (Anderson and Underwood, 1994) and could have greater potential for colonisation.

161. With regards to the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, several studies have also shown that the installation of artificial habitat have no significant effect on the soft sediment environments. For example, the soft sediment benthic community underwent no drastic changes eight to nine years after the installation of C-power and Belwind Offshore Wind Farms in Belgium (De Backer *et al.*, 2020). Furthermore, the species originally inhabiting the sandy substrate were still present and remained dominant in both Offshore Wind Farms (De Backer *et al.*, 2020). Additionally, post-construction monitoring at the Block Island Wind Farm in the USA showed no strong gradients of change in sediment grain size, enrichment, or benthic macrofauna within 30 m to 90 m distance bands of the wind turbines (Hutchison *et al.*, 2020a). Recent post-construction monitoring of the Beatrice Offshore Wind Farm in the Moray Firth demonstrated extensive biofouling on all the wind turbines with signs of zonation and successional development (APEM, 2022). Across all the wind turbines, plumose anemones *Metridium senile* and tube worms *S. triqueter* were the most abundant species, with the highest biomass at 40 m depth (APEM, 2022). The hermit crab *Pagurus bernhardus*, various flatfish species, and common sea urchin were found at the bases of the wind turbines with decreasing abundance further from the foundations, indicating a source of food although no biological matter could be seen (APEM, 2022). Similarly, at Hywind Scotland off the coast of Aberdeenshire, plumose anemones and tube worms *Spirobranchus* sp. dominated the bottom and mid-section of floating wind turbine substructures, and a general increase in epifouling growth between 2018 and 2020 was recorded (Karlsson *et al.*, 2022).

162. Larval distribution can be influenced by the introduction of hard substrates, which could have potential impacts on species distribution and population connectivity. Research from the oil and gas sector has examined the potential impact of infrastructure in the interception and production of larvae (McLean *et al.*, 2022). Sound, chemical cues, light, and vibrations can all trigger larval settlement. Where artificial hard structures exist in offshore waters far from natural reefs, their influence on larval dispersal and settlement may be comparatively high, in relation to platforms in more naturally connected environments, therefore influencing geographic and population connectivity (McLean *et al.*, 2022). As species become established on and around the artificial hard structures, they can start producing larvae, with one study demonstrating that networks of oil and gas infrastructure in the North Sea could facilitate ecological connectivity by acting as stepping stones for larval connectivity (Henry *et al.*, 2018). Similarly, another North Sea study found interannual variability in the North Atlantic Oscillation results in cold-water coral *Lophelia pertusa* larvae being dispersed from oil and gas structures across distances of ~300 km (Fox *et al.*, 2016). The influence of oceanographic features in species dispersal and distribution emphasises the importance of characterising the hydrodynamics underpinning potential connectivity (Boschetti *et al.*, 2020). Potential barriers to settlement, growth, reproduction and survival of larvae on offshore infrastructure also exist, such as cleaning regimes, surface coatings (e.g. antifoulant), and operational discharges.

163. Finally, artificial hard substrates can often support higher densities of INNS than natural environments, due to reduced competition from established native species, more vacant habitat, and year-round settlement allowing opportunistic colonisation of vacant space (Mineur *et al.*, 2012). However, increased risk and spread of INNS has been assessed separately in paragraphs 180 to 207.

164. The ocean quahog IEF and phosphorescent sea pen IEF require a soft sedimentary habitat, and physical change to hard artificial or rock substratum would represent habitat loss for these species, which are therefore highly vulnerable to this impact (Hill and Tyler-Walters, 2018, Tyler-Walters and Sabatini, 2017). Overall, all IEFs except dead man's fingers and sea tamarisk are deemed to be of high vulnerability, low recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be high (Table 8.19).

165. In contrast however, the dead man's fingers IEF and the sea tamarisk IEF naturally live on hard substrates, including bedrock, rocks, boulders, shells, and man-made artificial hard structures (Budd, 2008, Wilson, 2002). Therefore, this impact does not represent a change from a preferred habitat to an unsuitable one for these IEFs, in comparison to the other IEFs. In addition, hydroids (such as sea tamarisk) are typically one of the first taxa to colonise new substrates (Boero, 1984). For example, a study on marine growth on the North Sea oil platform Montrose Alpha recorded eight species of hydroid (although none were sea tamarisk), present on the hard structures associated with the platform (Forteath *et al.*, 1982). Therefore, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low (Table 8.19).

<u>Significance of the effect</u>

166. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the magnitude of the impact is deemed to be low, and the sensitivities of the receptor are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor beneficial significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** beneficial significance, which is not significant in EIA terms.

167. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. The potential for increased biodiversity as a result of this impact could be considered to be beneficial, however introduction of hard substrates would represent some small-scale habitat loss for these IEFs. Given the low footprint of long term habitat loss with respect to both the Array benthic subtidal ecology study area and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

<u>Secondary mitigation and residual effect</u>

168. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

EFFECTS TO BENTHIC SUBTIDAL ECOLOGY DUE TO REMOVAL OF HARD SUBSTRATES

169. The removal of artificial hard substrates in the decommissioning phase may affect the established benthic community associated with the Array benthic subtidal ecology study area, with the seabed returning to its current sandy sediments. These artificial hard structures are expected to have been colonised by a range of organisms over the 35 year lifecycle of the Array, which has been previously assessed above in 'Colonisation of hard structures'. The relevant MarESA pressure associated with this impact is the same as assessed above for 'Long term habitat loss and disturbance' and 'Colonisation of hard structures':

- Physical change (to another seabed type): the benchmark for which is change in sediment type from sedimentary or soft rock substrata to hard rock or artificial substrate or vice-versa.

170. In this case, however, the physical change to another seabed type refers to a change from artificial hard substrata to soft sandy sediments.

Decommissioning phase

Magnitude of impact

171. The MDS accounts for up to a total of 19.27 km^2 of artificial hard substrates to be removed from the seabed during the decommissioning phase, which represents up to 2.25% of the total Array benthic subtidal ecology study area (Table 8.12). In addition, MDS accounts for the removal of hard substrate in the water column, such as floating wind turbine foundations, dynamic cables, and anchor mooring lines (Table 8.12). As per the justification presented in Table 8.12, the MDS for this impact is the complete removal of all infrastructure installed on the seabed and in the water column in the Array benthic subtidal ecology study area, as this represents the largest potential impact. It should be noted that the decommissioning strategy is not yet defined, and cable protection, cable crossing protection, and scour protection may potentially be left *in situ.* Anchors will also be removed or cut on or at the seabed and left *in situ,* however are considered unlikely to contribute to this impact as they will be a significant depth below the seabed. Leaving cable protection, cable crossing protection, and scour protection *in situ* represents the MDS in the decommissioning phase for 'Long term habitat loss and disturbance' and has been assessed as such in paragraphs 101 to 103. In reality, if this infrastructure remains *in situ,* the MDS presented here will be an overestimation in the area of hard substrates removed.

172. Overall, for all IEFs, the impact is predicted to be of local spatial extent (2.25% of the Array benthic subtidal ecology study area), long term duration, continuous, and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

173. Removal of hard structures within the Array benthic subtidal ecology study area will represent a shift in seabed type and species assemblage. In terms of the MarESA, the sensitivity of the IEFs to this impact are as previously described for physical change (to another seabed type) in the assessment of 'Long term habitat loss and disturbance' (see Table 8.19 and paragraphs 94 to 97). All IEFs except for dead man's fingers and sea tamarisk were assessed as highly sensitive to the introduction of hard structures as these species and biotopes are dependent on soft, sandy, and/or muddy sediments (see Table 8.19 and paragraphs 94 to 97). However, the removal of hard substrates in the decommissioning phase would allow sandy and soft bottom sediments to gradually return at the former footprints of the installed artificial hard infrastructure. Therefore, this impact would result in an increase in available habitat for these IEFs.

174. Conversely, the dead man's fingers IEF and sea tamarisk IEF were assessed as having low sensitivity to the introduction of hard structures as these species could potentially colonise the installed hard substrates (see Table 8.19 and paragraphs 94 to 97). Therefore, a gradual return to soft, sandy bottom substrates following the removal of all infrastructure may represent a small loss of habitat for these IEFs.

175. Overall, all IEFs except dead man's fingers and sea tamarisk are deemed to be of low vulnerability, high recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be low.

176. In contrast however, as the dead man's fingers IEF and the sea tamarisk IEF naturally live on hard substrates, including bedrock, rocks, boulders, shells, and man-made artificial hard structures (Budd, 2008, Wilson, 2002), this impact represents a change from a preferred habitat to a less suitable one for these IEFs. Therefore, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of high vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of the effect

177. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be removed during the decommissioning phase (2.25% of the Array benthic subtidal ecology study area) and the widespread availability of alternative suitable habitat, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

178. For all other IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

179. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

INCREASED RISK OF INTRODUCTION OR SPREAD OF INNS

180. Vessels used during the construction, operation and maintenance, and decommissioning phases of the Array could inadvertently transport INNS. INNS could also be transported during turbine ballasting in the construction and decommissioning phases. The relevant MarESA pressure and its benchmark which has been used to inform this impact assessment is:

- introduction or spread of INNS: the benchmark for which is the introduction of one or more INNS.

181. This impact is related to the impact of 'Colonisation of hard substrates', which may lead to an increased risk of potential habitat that could be colonised by INNS.

Construction phase

Magnitude of impact

182. The MDS for this impact accounts for up to 7,902 vessel round trips over the course of the site preparation and construction phase, with up to 97 vessels on site at any one time (Table 8.12). These provide vectors for the potential introduction of INNS into the habitats within the Array benthic subtidal ecology study area. In addition, the installation of artificial hard substrate on the seabed and in the water column throughout the construction phase could provide new habitat for INNS to colonise into the operation and maintenance phase. Finally, turbines may be towed to and from ports to the site boundary, which may represent another pathway for introduction of INNS. Up to 265 turbines will be installed, with up to three turbines towed to the site boundary at any one time (Table 8.12). Ballasting may be required during towing, which would be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

183. There are many benthic INNS widespread and established in Scottish waters and the North Sea, including:

- modest barnacle *Austrominius modestus;*
- Japanese skeleton shrimp *Caprella mutica;*
- leathery sea squirt *Styela clava;*
- orange tipped sea squirt *Corella eumyota;*
- orange ripple bryozoan *Schizoporella japonica* (NatureScot, 2023).

184. However, there were no INNS recorded during the site-specific surveys for the Array (see volume 3, appendix 8.1, annex A).

185. Many of the vessels engaged in site preparation and construction activities will utilise ports and harbours in east coast of the Scotland and the UK during the construction phase. Therefore, the potential for introduction of INNS from outside this region is reduced. Some of the established INNS in Scottish waters, however, are known to spread as fouling on ships, such as the modest barnacle, which could introduce them to the Array benthic subtidal ecology study area. Delivery vessels may come directly to site from fabrication yards located in international ports and harbours, however, all vessels will be required to comply with the INNSMP.

186. As described in Table 8.17, an INNSMP will be implemented (volume 4, appendix 21, annex B), which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable. In addition, all vessels will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

187. Overall, for all IEFs, the impact is predicted to be of local spatial extent (with hard structures installed in up to 2.25% of the Array benthic subtidal ecology study area), medium term duration over the site preparation and construction phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

188. The sensitivity of the IEFs to increased risk of INNS is presented in Table 8.21. These sensitivities are based on the MarESA (where available).

189. The mobile sandy sediments of both the representative biotopes of the Offshore subtidal sands and gravels IEF and Subtidal sands and gravels IEF are typically at low risk of invasion by the INNS currently recorded in the UK, due to high levels of sediment disturbance (Tillin, 2016a, Tillin, 2016b). However, there are two INNS that may be of concern to these biotopes: the slipper limpet *Crepidula fornicata* and the carpet sea squirt *Didemnum vexillum.* There are patchy records of both of these INNS in Scottish waters (Begg *et al.*, 2020, Beveridge *et al.*, 2011, NatureScot, 2023). The slipper limpet may settle on stones, hard substrates (artificial or natural, such as bivalve shells), and can form dense carpets which smother the characteristic bivalves of these biotopes (e.g. *A. prismatica*) (Tillin, 2016a, Tillin, 2016b). Few other bivalves can live amongst stacks of slipper limpets (Blanchard, 1997). The carpet sea squirt typically colonises artificial hard surfaces but could have the potential to colonise and smother other seabed habitats (Tillin, 2016a, Tillin, 2016b). However, the slipper limpet and carpet sea squirt are typically more coastal species, with patchy records in the offshore environment (Gibson-Hall and Bilewitch, 2018, Rayment, 2008), so may not pose a significant threat to these IEFs. Overall, the representative biotopes of these IEFs would typically be too mobile for most INNS, however they are vulnerable to potential biotope reclassification if they were to be colonised by INNS (Tillin, 2016a, Tillin, 2016b). Overall, the Offshore subtidal sands and gravels and Subtidal sands and gravels IEFs are deemed to be of high vulnerability, low recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be high (Table 8.21).

190. For the remaining IEFs, there is limited evidence to their vulnerability and recoverability to INNS invasions, and the pressure of 'Introduction and spread of INNS' was not assessed in their MarESAs. However, as per the previous paragraph, ocean quahog and phosphorescent sea pen also typically inhabit soft sandy and/or muddy sediments, which are not typically at risk of invasion from most species. Therefore, following the same logic for the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, these species' habitats may be vulnerable to colonisation from slipper limpet or carpet sea squirt. Furthermore, installation of hard structures and subsequent colonisation by INNS would represent a loss of available habitat for these IEFs. However, given the burrowing capabilities of the ocean quahog (Powilleit *et al.*, 2009, Powilleit *et al.*, 2006), it is not likely that individuals' shells will be colonised by slipper limpets. Overall, the ocean quahog IEF and the phosphorescent sea pen IEF are deemed to be of high vulnerability, low recoverability, and national and regional value, respectively. The sensitivities of the receptors are, therefore, considered to be high (Table 8.21).

191. Both the dead man's fingers IEF and sea tamarisk IEF inhabit hard substrates, which are more likely to be colonised by INNS. Therefore, these species are likely to be more vulnerable to a wider range of INNS than the other IEFs. If their substrates are colonised by INNS, the dead man's fingers and sea tamarisk will be susceptible to a reduction in habitat and may be outcompeted. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of high vulnerability, low recoverability, and national value. The sensitivities of the receptors are, therefore, considered to be high (Table 8.21).

Table 8.21: Sensitivity of the IEFs to Increased Risk of INNS

IEF	Representative Biotopes	Sensitivity to Defined MarESA Pressure Introduction or Spread of INNS	Overall Sensitivity
Offshore subtidal sands and gravels and Subtidal sands and gravels	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.Epus.OborApri)	High	High
	Abra prismatica, Bathyporeia elegans, and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo)	High	High
Dead man's fingers*	N/A	Not assessed, due to insufficient evidence	High
Ocean quahog	N/A	Not assessed, due to insufficient evidence	High
Phosphorescent sea pen	N/A	No MarESA available, sensitivities to the defined pressures are discussed in paragraph 191 from the best available literature.	High
Sea tamarisk	N/A		High
*It should be noted that there is no MarESA available for dead man's fingers. For this IEF, only the MarLIN sensitivity assessment was available, which was superseded by the MarESA for the other IEFs in 2014.			

Significance of the effect

192. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed that could be colonised by INNS (2.25% of the Array benthic subtidal ecology study area), and the designed in mitigation measure of an INNSMP, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

193. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

194. The MDS for this impact accounts for up to 17,780 vessel round trips over the 35 year lifecycle of the Array, or 508 round trips per year (Table 8.12). There may be up to 31 vessels on site at any one time. As for the construction phase, these vessels provide vectors for the potential introduction of INNS into the

habitats within the Array benthic subtidal ecology study area. In addition, the installation of artificial hard substrate on the seabed and in the water column in the construction phase could provide new habitat for INNS to colonise throughout the lifecycle of the Array.

195. As above for the construction phase, many of the vessels within the operation and maintenance phase are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the risk of introduction of INNS from outside this region is reduced.

196. As above for the construction phase, the implementation of an INNSMP is a designed in measure which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable (Table 8.17). As above, all vessels will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

197. Overall, for all IEFs, the impact is predicted to be of local spatial extent (with hard structures installed in up to 2.25% of the Array benthic subtidal ecology study area), long term duration, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

198. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phase (see Table 8.21 and paragraphs 188 to 191) and have not been repeated here.

Significance of the effect

199. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed that could be colonised by INNS (2.25% of the Array benthic subtidal ecology study area), and the designed in mitigation measure of an INNSMP, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

200. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

201. Information on ballasting and vessel movements in the decommissioning phase are not yet defined at this stage. However, the MDS for this impact assumes that vessel return trips and presence within the Array benthic subtidal ecology study area will be similar to that of the construction phase (Table 8.12). In addition, up to 6.79 km^2 of infrastructure is proposed to be left *in situ* during the decommissioning phase (0.79% of the Array benthic subtidal ecology study area). As per 'Long term subtidal habitat loss and disturbance' above, this comprises all cable protection (5.83 km^2), cable crossing protection (24,000 m^2), and scour protection (928,562 m^2) (Table 8.12). It is assumed that any anchors left in-situ would be cut at or just below the seabed and so would not increase the risk of spread of INNS.

202. As above for the construction phase, many of the vessels engaged in decommissioning activities will utilise ports and harbour on the east coast of Scotland and the UK. Therefore, the potential for introduction of INNS from outside this region is reduced. Where vessels originate and depart to international ports and harbours operators will be required to comply with any controls set out in the INNSMP.

203. As above for the construction phase, the implementation of an INNSMP is a designed in measure which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable (Table 8.17). As above, all vessels will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

204. Overall, for all IEFs, the impact is predicted to be of local spatial extent (with hard structures remaining in up to 0.79% of the Array benthic subtidal ecology study area), long term duration, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

205. The sensitivities of all IEFs are considered to be as previously described for the site preparation and construction phase (see Table 8.21 and paragraphs 188 to 191) and have not been repeated here.

Significance of the effect

206. For all IEFs, the magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed that could be colonised by INNS (2.25% of the Array benthic subtidal ecology study area), and the designed in mitigation measure of an INNSMP, the effect is concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

207. No secondary benthic subtidal ecology mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

8.12. CUMULATIVE EFFECTS ASSESSMENT

8.12.1. METHODOLOGY

208. The CEA assesses the LSE[1] associated with the Array together with other relevant plans, projects and activities. Cumulative effects are defined as the combined effect of the Array in-combination with the effects from a number of different projects, on the same receptor or resource. Further details on CEA methodology are provided in volume 1, chapter 6.

209. The plans and projects selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see volume 3, appendix 6.4 of the Array EIA Report). Volume 3, appendix 6.4 further provides information regarding how information pertaining to other plans and projects is gained and applied to the assessment. Each project or plan has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, impact-receptor pathways and the spatial/temporal scales involved.

210. In undertaking the CEA for the Array, it should be noted that other plans and projects under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the Array. Therefore, a tiered approach has be adopted which provides a framework for placing relative weight upon the potential for each project/plan to be included in the CEA to ultimately be realised, based upon the project/plan's current stage of maturity and certainty in the projects' parameters. The tiered approach which will be utilised within the Array CEA employs the following tiers:

- tier 1 assessment – Array with Proposed offshore export cable corridor(s) and Proposed onshore transmission infrastructure and all plans/projects which became operational since baseline characterisation, those under construction, and those with consent and submitted but not yet determined;
- tier 2 assessment – All plans/projects assessed under Tier 1, plus projects with a Scoping Report; and
- tier 3 assessment – All plans/projects assessed under Tier 2, which are reasonably foreseeable, plus those projects likely to come forward when an Agreement for Lease (AfL) has been granted.

211. The specific projects scoped into the CEA for benthic subtidal ecology are outlined in Table 8.22 and presented in Figure 8.6. Given that there is no potential pathway for impact to benthic subtidal ecology due to the Proposed onshore transmission infrastructure, this project has not been considered further within the CEA. The Proposed offshore export cable corridor(s), however, remains as part of the Tier 1 assessment, due to a potential receptor impact pathway.

212. The range of potential cumulative impacts that are identified and included in Table 8.23 is a subset of those considered for the Array alone assessment. Most of the impacts included for the alone assessment (see Table 8.12) are brought forward to the CEA, with the exception of 'Increased SSCs and associated deposition' This is because this impact is regarded to be highly localised and temporary in nature. Therefore, it is considered that this impact has limited or no potential to interact with the other plans or projects identified. This impact has therefore not been taken forward for detailed cumulative assessment.

213. Similarly, some of the potential impacts considered within the Array alone assessment are specific to a particular phase of development (e.g. construction, operation and maintenance or decommissioning). The potential for cumulative effects with other plans or projects requires spatial or temporal overlap with the Array during certain phases of development, therefore impacts associated with a certain phase may be omitted from further consideration where no plans or projects have been identified that have the potential for cumulative effects during this phase of development.

214. For the purposes of this Array EIA Report, a 50 km screening buffer around the Array was used to identify other plans and projects to be included within the CEA. This buffer is considered appropriate and precautionary as all impacts considered within the CEA will be localised within its extent.

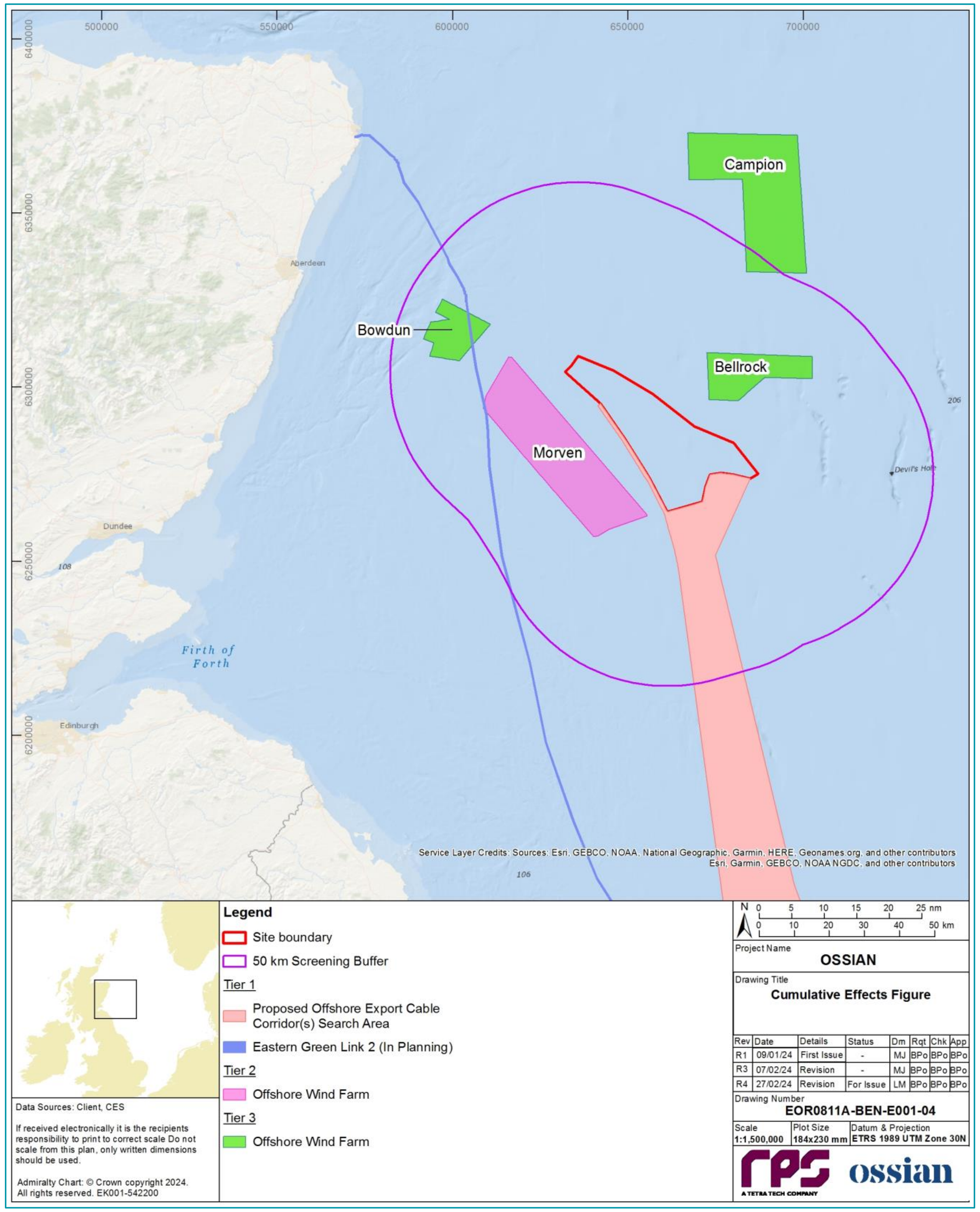


Figure 8.6: Other Projects/Plans Screened into the CEA for Benthic Subtidal Ecology

Table 8.22: List of Other Plans and Projects Considered within the CEA for Benthic Subtidal Ecology

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array Area (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Tier 1						
Proposed offshore export cable corridor(s)	Planned	0.00	The Proposed offshore export cable corridor(s) for the Array	2030 to 2037	2038 to 2072	Considered as part of the Tier 1 assessment alongside the Array. The construction and operation and maintenance phases the Proposed offshore export cable corridor(s) overlap with those of the Array.
Subsea Cables						
Eastern Green Link 2	Marine License Application	24.37	Transmission cable between Scotland and England	2025 to 2029	2030 onwards	No spatial overlap*, but the operation and maintenance phase of Eastern Green Link 2 overlaps temporally with that of the Array.
Tier 2						
Offshore Wind Projects and Associated Cables						
Morven Offshore Wind Farm	Scoping	5.50	Up to 191 wind turbines at a capacity of 2,300 MW	2031 to 2037	2038 onwards	No spatial overlap*, but the construction and operation and maintenance phases of Morven may overlap temporally with those of the Array.
Tier 3						
Offshore Wind Projects and Associated Cables						
Morven Offshore Export Cable Corridor(s)	Pre-planning	5.50	Proposed export cable corridor(s) for the Morven Offshore Wind Farm	Unknown	Unknown	No spatial overlap*, but the construction and operation and maintenance phases may overlap temporarily with those of the Array.
Bellrock Offshore Wind Farm	Pre-planning	8.67	Offshore wind farm with a capacity of up to 1,200 MW	Unknown	Unknown	No spatial overlap*, but the construction and operation and maintenance phases of Bellrock may overlap temporally with those of the Array.
Bowdun Offshore Wind Farm	Pre-planning	25.36	Up to 60 wind turbines at a capacity of 1,000 MW	Unknown	Unknown	No spatial overlap*, but the construction and operation and maintenance phases of Bowdun may overlap temporally with those of the Array.
Campion Offshore Wind Farm	Pre-planning	44.15	Up to 100 wind turbines at a capacity of 2,000 MW	Unknown	Unknown	No spatial overlap*, but the construction and operation and maintenance phase of Campion may overlap temporally with those of the Array.
Subsea Cables						
Eastern Green Link 3	Planned	Unknown	Transmission cable between Scotland and England	Unknown	Unknown	Potential for spatial* and temporal overlap with the Array
Eastern Green Link 4	Planned	Unknown	Transmission cable between Scotland and England	Unknown	Unknown	Potential for spatial* and temporal overlap with the Array
*'Spatial overlap' in this context refers to spatial overlap between the Array benthic subtidal ecology study area and the plans and projects considered within the CEA. All the plans and projects included in this table overall spatially with the 50 km screening buffer used, but none overlap spatially with the Array or the Proposed offshore export cable corridor(s).						

8.12.2. MAXIMUM DESIGN SCENARIO

215. The MDSs identified in Table 8.12 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented in Table 8.23 and assessed in this section have been selected from the details provided in volume 1, chapter 3 of the Array EIA Report as well as the information available on other plans and projects (see volume 3, appendix 6.4), to inform a 'MDS'. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Description (volume 1, chapter 3), (e.g. different wind turbine layout), to that assessed here, be taken forward in the final design scheme.

Table 8.23: Maximum Design Scenario Considered for Each Impact as part of the Assessment of Likely Significant Cumulative Effects on Benthic Subtidal Ecology

Potential Cumulative Effect	Phase[6] C	O	D	Tier	Maximum Design Scenario
Temporary habitat loss and disturbance	✓	✓	✓	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Proposed offshore export cable corridor(s) (construction and operation and maintenance phases); and • Eastern Green Link 2 (operation and maintenance phase). **Operation and Maintenance Phase** • Proposed offshore export cable corridor(s) (operation and maintenance and decommissioning phases); and • Eastern Green Link 2 (operation and maintenance and decommissioning phases). **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
	✓	✓	✓	2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Morven Offshore Wind Farm (construction and operation and maintenance phases); and • Tier 1 projects. **Operation and Maintenance Phase** • Morven Offshore Wind Farm (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); and • Tier 1 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.

[6] C = Construction, O = Operation and maintenance, D = Decommissioning

Potential Cumulative Effect	Phase[6] C	O	D	Tier	Maximum Design Scenario
	✓	✓	✓	3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Morven Offshore Export Cable Corridor(s) (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Bellrock Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Bowdun Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Campion Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Eastern Green Link 3 (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Eastern Green Link 4 (phases currently unknown, but likely to be the construction and operation and maintenance phases); and • Tier 1 and Tier 2 projects. **Operation and Maintenance Phase** • Morven Offshore Export Cable Corridor(s) (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); • Bellrock Offshore Wind Farm (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); • Bowdun Offshore Wind Farm (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); • Campion Offshore Wind Farm (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); • Eastern Green Link 3 (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); • Eastern Green Link 4 (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); and • Tier 1 and Tier 2 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
Long term habitat loss and disturbance	✓	✓	✓	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Construction and Operation and Maintenance Phases** • Proposed offshore export cable corridor(s) (all phases). • Eastern Green Link 2 (operation and maintenance and decommissioning phases). **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
	✓	✓	✓	2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Construction and Operation and Maintenance Phases** • Morven Offshore Wind Farm (construction and operation and maintenance phases); and • Tier 1 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.

Potential Cumulative Effect	Phase[6] C	O	D	Tier	Maximum Design Scenario
	✓	✓	✓	3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Construction and Operation and Maintenance Phases** • Morven Offshore Export Cable Corridor(s) (phases currently unknown, but likely to construction and operation and maintenance phases); • Bellrock Offshore Wind Farm (phases currently unknown, but likely to construction and operation and maintenance phases); • Bowdun Offshore Wind Farm (phases currently unknown, but likely to construction and operation and maintenance phases); • Campion Offshore Wind Farm (phases currently unknown, but likely to construction and operation and maintenance phases); • Eastern Green Link 3 (phases currently unknown, but likely to construction and operation and maintenance phases); • Eastern Green Link 4 (phases currently unknown, but likely to construction and operation and maintenance phases); and • Tier 1 and Tier 2 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
Effects to benthic subtidal ecology due to EMF from subsea electrical cabling	×	✓	×	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Proposed offshore export cable corridor(s) (operation and maintenance phase); and • Eastern Green Link 2 (operation and maintenance phase).
	×	✓	×	2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Morven Offshore Wind Farm (operation and maintenance phase); and • Tier 1 projects
	×	✓	×	3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Morven Offshore Export Cable Corridor(s) (operation and maintenance phase); • Bellrock Offshore Wind Farm (operation and maintenance phase); • Bowdun Offshore Wind Farm (operation and maintenance phase); • Campion Offshore Wind Farm (operation and maintenance phase); • Eastern Green Link 3 (operation and maintenance phase); • Eastern Green Link 4 (operation and maintenance phase); and • Tier 1 and Tier 2 projects.
Colonisation of hard substrates	×	✓	×	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Proposed offshore export cable corridor(s) (operation and maintenance phase); and • Eastern Green Link 2 (operation and maintenance phase).
	×	✓	×	2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Morven Offshore Wind Farm (operation and maintenance phase); and • Tier 1 projects

Potential Cumulative Effect	Phase[6] C	O	D	Tier	Maximum Design Scenario
	×	✓	×	3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Operation and Maintenance Phase** • Morven Offshore Export Cable Corridor(s) (operation and maintenance phase); • Bellrock Offshore Wind Farm (operation and maintenance phase); • Bowdun Offshore Wind Farm (operation and maintenance phase); • Campion Offshore Wind Farm (operation and maintenance phase); • Eastern Green Link 3 (operation and maintenance phase); • Eastern Green Link 4 (operation and maintenance phase); and • Tier 1 and Tier 2 projects.
Effects to benthic subtidal ecology due to removal of hard substrates	×	×	✓	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Decommissioning Phase** • Proposed offshore export cable corridor(s) (decommissioning phase).
				2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
				3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
Increased risk of INNS	✓	✓	✓	1	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Proposed offshore export cable corridor(s) (construction and operation and maintenance phases); and • Eastern Green Link 2 (operation and maintenance phase). **Operation and Maintenance Phase** • Proposed offshore export cable corridor(s) (operation and maintenance and decommissioning phases); and • Eastern Green Link 2 (operation and maintenance and decommissioning phases). **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.
	✓	✓	✓	2	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Morven Offshore Wind Farm (construction and operation and maintenance phases); and • Tier 1 projects. **Operation and Maintenance Phase** • Morven Offshore Wind Farm (phases currently unknown, but likely to be the operation and maintenance and decommissioning phases); and • Tier 1 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.

Potential Cumulative Effect	Phase[6] C	O	D	Tier	Maximum Design Scenario
	✓	✓	✓	3	The MDS is as described above for the Array alone (Table 8.12) and has been assessed cumulatively with the following plans and projects: **Site Preparation and Construction Phases** • Morven Offshore Export Cable Corridor(s) (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Bellrock Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Bowdun Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Campion Offshore Wind Farm (phases currently unknown, but likely to be the construction and operation and maintenance phases); • Eastern Green Link 3 (phases currently unknown); • Eastern Green Link 4 (phases currently unknown); and • Tier 1 and Tier 2 projects. **Operation and Maintenance Phase** • Morven Offshore Export Cable Corridor(s) (phases currently unknown, but likely to be operation and maintenance phase); • Bellrock Offshore Wind Farm (phases currently unknown, but likely to be operation and maintenance phase); • Bowdun Offshore Wind Farm (phases currently unknown, but likely to be operation and maintenance phase); • Campion Offshore Wind Farm (phases currently unknown, but likely to be operation and maintenance phase); • Eastern Green Link 3 (phases currently unknown, but likely to be operation and maintenance phase); • Eastern Green Link 4 (phases currently unknown, but likely to be operation and maintenance phase); and • Tier 1 and Tier 2 projects. **Decommissioning Phase** There are currently no known projects which will result in a cumulative effect during the decommissioning phase of the Array.

8.12.3. CUMULATIVE EFFECTS ASSESSMENT

216. An assessment of the likely significance of the cumulative effects of the Array upon benthic subtidal ecology receptors arising from each identified impact is given below.

TEMPORARY HABITAT LOSS AND DISTURBANCE

217. There is potential for cumulative temporary habitat loss and disturbance as a result of activities associated with the Array and other plans and projects. Activities include sand wave and boulder clearance and relocation, UXO clearance, cable installation, jack up vessel use, and cable repair and reburial. For the purposes of this Array EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective tiers are outlined in Table 8.23.

Tier 1

<u>Construction phase</u>

Magnitude of impact

218. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the construction and operation and maintenance phases of the Proposed offshore export cable corridor(s);
- the operation and maintenance phase of the Eastern Green Link 2 (Table 8.23).

219. Site preparation and construction activities at the Eastern Green Link 2 project are planned to occur between 2024 to 2029, so will not overlap with this phase of the Array (Table 8.22). For clarity, and to give an indication in the difference in scale between the Eastern Green Link 2 and the Array, values of temporary habitat loss and disturbance in the site preparation and construction phase of the Eastern Green Link 2 are presented in Table 8.24 (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). Within the Environmental Appraisal Report for the Eastern Green Link 2, no values were provided for temporary habitat loss and disturbance during its operation and maintenance phase (which coincides with the site preparation and construction phase of the Array). However, it was noted that it would be significantly lower than the value of 15.20 km^2 provided for the site preparation and construction phase (Table 8.24) (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). At the time of writing this Array EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s), but the activities and footprints of disturbance associated with its site preparation and construction phase are expected to be similar to those of the Eastern Green Link 2, given that both projects are both High Voltage Direct Current (HVDC) subsea power cables.

220. Further, activities associated with the site preparation and construction phase for the Proposed offshore export cable corridor(s) are expected to be of an equal or lesser extent than those represented by the MDS for the Array alone, which represented up to 49.95 km^2 of temporary habitat loss and disturbance (Table 8.24). As outlined in paragraphs 58 to 60 for the Array alone, the impacts of cable installation and seabed preparation are likely to be reversible. Other activities associated with the Array during this phase are not likely to occur within the Tier 1 projects, such as jack up vessel use and temporary wet storage. The cumulative magnitude of impact of the Array with the Tier 1 projects is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

Table 8.24: Cumulative Footprint of Temporary Habitat Loss and Disturbance (km^2) for the Tier 1 Projects' Site Preparation and Construction Phases

Project	Total Footprint of Temporary Habitat Loss and Disturbance (km^2)	Reference
The Array	49.95	Table 8.12
Eastern Green Link 2	15.20 (due to boulder clearance and relocation and cable installation)	National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc (2022)
Proposed offshore export cable corridor(s)	Total footprint not available at present, however, the impacts magnitude will be similar in nature to the Eastern Green Link 2 project. The export cable will also extend into the Ossian Array site boundary and would extend to a number of the OSPs,	N/A
Total	**65.15 (plus approximate 15km² to 16 km² associated with the Proposed offshore export cable corridor(s)).**	

221. Within this phase of development of the Array, site preparation and construction activities are anticipated to occur intermittently. They will be spread out across the full allotted timeframe with only a small proportion of the MDS footprint for this impact being affected at any one time. There will be no spatial overlap between the Array and the Eastern Green Link 2, however, there may be some spatial overlap between the Array and the Proposed offshore export cable corridor(s), given their proximity.

222. The cumulative impact is predicted to be of local spatial extent, medium term duration (between 2030 and 2038), intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

223. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and its paragraphs 66 to 70).

224. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability, and national value. The sensitivity of the receptor is, therefore, considered to be high.

225. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

226. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. There will be a low footprint of temporary habitat loss and disturbance with respect to the Tier 1 projects and the 50 km screening area used for the CEA and regional benthic subtidal ecology study area as a whole. Due to the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

227. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

228. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

229. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the operation and maintenance and decommissioning phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance and decommissioning phases of the Eastern Green Link 2 (Table 8.23).

230. At the time of writing this Array EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that the two Tier 1 projects are both HVDC subsea power cables, activities associated with their operation and maintenance phase are expected to be of an equal or lesser extent than those represented by the MDS for the Array alone, which were up to 51.41 km^2 of temporary habitat loss and disturbance (Table 8.12). The cumulative magnitude of impact of the Array with the Tier 1 projects is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

231. Within the Environmental Appraisal Report for the Eastern Green Link 2, no values were provided for temporary habitat loss and disturbance during the operation and maintenance phase, however it was noted that they would be significantly lower than the value of 15.20 km^2 provided for the site preparation and construction phase (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022).

232. The cumulative spatial extent of this impact in the operation and maintenance phase therefore likely to be small in relation to the whole Array benthic subtidal ecology study area, although there is the potential for repeated disturbance to the habitats in the immediate vicinity infrastructure and cables. There will be no spatial overlap between the Array and the Eastern Green Link 2, however, there may be some spatial overlap between the Array and the Proposed offshore export cable corridor(s), given their proximity.

233. The cumulative impact is predicted to be of local spatial extent, long term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

234. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and paragraphs 66 to 70).

235. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivity of the receptor is, therefore, considered to be high.

236. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

237. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to the Tier 1 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

238. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

239. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 2

Construction phase

Magnitude of impact

240. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). As with the Array, site preparation and construction activities applicable to this impact for the Morven Offshore Wind Farm are:

- site preparation (sand wave clearance and boulder clearance and relocation);
- cable installation; and
- jack up vessel use for infrastructure installation (Morven Offshore Wind Limited, 2023).

241. However, it should be noted that no offshore temporary wet storage was included within the Scoping Report for Morven Offshore Wind Farm (Morven Offshore Wind Limited, 2023). Given the higher number of wind turbines and energy generation capacity of the Array in comparison to Morven Offshore Wind Farm (Table 8.22) it is likely that the maximum footprints of temporary habitat loss and disturbance of the Array will be larger than those for Morven Offshore Wind Farm (49.95 km^2 for the Array; Table 8.12). As outlined in paragraphs 58 to 61 for the Array alone, the impacts of cable installation, seabed preparation, and jack up vessel use are likely to be reversible. The cumulative magnitude of the Tier 2 assessment is therefore not expected to a represent material additional impact to that defined for the assessment of the Array alone (section 8.11).

242. The maximum duration of the offshore construction phase for the Array is up to eight years between 2031 to 2038, and between 2031 to 2038 for Morven Offshore Wind Farm (Table 8.22). Therefore, there may be full temporal overlap between the site preparation and construction activities of the Array and Morven Offshore Wind Farm. Given the reversibility and short temporal overlap in the Tier 2 assessment, cumulative impacts will be low.

243. The cumulative impact is predicted to be of local spatial extent, medium term duration, intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

244. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and paragraphs 66 to 70).

245. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivity of the receptor is, therefore, considered to be high.

246. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

247. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to the Tier 2 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

248. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

249. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

250. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). As with the Array, operation and maintenance activities applicable to this impact for the Morven Offshore Wind Farm are cable repair and reburial and the use of jack up vessels for operation and maintenance activities (Morven Offshore Wind Limited, 2023). Within the Scoping Report for Morven Offshore Wind Farm, the extent of these activities is expected to be lower than that of the site preparation and construction phase (Morven Offshore Wind Limited, 2023).

251. For the Array, up to 51.41 km^2 of temporary habitat loss and disturbance may occur due to operation and maintenance activities (Table 8.12). Given the higher number of wind turbines and energy generation capacity of the Array in comparison to Morven Offshore Wind Farm (Table 8.22) it is likely that the maximum footprints of temporary habitat loss and disturbance of the Array will be larger than those for Morven Offshore Wind Farm.

252. The cumulative spatial extent of this impact in the operation and maintenance phase therefore likely to be small in relation to the whole Array benthic subtidal ecology study area, although there is the potential for repeated disturbance to the habitats in the immediate vicinity infrastructure and cables. The cumulative magnitude of impact of the Tier 2 assessment is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

253. The cumulative impact is predicted to be of local spatial extent, long term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

254. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and paragraphs 66 to 70).

255. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivity of the receptor is, therefore, considered to be high.

256. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

257. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to the Tier 2 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

258. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

259. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 3

Construction phase

Magnitude of impact

260. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4 (Table 8.23).

261. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. The site preparation and construction activities associated with the Bowdun Offshore Wind Farm are likely to be similar to those of the Array, and those associated with Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to those discussed above for the Eastern Green Link 2 in the Tier 1 assessment (paragraphs 218 to 222). Given the higher number of wind turbines and energy generation capacity of the Array in comparison to the Bellrock, Bowdun, and Campion Offshore Wind Farms (Table 8.22) it is likely that the maximum footprints

of temporary habitat loss and disturbance of the Array will be larger than those of the latter (49.95 km^2 for the Array; Table 8.12). As outlined in paragraphs 58 to 61 for the Array alone, the impacts of cable installation, seabed preparation, and jack up vessel use are likely to be reversible. The cumulative magnitude of impact of the Tier 3 assessment is therefore not expected to represent material additional impact to that defined for the assessment of the Array alone (section 8.11).

262. The maximum duration of the offshore construction phase for the Array is between 2031 to 2038, but there are currently no dates available for the construction phases of any of the Tier 3 projects (Table 8.22). Therefore, there may be minimal overlap between the site preparation and construction activities of the Array and that of the Tier 3 projects, but this cannot be confirmed at this stage.

263. The cumulative impact is predicted to be of local spatial extent, medium term duration, intermittent, and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

264. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and paragraphs 66 to 70).

265. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivity of the receptor is, therefore, considered to be high.

266. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

267. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to the Tier 3 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

268. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

269. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

270. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4 (Table 8.23).

271. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. The activities associated with Bellrock, Bowdun, and Campion Offshore Wind Farms are likely to be similar to those of the Array, and those associated with Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to those discussed above for the Eastern Green Link 2 in the Tier 1 assessment (paragraphs 229 to 233). These activities include cable repair and reburial and use of jack up vessels for infrastructure maintenance.

272. For the Array, up to 51.41 km^2 of temporary habitat loss and disturbance may occur due to operation and maintenance activities (Table 8.12). Given the higher number of wind turbines and energy generation capacity of the Array in comparison to the Tier 3 offshore wind farms (Table 8.22) it is likely that the maximum footprints of temporary habitat loss and disturbance of the Array will be larger than those of the Tier 3 projects.

273. The cumulative spatial extent of this impact in the operation and maintenance phase likely to be small in relation to the whole Array benthic subtidal ecology study area, although there is the potential for repeated disturbance to the habitats in the immediate vicinity infrastructure and cables. The cumulative magnitude of impact for Tier 3 assessment is not expected to represent material additional impact to that defined for the assessment of the Array alone (section 8.11).

274. The cumulative impact is predicted to be of local spatial extent, long term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

275. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.18 and paragraphs 66 to 70).

276. Overall, the ocean quahog IEF is deemed to be of high vulnerability, low recoverability and national value. The sensitivity of the receptor is, therefore, considered to be high.

277. Overall, all other IEFs are deemed to be of medium to high vulnerability, high recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

278. Overall, for the ocean quahog IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivity of the receptor is considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of temporary habitat loss and disturbance with respect to the Tier 3 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

279. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

280. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

LONG TERM HABITAT LOSS AND DISTURBANCE

281. There is potential for cumulative long term habitat loss and disturbance due to infrastructure installed during the construction of the Array and the other plans and projects. This long term habitat loss will persist into the operation and maintenance phase as infrastructure is installed, and as such, the construction and operation and maintenance phases have been assessed together. Infrastructure installed includes: foundations, scour protection, cable protection, cable crossing protection, junction boxes, mooring lines, and anchors. For the purposes of this Array EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective Tiers are outlined in Table 8.23.

Tier 1

Construction and operation and maintenance phases

Magnitude of impact

282. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- all phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance and decommissioning phases of the Eastern Green Link 2 (Table 8.23).

283. At the time of writing this Array EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that these two Tier 1 projects are both HVDC subsea power cables, there will be less infrastructure installed to constitute long term habitat loss than for the Array. It is likely that long term habitat loss will occur at the Tier 1 projects as a result of cable and/or pipeline protection and crossing protection.

284. For the Array, up to 19.27 km^2 of long term habitat loss and disturbance may occur due to the installation of infrastructure, and an additional 778,464 m^2 due to long term seabed disturbance from mooring lines and dynamic cabling (Table 8.12). Within the Environmental Appraisal Report for the Eastern Green Link 2, a total footprint of up to 2.20 km^2 long term habitat loss and disturbance was predicted to occur (Table 8.25) (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). This was comprised of up to 2 km^2 of rock berm and up to 0.2 km^2 of pipeline and cable crossing protection (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). This is considerably lower than the total 20.08 km^2 of long term habitat loss included in the MDS for the Array (Table 8.25).

Table 8.25: Cumulative Footprint of Long Term Habitat Loss and Disturbance (km^2) for the Tier 1 Projects

Project	Total Footprint of Long Term Habitat Loss and Disturbance (km^2)	Reference
The Array	20.08 (comprised of 19.27 km^2 + 778,464 m^2)	Table 8.12
Eastern Green Link 2	2.20	National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc (2022)
Proposed offshore export cable corridor(s)	Total footprint not available at present, however, the impacts magnitude will be similar in nature to the Eastern Green Link 2 project. The export cable will also extend into the Ossian Array site boundary and would extend to a number of the OSPs.	N/A
Total	**22.28 (plus approximately 2km² to 3 km² associated with the Proposed offshore export cable corridor(s)).**	

285. As outlined in paragraph 93 for the Array alone, this impact presents some measurable but minor long term loss of and alteration to the affected areas of seabed within the entire Array benthic subtidal ecology study area and but less so within the regional benthic subtidal ecology study area. The cumulative magnitude of impact of the Array with the Tier 1 projects is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

286. The cumulative impact is predicted to be of local spatial extent, long term duration, continuous and of low reversibility within the construction and operation and maintenance phase. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

287. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 94 to 97).

288. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

289. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

290. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

291. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of long term habitat loss and disturbance with respect to both the Tier 1 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

292. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 2

Construction and operation and maintenance phase

Magnitude of impact

293. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). As with the Array, infrastructure associated with long term habitat loss and disturbance includes foundations, scour protection, cable protection, and cable crossing protection, although further detail was not provided in the Scoping Report for Morven Offshore Wind Farm (Morven Offshore Wind Limited, 2023).

294. For the Array, up to 19.27 km^2 of long term habitat loss and disturbance may occur due to the installation of infrastructure, and an additional 778,464 m^2 due to long term seabed disturbance from mooring lines and dynamic cabling (Table 8.12). Given that Morven will be a fixed foundation Wind Farm and the Array is floating, it is not possible to determine which one will have a greater footprint of long term habitat loss and disturbance given the difference in wind turbine numbers between them. In the absence of a MDS for Morven Offshore Wind Farm, even if it is assumed that it will have a larger potential for long term habitat loss and disturbance, the cumulative magnitude of impact is still not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11). This is due to the low footprint of impact (2.25% of the Array benthic subtidal ecology study area) associated with this impact, in context of available habitat in the regional benthic subtidal ecology study area. Further, there will be no spatial overlap between long term habitat loss associated with the Array and Morven Offshore Wind Farm, thereby reducing the likelihood of a cumulative impact.

295. The cumulative impact is predicted to be of local spatial extent, long term duration, continuous and of low reversibility within the construction and operation and maintenance phase. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

296. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 94 to 97).

297. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

298. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

299. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

300. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of long term habitat loss and disturbance with respect to both the Tier 2 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

301. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 3

Construction and operation and maintenance phase

Magnitude of impact

302. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4 (Table 8.23).

303. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. The infrastructure associated with Bellrock, Bowdun, and Campion Offshore Wind Farms is likely to be similar to that of the Array, and those associated with Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to those discussed above for the Eastern Green Link 2 in the Tier 1 assessment (paragraphs 282 to 286).

304. For the Array, up to 19.27 km^2 of long term habitat loss and disturbance may occur due to the installation of infrastructure, and an additional 778,464 m^2 due to long term seabed disturbance from mooring lines and dynamic cabling (Table 8.12). The three Tier 3 offshore wind farms are either fully floating or containing some floating wind turbines, similar to the Array, which is a fully floating project. Therefore, given the higher number of wind turbines and energy generation capacity of the Array in comparison to the Tier 3 offshore wind farms (Table 8.22), it is likely that the maximum footprint of long term habitat loss and disturbance of the Array will be larger than those of the Tier 3 projects.

305. The cumulative spatial extent of this impact in the construction and operation and maintenance phase is likely to be small in relation to the whole Array benthic subtidal ecology study area. The cumulative magnitude of impact of the Tier 3 assessment is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

306. The cumulative impact is predicted to be of local spatial extent, long term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

307. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 94 to 97).

308. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

309. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

310. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

311. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate adverse significance. Given the low footprint of long term habitat loss and disturbance with respect to both the Tier 3 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

312. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

EFFECTS TO BENTHIC SUBTIDAL ECOLOGY DUE TO EMF FROM SUBSEA ELECTRICAL CABLING

313. Within the operation and maintenance phase, there is potential for EMFs to be produced by the subsea electrical cabling associated with the Array and the other plans and projects. For the purposes of this EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective Tiers are outlined in Table 8.23.

Tier 1

Operation and maintenance phase

Magnitude of impact

314. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the operation and maintenance phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance phases of the Eastern Green Link 2 (Table 8.23).

315. At the time of writing this EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that these two Tier 1 projects are both HVDC subsea power cables, they will not include dynamic cabling, and will likely be entirely buried and protected where burial is not practicable. It can be assumed that for the Proposed offshore export cable corridor(s), as per the Array, cables will be buried to a depth of at least 0.4 m and cable protection will be used where not possible, and length will be approximately 400 km. As detailed in the assessment for the Array alone (section 8.11), cable burial and cable protection are common industry practice measures, which can reduce EMF levels in the benthic environment (Chapman *et al.*, 2023, CSA Ocean Sciences Inc and Exponent, 2019, Gill *et al.*, 2005, Gill *et al.*, 2009, Hervé, 2021). For example, the Environmental Appraisal Report for the Eastern Green Link 2 presented modelling that a burial depth of 1 m reduced EMFs to background levels by 20 m distance from the cable, both vertically and horizontally (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022)

316. The MDS for the Array accounts for up to 1,261 km of 66 kV inter-array cables, with up to 116 km within the water column (i.e. 'dynamic cables') and the rest buried at a minimum target depth of 0.4 m (Table 8.12). There will also be up to 236 km of interconnector cables buried to a minimum target depth of 0.4 m (Table 8.12). It has been estimated in the MDS that up to 20% of these buried cables will require cable protection, with up to 24 cable crossings also requiring protection.

317. As presented in paragraph 142, EMF levels in the vicinity of subsea cables are influenced by a variety of design and installation factors, including distance between cables, cable sheathing, number of conductors, and internal cable configuration. Further, the intensity of EMF from subsea cables decreases at approximately the inverse square/power of the distance away from the cable (Hutchison *et al.*, 2021). This attenuation is the same for buried, unburied, and dynamic cables (Hutchison *et al.*, 2021). Therefore, the cumulative magnitude of impact with the Tier 1 projects is likely to be highly localised to within metres to tens of metres from cables.

318. The cumulative impact is predicted to be of local spatial extent (given impacts are likely to be highly localised to cables), long term duration, continuous, and of high reversibility (as cables will be removed after the operation and maintenance phase). It is predicted that the impact will affect the receptors directly. This impact presents some measurable, long term minor alteration to the affected areas of seabed. The magnitude is therefore considered to be low.

Sensitivity of the receptor

319. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see paragraphs 145 to 150).

320. Overall, on a precautionary basis in the absence of more information, all IEFs are deemed to be of medium vulnerability, medium recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

321. For all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

322. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 2

Operation and maintenance phase

Magnitude of impact

323. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). The MDS for the Array accounts for up to 1,261 km of 66 kV inter-array cables, with up to 116 km within the water column (i.e. 'dynamic cables') and the rest buried at a minimum target burial depth of 0.4 m (Table 8.12). There will also be up to 236 km of interconnector cables buried to a minimum target burial depth of 0.4 m (Table 8.12). Final target burial depths will be subject to a CBRA. It has been estimated in the MDS that up to 20% of these buried cables will require cable protection, with up to 24 cable crossings also requiring protection. As only a Scoping Report is available for the Morven Offshore Wind Farm, cable lengths, dimensions, and voltages are not currently available. However, given the scale of the project, it is likely that they will be of a similar extent to those of the Array, albeit with less dynamic cabling given that the Morven Offshore Wind Farm is not a floating project.

324. As presented in paragraph 142 and within the Tier 1 assessment, EMF levels in the vicinity of subsea cables are influenced by a variety of design and installation factors, including distance between cables, cable sheathing, number of conductors, and internal cable configuration. As detailed in the assessment for the Array alone (section 8.11), cable burial and cable protection are common industry practice measures, which can reduce EMF levels in the benthic environment (Chapman *et al.*, 2023, CSA Ocean Sciences Inc and Exponent, 2019, Gill *et al.*, 2005, Gill *et al.*, 2009, Hervé, 2021). Further, this was demonstrated in the Environmental Appraisal Report for the Eastern Green Link 2 in the Tier 1 assessment (paragraph 315), which found that burial at 1 m reduced EMFs to background levels by 20 m both vertically and horizontally (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). Further, the intensity of EMF from subsea cables decreases at approximately the inverse square/power of the distance away from the cable (Hutchison *et al.*, 2021). This attenuation is the same for buried, unburied, and dynamic cables (Hutchison *et al.*, 2021). Therefore, the cumulative magnitude of impact with the Tier 2 projects is likely to be highly localised to within metres to tens of metres from cables.

325. The cumulative impact is predicted to be of local spatial extent (given impacts are likely to be highly localised to cables), long term duration, continuous, and of high reversibility (as cables will be removed after the operation and maintenance phase). It is predicted that the impact will affect the receptors directly. This impact presents some measurable, long term minor alteration to the affected areas of seabed. The magnitude is therefore considered to be low.

Sensitivity of the receptor

326. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see paragraphs 145 to 150).

327. Overall, on a precautionary basis in the absence of more information, all IEFs are deemed to be of medium vulnerability, medium recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

328. For all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

329. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 3

Operation and maintenance phase

Magnitude of impact

330. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4 (Table 8.23).

331. The MDS for the Array accounts for up to 1,261 km of 66 kV inter-array cables, with up to 116 km within the water column (dynamic cables) and the rest buried at a minimum target depth of 0.4 m (Table 8.12). There will also be up to 236 km of interconnector cables buried to a minimum target depth of 0.4 m (Table 8.12). It has been estimated in the MDS that up to 20% of these buried cables will require cable protection, with up to 24 cable crossings also requiring protection. As there is no project specific information regarding cable lengths, dimension, and voltages currently available for the Tier 3 projects. However, given the scale of the projects, it is likely that the Bellrock, Bowdun, and Campion Offshore Wind Farms will be of a similar extent to those of the Array and Morven Offshore Wind Farm. Similarly, the Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to as described in paragraph 315 for the Eastern Green Link 2.

332. As presented in paragraph 142 and within the Tier 1 assessment, EMF levels in the vicinity of subsea cables are influenced by a variety of design and installation factors, including distance between cables, cable sheathing, number of conductors, and internal cable configuration. As detailed in the assessment for the Array alone (section 8.11), cable burial and cable protection are common industry practice measures, which can reduce EMF levels in the benthic environment (Chapman *et al.*, 2023, CSA Ocean Sciences Inc and Exponent, 2019, Gill *et al.*, 2005, Gill *et al.*, 2009, Hervé, 2021). Further, this was demonstrated in the Environmental Appraisal Report for the Eastern Green Link 2 in the Tier 1 assessment (paragraph 315), which found that burial at 1 m reduced EMFs to background levels by 20 m both vertically and horizontally (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). Further, the intensity of EMF from subsea cables decreases at approximately the inverse square/power of the distance away from the cable (Hutchison *et al.*, 2021). This attenuation is the same for buried, unburied, and dynamic cables (Hutchison *et al.*, 2021). Therefore, the cumulative magnitude of impact with the Tier 3 projects is likely to be highly localised to within metres to tens of metres from cables.

333. The cumulative impact is predicted to be of local spatial extent (given impacts are likely to be highly localised to cables), long term duration, continuous, and of high reversibility (as cables will be removed after the operation and maintenance phase). It is predicted that the impact will affect the receptors directly. This impact presents some measurable, long term minor alteration to the affected areas of seabed. The magnitude is therefore considered to be low.

Sensitivity of the receptor

334. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see paragraphs 145 to 150).

335. Overall, on a precautionary basis in the absence of more information, all IEFs are deemed to be of medium vulnerability, medium recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be medium.

Significance of effect

336. For all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be medium. The cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

337. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

COLONISATION OF HARD SUBSTRATES

338. The introduction of the hard substrates at the Array and the other projects may potentially affect the established benthic community by providing new habitat and ecosystem function. Hard substrates include foundations, scour protection, cable protection, cable crossing protection, and junction boxes. These artificial hard structures are expected to be colonised by a range of organisms, which could lead to local biodiversity increases. For the purposes of this EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective Tiers are outlined in Table 8.23.

Tier 1

Operation and maintenance phase

Magnitude of impact

339. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the operation and maintenance phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance phases of the Eastern Green Link 2 (Table 8.23).

340. At the time of writing this EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that these two projects are both HVDC subsea power cables, the area of hard structures installed will be of a significantly lesser extent to that represented by the MDS for the Array alone, which is up to 19.27 km^2 on the seabed and an unquantified area within the water column (Table 8.26). The cumulative magnitude of impact of the Array with the Tier 1 projects is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

341. Within the Environmental Appraisal Report for the Eastern Green Link 2, a total footprint of up to 2.20 km^2 of artificial hard substrates was predicted to be installed (see Table 8.26), comprised of up to 2 km^2 of rock berm and up to 0.2 km^2 of pipeline and cable crossing protection (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). For the Proposed offshore export cable corridor(s), the area of installed hard substrate is expected to be similar to that of the Eastern Green Link 2, given the similarity in nature of the two Tier 1 projects. The cumulative spatial extent of this impact in the operation and maintenance phase therefore likely to be small in relation to the whole Array benthic subtidal ecology study area.

Table 8.26: Cumulative Footprint of Hard Substrates Installed (km^2) for the Tier 1 Projects

Project	Total Footprint of Hard Substrates Installed (km^2)	Reference
The Array	19.27	Table 8.12
Eastern Green Link 2	2.20	National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc (2022)
Proposed offshore export cable corridor(s)	Total footprint not available at present, however, the impacts magnitude will be similar in nature to the Eastern Green Link 2 project. The export cable will also extend into the Ossian Array site boundary and would extend to a number of the OSPs.	N/a
Total	**21.47 (plus an approximate of 2 km to 3 km^2 associated with the Proposed offshore export cable corridor(s)).**	

342. Further, as per paragraph 156, it expected that these artificial hard substrates will be colonised by epifaunal species local to the Array benthic subtidal ecology study area. However, this impact will represent a shift in the baseline seabed conditions from soft to hard substrate in the areas where the infrastructure is installed. This could result in beneficial effects, such as increased biodiversity and potential reef effects (Bender *et al.*, 2020, De Mesel *et al.*, 2015, Karlsson *et al.*, 2022, Lindeboom *et al.*, 2011, Mavraki *et al.*, 2020).

343. Although this impact is expected to be beneficial in terms of increasing biodiversity and enhancing reef effects, the installation of hard structures will result in habitat loss for the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF. However, given the wide availability of both habitats over the Array benthic subtidal ecology study area and regional benthic subtidal ecology study area, and the localised nature of this impact, this impact is only expected to result in minor loss or alteration to the soft bottom sediments of these IEFs as a whole. The cumulative magnitude of impact of the Array with the Tier 1 projects is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

344. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

345. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 159 to 165).

346. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

347. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

348. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor beneficial significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** beneficial significance, which is not significant in EIA terms.

349. For all other IEFs, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. The potential for increased biodiversity as a result of this impact could be considered to be beneficial, however introduction of hard substrates would represent some small-scale habitat loss for these IEFs. Given the low footprint of long term habitat loss with respect to the Tier 1 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

350. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 2

Operation and maintenance phase

Magnitude of impact

351. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). As with the Array, hard substrates installed at the Morven Offshore Wind Farm include foundations, scour protection, and cable protection (Morven Offshore Wind Limited, 2023).

352. For the Array, hard structures will be installed on the seabed and in the water column (Table 8.12). Given that Morven will be a fixed foundation wind farm and the Array is floating, it is not possible to determine which one will have a greater footprint of hard substrate, given the difference in wind turbine numbers between them. In the absence of a MDS for Morven Offshore Wind Farm, even if it is assumed that it will have a larger footprint, the cumulative magnitude of impact is still not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11). This is due to the low footprint of impact (2.25% of the Array benthic subtidal ecology study area) associated with this impact, in context of available habitat in the regional benthic subtidal ecology study area. Further, there will be no spatial overlap between installed hard structures associated with the Array and Morven Offshore Wind Farm, thereby reducing the likelihood of a cumulative impact.

353. As per paragraphs 342 to 344 for the Tier 1 assessment, it is expected that the hard substrates will be colonised by local epifauna, but will still represent a shift in the baseline conditions from soft sediments to hard substrate. However, this is expected to have beneficial effects, such as increased biodiversity and reef effects (Bender *et al.*, 2020, De Mesel *et al.*, 2015, Karlsson *et al.*, 2022, Lindeboom *et al.*, 2011, Mavraki *et al.*, 2020). Although a shift from soft sediments to hard structures will constitute habitat loss for the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, the localised nature of the footprints is likely to only result in a minor loss to the soft bottom substrates in the Array benthic subtidal ecology study area and less so within the regional benthic subtidal ecology study area.

354. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

355. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 159 to 165).

356. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

357. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

358. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor beneficial significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** beneficial significance, which is not significant in EIA terms.

359. For all other IEFs, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. The potential for increased biodiversity as a result of this impact could be considered to be beneficial, however introduction of hard substrates would represent some small-scale habitat loss for these IEFs. Given the low footprint of long term habitat loss with respect to the Tier 2 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

360. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 3

Operation and maintenance phase

Magnitude of impact

361. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4 (Table 8.23).

362. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. The extent of hard substrates associated with Bellrock, Bowdun, and Campion Offshore Wind Farms is likely to be similar to that of the Array, and those associated with Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 likely to be similar to those discussed above for the Eastern Green Link 2 in the Tier 1 assessment (paragraphs 339 to 344).

363. For the Array, hard structures will be installed on the seabed and in the water column (Table 8.12). The three Tier 3 offshore wind farms are either fully floating or containing some floating wind turbines, similar to the Array which is a fully floating project. Therefore, given the higher number of wind turbines and energy generation capacity of the Array in comparison to the Tier 3 offshore wind farms (Table 8.22), it is likely that the maximum footprint of hard structures installed for the Array will be larger than those of the Tier 3 projects. The cumulative magnitude of impact of the Tier 3 projects is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

364. As per paragraphs 342 to 344 for the Tier 1 assessment, it is expected that the hard substrates will be colonised by local epifauna, but will still represent a shift in the baseline conditions from soft sediments to hard substrate. However, this is expected to have beneficial effects, such as increased biodiversity and reef effects (Bender *et al.*, 2020, De Mesel *et al.*, 2015, Karlsson *et al.*, 2022, Lindeboom *et al.*, 2011, Mavraki *et al.*, 2020). Although a shift from soft sediments to hard structures will constitute habitat loss for the Offshore subtidal sands and gravels IEF and the Subtidal sands and gravels IEF, the localised nature of the footprints is likely to only result in a minor loss to the soft bottom substrates in the Array benthic subtidal ecology study area and less so within the regional benthic subtidal ecology study area.

365. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

366. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 159 to 165).

367. Overall, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of low vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be low.

368. Overall, all other IEFs are deemed to be of high vulnerability, low recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

369. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor beneficial significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** beneficial significance, which is not significant in EIA terms.

370. For all other IEFs, the cumulative magnitude of impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. The potential for increased biodiversity as a result of this impact could be considered to be beneficial, however introduction of hard substrates would represent some small-scale habitat loss for these IEFs. Given the low footprint of long term habitat loss with respect to the Tier 3 projects and the North Sea as a whole, and the widespread availability of alternative suitable habitat, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

371. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

EFFECTS TO BENTHIC SUBTIDAL ECOLOGY DUE TO REMOVAL OF HARD SUBSTRATES

372. The removal of artificial hard substrates in the decommissioning phase of the Array and other projects may affect the established benthic community upon these structures, with the seabed returning to its previous sandy sediments. For the purposes of this EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective Tiers are outlined in Table 8.23.

Tier 1

<u>Decommissioning phase</u>

Magnitude of impact

373. There was one Tier 1 project identified with potential for cumulative effects associated with this impact:

- the decommissioning phase of the Proposed offshore export cable corridor(s) (Table 8.23).

374. The MDS for the Array alone accounts for up to a total of 19.27 km^2 of artificial hard substrates to be removed from the seabed during the decommissioning phase, which represents up to 2.25% of the total Array benthic subtidal ecology study area (Table 8.12). In addition, the MDS accounts for the removal of hard substrate in the water column, such as floating wind turbine foundations, anchor mooring lines, and dynamic cables (Table 8.12). As per the justification presented in Table 8.12 for the Array alone, the MDS for this impact is the complete removal of all infrastructure installed on the seabed and in the water column in the Array benthic subtidal ecology study area, as this represents the largest potential impact. These hard substrates include:

- mooring lines and anchors on the seabed;
- OSP foundations;
- inter-array and interconnector cable protection and cable crossing protection;
- subsea junction boxes;
- scour protection for mooring lines, anchors, OSP foundations, and subsea junction boxes; and
- floating wind turbine foundations in the water column.

375. It should be noted that the decommissioning strategy is not yet defined, and cable protection, cable crossing protection, and scour protection may potentially be left *in situ.* Anchors will also be removed or cut on or at the seabed and left *in situ,* however, are considered unlikely to contribute to this impact as they will be a significant depth below the seabed. Leaving cable protection, cable crossing protection, and scour protection *in situ* represents the MDS in the decommissioning phase for 'Long term habitat loss and disturbance' and has been assessed as such in paragraphs 282 *et seq.* In reality, if this infrastructure remains *in situ,* the MDS presented here will be an overestimation of the area of hard substrates removed.

376. There is currently no publicly available information available on the footprint of hard substrates installed at the Proposed offshore export cable corridor(s). However, given that it is a HVDC subsea power cable project, the area of hard structures installed will be of a significantly lesser extent than that represented by the MDS for the Array alone (see previous paragraph). The cumulative magnitude of impact of the Array with this Tier 1 project is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

377. Overall, for all IEFs, the impact is predicted to be of local spatial extent, long term duration, continuous, and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

378. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.19 and paragraphs 94 to 97).

379. Overall, all IEFs except dead man's fingers and sea tamarisk are deemed to be of low vulnerability, high recoverability, and national and regional value. The sensitivities of the receptors are, therefore, considered to be low.

380. In contrast however, the dead man's fingers IEF and sea tamarisk IEF are deemed to be of high vulnerability, medium recoverability, and regional value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

381. Overall, for the dead man's fingers IEF and sea tamarisk IEF, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the cumulative effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be removed during the decommissioning phase (2.25% of the Array benthic subtidal ecology study area, and a presumably lower value for the Proposed offshore export cable corridor(s)) and the widespread availability of alternative suitable habitat, the cumulative effect will therefore be of **minor** adverse significance, which is not significant in EIA terms.

382. For all other IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be low. Based on Table 8.16, the cumulative effect will, therefore, be of negligible to minor adverse significance. Based on expert judgement and adopting a precautionary approach, the cumulative effect has been concluded to be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

383. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tiers 2 and 3

384. There were no Tier 1 or Tier 2 projects identified with the potential to result in cumulative effects associated with this impact (Table 8.23).

INCREASED RISK OF INTRODUCTION OR SPREAD OF INNS

385. Vessels used during the construction and operation and maintenance phases of the Array and the other projects could inadvertently transport INNS. This impact is related to the impact of 'Colonisation of hard substrates', which may lead to an increased risk of potential habitat that could be colonised by INNS. For the purposes of this EIA Report, this effect has been assessed using the tiered approach outlined in section 8.12.1. The plans and projects screened into the CEA for this impact and their respective Tiers are outlined in Table 8.23.

Tier 1

Construction phase

Magnitude of impact

386. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the construction and operation and maintenance phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance phase of the Eastern Green Link 2 (Table 8.23).

387. At the time of writing this EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that these two projects are both HVDC subsea power cables, there will be fewer vessel trips associated with their overlapping phases than those associated with the site preparation and construction activities of the Array. Similarly, as assessed above in 'Colonisation of hard substrates', there will be fewer hard substrates (with the potential for colonisation by INNS) installed for the Tier 1 projects in comparison to the Array.

388. The MDS for the Array accounts for up to 7,902 vessel round trips over the course of the site preparation and construction phase, with up to 97 vessels on site at any one time (Table 8.12). These provide vectors for the potential introduction of INNS into the habitats within the Array benthic subtidal ecology study area. In addition, the installation of hard substrate on the seabed and in the water column throughout the construction phase could provide new habitat for INNS to colonise. There were no values of vessel movements provided within the Environmental Appraisal Report for the Eastern Green Link 2, however the impact of increased risk of INNS was assessed as having negligible/minor significance (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). The cumulative magnitude of the Array with the Tier 1 projects is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

389. Many of the vessels associated with the Tier 1 projects and the Array are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the potential for introduction of INNS from outside this region is reduced.

390. As described in Table 8.17, an INNSMP will be implemented, which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable. In addition, all vessels associated with the Array will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable. Adherence to the IMO guidelines is also listed as an designed in mitigation commitment for the Eastern Green Link 2 (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022), and it is likely that the same will apply to the Proposed offshore export cable corridor(s).

391. Overall, for all IEFs, the impact is predicted to be of local spatial extent, medium term duration over the site preparation and construction phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

392. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

393. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

394. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 1 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

395. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

396. There were two Tier 1 projects identified with potential for cumulative effects associated with this impact:

- the operation and maintenance and decommissioning phases of the Proposed offshore export cable corridor(s); and
- the operation and maintenance and decommissioning phases of the Eastern Green Link 2 (Table 8.23).

397. At the time of writing this EIA Report, there was no Offshore EIA Report available for the Proposed offshore export cable corridor(s). However, given that these two projects are both HVDC subsea power cables, there will be fewer vessel trips associated with operation and maintenance activities than those of the Array. Similarly, as assessed above in 'Colonisation of hard substrates', there will be fewer hard substrates (with the potential for colonisation by INNS) installed for the Tier 1 projects in comparison to the Array.

398. The MDS for the Array accounts for up to 17,780 vessel round trips over its 35 year lifecycle, or 508 round trips per year (Table 8.12). There may be up to 31 vessels on site at any one time. As above for the site preparation and construction phase, these vessels provide vectors for the potential introduction of INNS into the habitats within the Array benthic subtidal ecology study area. In addition, the installation of up to 19.27 km^2 of artificial hard substrate in the construction phase could provide new habitat for INNS to colonise throughout the lifecycle of the Array. There were no values of vessel movements provided within the Environmental Appraisal Report for the Eastern Green Link 2, however the impact of increased risk of INNS was assessed as having negligible/minor significance (National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc, 2022). The cumulative magnitude of the Array with the Tier 1 projects is not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

399. As above for the site preparation and construction phase, many of the vessels within the operation and maintenance phase are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the risk of introduction of INNS from outside this region is reduced.

400. As above for the site preparation and construction phase, the implementation of an INNSMP is a designed in measure which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable (Table 8.17). As above, all vessels will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

401. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

402. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

403. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

404. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 1 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

405. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 2

Site preparation and construction phase

Magnitude of impact

406. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). Like the Array, vessel movement at the Morven Offshore Wind Farm represents a vector for INNS transport, and hard substrates installed represent potential new habitat for INNS to colonise.

407. The MDS for the Array accounts for up to 7,902 vessel round trips over the course of the site preparation and construction phase, with up to 97 vessels on site at any one time (Table 8.12). These provide vectors for the potential introduction of INNS into the habitats within the Array benthic subtidal ecology study area. In addition, the installation of hard substrate on the seabed and in the water column throughout the construction phase could provide new habitat for INNS to colonise. There were no values of vessel movements provided within the Scoping Report for Morven Offshore Wind Farm, however the impact was scoped in (Morven Offshore Wind Limited, 2023). Given the higher number of wind turbines and energy generation capacity of the Array in comparison to Morven Offshore Wind Farm (Table 8.22), it is likely that there may be more vessel movements and potential for introduction of INNS associated with the Array. The cumulative magnitude of impact in the Tier 2 assessment is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11). Further, vessel movements associated with the Morven Offshore Wind Farm and the Array may follow similar routes and vessels associated with the Array may pass through the Morven Offshore Wind Farm. However, vessels associated with both will be required to comply with an INNSMP, which includes the IMO ballast water management guidelines, which help reduce the risk of potential introduction and spread of INNS as far as practicable (Table 8.17).

408. As above for the Tier 1 assessment, many of the vessels are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the potential for introduction of INNS from outside this region is reduced.

409. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, medium term duration over the site preparation and construction phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

410. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

411. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

412. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 2 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

413. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

<u>Operation and maintenance phase</u>

Magnitude of impact

414. In addition to the Tier 1 projects, there was one Tier 2 project identified with potential for cumulative effects associated with this impact: Morven Offshore Wind Farm (Table 8.23). Like the Array, vessel movement at the Morven Offshore Wind Farm represents a vector for INNS transport, and hard substrates installed during the construction phase represent potential new habitat for INNS to colonise in the operation and maintenance phase.

415. The MDS for the Array accounts for up to 17,780 vessel round trips over its 35 year lifecycle, or 508 round trips per year (Table 8.12). There may be up to 31 vessels on site at any one time. As above for the site preparation and construction phase, these vessels provide vectors for the potential introduction of INNS into the habitats within the Array benthic subtidal ecology study area. In addition, the installation of artificial hard substrate on the seabed and in the water column during the construction phase could provide new habitat for INNS to colonise throughout the lifecycle of the Array. In the absence of a MDS for Morven Offshore Wind Farm, even if it is assumed that it will have a larger footprint, the cumulative magnitude of impact is still not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11). Further, vessel movements associated with the Morven Offshore Wind Farm and the Array may follow similar routes and vessels associated with the Array may pass through the Morven Offshore Wind Farm. However, vessels associated with both will be required to comply with an INNSMP, which includes the IMO ballast water management guidelines, which help reduce the risk of potential introduction and spread of INNS as far as practicable (Table 8.17).

416. As above for the site preparation and construction phase, many of the vessels are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the potential for introduction of INNS from outside this region is reduced.

417. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration over the operation and maintenance phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

418. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

419. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

420. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 2 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

421. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

Tier 3

<u>Construction phase</u>

Magnitude of impact

422. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4.

423. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. Vessel activities associated with Bellrock, Bowdun, and Campion Offshore Wind Farms are likely to be similar to those of the Array, and those associated with the Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to those discussed above for the Eastern Green Link 2 in the Tier 1 assessment (paragraphs 386 to 393). Given the higher number of wind

turbines and energy generation capacity of the Array in comparison to the Bellrock, Bowdun, and Campion Offshore Wind Farms (Table 8.22) it is likely that the maximum area of hard substrates installed (that could be colonised by INNS) will be higher for the Array (19.27 km^2 on the seabed and an unquantifiable area in the water column; Table 8.12). Further, as Bellrock and Campion Offshore Wind Farms are floating projects, the towing of wind turbines may also represent an additional pathway for INNS, as per the Array. However, further information on this is unavailable at the time of writing. The cumulative magnitude of impact of the Tier 3 assessment is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

424. As above for the Tier 1 assessment, many of the vessels are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the potential for introduction of INNS from outside this region is reduced.

425. As above for the Tier 1 assessment, the implementation of an INNSMP is a designed in measure which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable (Table 8.17). All vessels associated with the Tier 2 assessment will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

426. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, medium term duration over the site preparation and construction phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

427. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

428. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

429. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 3 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

430. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

<u>Operation and maintenance phase</u>

Magnitude of impact

431. In addition to the Tier 1 and Tier 2 projects, there were six Tier 3 projects identified with potential for cumulative effects associated with this impact:

- Morven Offshore Export Cable Corridor(s);
- Bellrock Offshore Wind Farm;
- Bowdun Offshore Wind Farm;
- Campion Offshore Wind Farm;
- Eastern Green Link 3; and
- Eastern Green Link 4.

432. As these are Tier 3 projects, there are no Scoping Reports or EIA documents available in the public domain. Therefore, there is no information available on the impact that these Tier 3 projects will have on benthic subtidal ecology. Vessel activities associated with Bellrock, Bowdun, and Campion Offshore Wind Farms are likely to be similar to those of the Array, and those associated with the Morven Offshore Export Cable Corridor(s) and Eastern Green Link 3 and 4 are likely to be similar to those discussed above for the Eastern Green Link 2. Given the higher number of wind turbines and energy generation capacity of the Array in comparison to the Bellrock, Bowdun, and Campion Offshore Wind Farms (Table 8.22) it is likely that the maximum area of hard substrates (that could be colonised by INNS) will be higher for the Array (19.27 km^2; Table 8.12). The cumulative magnitude of impact of the Tier 3 assessment is therefore not expected to represent a material additional impact to that defined for the assessment of the Array alone (section 8.11).

433. As above for the site preparation and construction phase, many of the vessels are likely to come to and from the vicinity of the Array benthic subtidal ecology study area. Therefore, the potential for introduction of INNS from outside this region is reduced.

434. As above for the site preparation and construction phase, the implementation of an INNSMP is a designed in measure which aims to manage and reduce the potential risk of introduction and spread of INNS as far as reasonably practicable (Table 8.17). All vessels associated with the Tier 3 assessment will be required to comply with the IMO ballast water management guidelines, which will help reduce the risk of potential introduction and spread of INNS as far as practicable.

435. Overall, for all IEFs, the cumulative impact is predicted to be of local spatial extent, long term duration over the operation and maintenance phase, intermittent (in terms of invasions), and of low reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore considered to be low.

Sensitivity of the receptor

436. The sensitivities of the benthic subtidal ecology IEFs are as previously described above for the assessment of the Array alone (see Table 8.21 and paragraphs 188 to 191).

437. Overall, all IEFs are deemed to be of high vulnerability, low recoverability, and regional to national value. The sensitivities of the receptors are, therefore, considered to be high.

Significance of effect

438. Overall, for all IEFs, the cumulative magnitude of the impact is deemed to be low, and the sensitivities of the receptors are considered to be high. As per Table 8.16, the effect will, therefore, be of minor to moderate significance. Given the low footprint of hard substrates to be installed in the Tier 3 projects that could be colonised by INNS, and the designed in mitigation measure of an INNSMP, the cumulative effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

439. No benthic subtidal ecology mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the designed in measures outlined in section 8.10) is not significant in EIA terms.

8.13. PROPOSED MONITORING

440. This section outlines the proposed monitoring proposed for benthic subtidal ecology. No project specific monitoring measures are proposed given that no significant impacts were predicted from the Array alone or cumulatively with other plans and projects. However, the Applicant will engage with MD-LOT, NatureScot, and other relevant key stakeholders to identify and contribute to targeted and proportionate regional or strategic monitoring to better understand the environmental effects of offshore wind taking account of known evidence gaps. This may involve engaging and contributing to ongoing strategic initiatives from ScotMER forum (Scottish Government, 2024).

8.14. TRANSBOUNDARY EFFECTS

441. A screening of transboundary impacts has been carried out and has identified that there were no likely significant transboundary effects with regard to benthic subtidal ecology from the Array upon the interests of European Economic Area (EEA) states.

8.15. INTER-RELATED EFFECTS (AND ECOSYSTEM ASSESSMENT)

442. A description of the likely inter-related effects arising from the Array on benthic subtidal ecology is provided in volume 3, appendix 18.1 of the Array EIA Report. For benthic subtidal ecology, the following potential impacts have been considered within the inter-related assessment:

- temporary habitat loss and disturbance;
- long term habitat loss and disturbance;
- increased SSCs and associated deposition;
- effects to benthic subtidal ecology from EMF from subsea electrical cabling;
- colonisation of hard substrates;
- effects to benthic subtidal ecology due to removal of hard substrates; and
- increased risk of INNS.

443. Table 8.27 lists the inter-related effects (project lifetime effects) that are predicted to arise during the construction, operation and maintenance phase, and decommissioning of the Array and also the inter-related effects (receptor-led effects) that are predicted to arise for benthic subtidal ecology receptors.

444. As noted above, effects on benthic subtidal ecology also have the potential to have secondary effects on other receptors and these effects are fully considered in the topic-specific chapters. These receptors and effects are:

- fish and shellfish ecology;
  - temporary (during construction, operation and maintenance and decommissioning phases), long term (during operation and maintenance phase only) and permanent habitat alteration (post decommissioning) habitat loss and disturbance;
- marine mammals;
  - effects on marine mammals due to altered prey availability; and
- offshore ornithology
  - changes to prey availability.

Table 8.27: Summary of Likely Significant Inter-Related Effects for Benthic Subtidal Ecology from Individual Effects Occurring Across the Construction, Operation and Maintenance and Decommissioning Phases of the Array (Array Lifetime Effects) and from Multiple Effects Interacting Across all Phases (Receptor-led Effects)

Description of Impact	Phase[7] C	O	D	Likely Significant Inter-Related Effects
Array Lifetime Effects				
Temporary habitat loss and disturbance	✓	✓	✓	When habitat loss or disturbance is considered additively across all phases, the total area of habitat affected is larger than when considered across an individual phase (i.e. just construction). However, temporary and long term loss and disturbance will be highly localised to the vicinity of the activities during each phase of the Array. Individual activities resulting in temporary habitat loss and disturbance will occur intermittently throughout this time with only a small proportion of the total area of habitat being impacted at any one time. The predominantly sand and coarse sediment habitats that are most likely to be affected are typical of, and widespread throughout, the regional benthic subtidal ecology study area and North Sea. Further, all benthic habitats are predicted to recover from temporary habitat loss and disturbance. Certain locations may experience repeated disturbance (e.g. touchdown of point of mooring lines and dynamic cables) with areas of seabed considered to be unavailable to benthic species. This does not represent a change in sedimentary habitat and replacement with artificial substrates. The estimated footprint of repeated disturbance assumed within the MDS equates to up to 0.09% of the total site boundary. It is predicted that the communities will have fully recovered from construction impacts by this time. Therefore, across the lifetime of the Array, the effects on benthic subtidal receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related effects are of negligible to minor adverse significance which is not significant in EIA terms.
Long term habitat loss and disturbance	✓	✓	✓	
Increased SSCs and associated deposition	✓	✓	✓	Effects from increased SSCs and associated deposition caused by seabed disturbance will be short lived and intermittent across each phase. Benthic subtidal IEFs potentially affected by increased SSC and deposition are likely to have recovered in the intervening period between phases/events. Due to this and the low sensitivity (and/or high recoverability) of the species and habitats in question, the interaction of these impacts across the stages of the Array's lifecycle is predicted to result in an effect of minor significance in all phases (i.e. not of any greater significance than those assessed for each individual phase). Therefore, across the lifetime of the Array, the effects on benthic subtidal receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related effects are of negligible to minor adverse significance which is not significant in EIA terms.
Effects to benthic subtidal ecology from EMF from subsea electrical cabling	×	✓	×	This effect will arise during the operation and maintenance phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Colonisation of hard substrates	×	✓	×	
Effects to benthic subtidal ecology due to removal of hard substrates	×	×	✓	This effect has will arise during the decommissioning phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Increased risk of INNS	✓	✓	✓	Although vessels associated with all phases of the Array (potentially from countries of origin other than the UK) may facilitate the spread of INNS, this effect will predominantly arise during the operation and maintenance phase as many INNS will require the hard substrate to be in place to provide substrate on which to settle. It should be noted that infaunal INNS may occur (i.e. those which will settle on or in the sediment, however the risk of this is less likely. However, the designed in measures include the implementation of an Invasive Non-Native Species Management Plan (INNSMP) as part of the EMP (volume 4, appendix 21, annex B). This will require that the risk of potential introduction and spread of INNS will be reduced as far as practicable across all phases. Therefore, across the lifetime of the Array, the effects on benthic subtidal receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related effects are of minor adverse significance which is not significant in EIA terms.
Receptor led effects				
There is potential for spatial and temporal interactions between the effects arising from temporary and long term habitat loss and disturbance, and increased SSC and associated deposition effects on benthic habitats during the lifetime of the Array. Based on current understanding, and expert knowledge, the greatest potential for inter-related impacts is predicted to arise through the interaction of the following: • direct (both temporary and permanent) habitat loss and disturbance from the activities and infrastructure detailed in the MDS; and • indirect habitat disturbance due to increased SSCs and associated deposition. These individual impacts were assigned a significance of negligible to minor adverse as standalone impacts and although potential inter-related impacts may arise (i.e. spatial and temporal overlap of direct habitat disturbance), it is predicted that this will not be any more significant than the individual impacts in isolation. This is because the combined area of habitat potentially affected would be typically restricted to the site boundary, the habitats affected are widespread across the regional benthic subtidal ecology study area and, where temporary disturbance occurs, full recovery of the benthos is predicted. As such, these interactions are predicted to be no greater than the individual effects assessed in isolation. As a result, the receptor-led effects are of minor adverse significance which is not significant in EIA terms.				

[7] C = Construction, O = Operation and maintenance, D = Decommissioning

8.16. SUMMARY OF IMPACTS, MITIGATION, LIKELY SIGNIFICANT EFFECTS AND MONITORING

445. Information on benthic subtidal ecology within the Array benthic subtidal ecology study area was collected through a detailed desktop study (Table 8.6) and through site-specific surveys (see section 8.6.3). This information is summarised in section 8.7.

446. Table 8.28 presents a summary of the potential impacts, designed in measures and the conclusion of LSE[1] in EIA terms in respect to benthic subtidal ecology. The impacts assessed were:

- temporary habitat loss and disturbance;
- long term habitat loss and disturbance;
- increased SSCs and associated deposition;
- effects to benthic subtidal ecology from EMF from subsea electrical cabling;
- colonisation of hard substrates;
- effects to benthic subtidal ecology due to removal of hard substrates; and
- increased risk of INNS.

447. Overall, it is concluded that there will be no LSE[1] arising from the Array during the construction, operation and maintenance or decommissioning phases.

448. Table 8.29 presents a summary of the potential impacts, designed in measures and the conclusion of likely significant cumulative effects on benthic subtidal ecology in EIA terms. The cumulative effects assessed were:

- temporary habitat loss and disturbance;
- long term habitat loss and disturbance;
- effects to benthic subtidal ecology from EMF from subsea electrical cabling;
- colonisation of hard substrates;
- effects to benthic subtidal ecology due to removal of hard substrates; and
- increased risk of INNS.

449. Overall, it is concluded that there will be no likely significant cumulative effects from the Array alongside other projects and plans.

450. No likely significant transboundary or inter-related effects have been identified in regard to effects of the Array.

Table 8.28: Summary of Likely Significant Environmental Effects, Secondary Mitigation and Monitoring

Description of Impact	Phase	Magnitude of Impact	Sensitivity of the Receptor	Significance of Effect	Additional Measures	Significance of Residual Effect	Proposed Monitoring
Temporary habitat loss and disturbance	Site preparation and construction Operation and maintenance	All IEFs: Low	Ocean quahog IEF: High All other IEFs: Medium	All IEFs: Minor adverse	None proposed	N/A	None
	Decommissioning	All IEFs: Negligible		Ocean quahog IEF: Minor adverse All other IEFs: Minor adverse			
Long term habitat loss and disturbance	Construction and operation and maintenance phases Decommissioning	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor adverse All other IEFs: Minor adverse	None proposed	N/A	None
Increased SSCs and associated deposition	Site preparation and construction Operation and maintenance Decommissioning	All IEFs: Low	All IEFs: Low	All IEFs: Minor adverse	None proposed	N/A	None
Effects to benthic subtidal ecology from EMF from subsea electrical cabling	Operation and maintenance	All IEFs: Low	All IEFs: Medium	All IEFs: Minor adverse	None proposed	N/A	None
Colonisation of hard substrates	Operation and maintenance	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor beneficial All other IEFs: Minor adverse	None proposed	N/A	None
Effects to benthic subtidal ecology due to removal of hard substrates	Decommissioning	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor adverse All other IEFs: Minor adverse	None proposed	N/A	None
Increased risk of INNS	Site preparation and construction Operation and maintenance Decommissioning	All IEFs: Low	All IEFs: High	All IEFs: Minor adverse	None proposed	N/A	None

Table 8.29: Summary of Likely Significant Cumulative Environment Effects, Mitigation and Monitoring

Description of Impact	Phase	Cumulative Effects Assessment Tier	Magnitude of Impact	Sensitivity of the Receptor	Significance of Effect	Additional Measures	Significance of Residual Effect	Proposed Monitoring
Temporary habitat loss and disturbance	Site preparation and construction	Tiers 1, 2, and 3	All IEFs: Low	Ocean quahog IEF: High All other IEFs: Medium	All IEFs: Minor adverse	None proposed	N/A	None
	Operation and maintenance	Tiers 1, 2, and 3						
Long term habitat loss and disturbance	Construction and operation and maintenance phases	Tiers 1, 2, and 3	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor adverse All other IEFs: Minor adverse	None proposed	N/A	None
Effects to benthic subtidal ecology from EMF from subsea electrical cabling	Operation and maintenance	Tiers 1, 2, and 3	All IEFs: Low	All IEFs: Medium	All IEFs: Minor adverse	None proposed	N/A	None
Colonisation of hard substrates	Operation and maintenance	Tiers 1, 2, and 3	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor beneficial All other IEFs: Minor adverse	None proposed	N/A	None
Effects to benthic subtidal ecology due to removal of hard substrates	Decommissioning	Tier 1 only (no Tier 2 or 3 projects identified for this impact)	All IEFs: Low	Dead man's fingers IEF and sea tamarisk IEF: Low All other IEFs: High	Dead man's fingers IEF and sea tamarisk IEF: Minor adverse All other IEFs: Minor adverse	None proposed	N/A	None
Increased risk of INNS	Site preparation and construction	Tiers 1, 2, and 3	All IEFs: Low	All IEFs: High	All IEFs: Minor adverse	None proposed	N/A	None
	Operation and maintenance	Tiers 1, 2, and 3						

8.17. REFERENCES

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