Cambois Connection – Marine Scheme

Environmental Statement – Volume 2

ES Chapter 8: Benthic Subtidal and Intertidal Ecology

sse Renewables

Revision Information

Rev	Issue Status	Date	Originator	Checker	Approver
R01	Issue for review	09/06/2023	JG	NL	JA
R02	Issue for review	04/07/2023	JG	NL	JA
A01	Approved for use	14/07/2023	JG	JO	JA

Approval for Issue

Approver's name	SIGNATURE	DATE
Sarah Edwards	[Redacted]	**24/07/2024**

Prepared by:	**Xodus**
Prepared for:	**SSE Renewables**
Checked by:	**Kerrie Craig**
Accepted by:	**Kerrie Craig**
Approved by:	**Sarah Edwards**

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Acronyms

Acronym	Definition
BBWF	Berwick Bank Wind Farm
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CSEMP	Clean Safe Seas Environmental Monitoring Programme
DDV	Drop Down Video
DEFRA	Department for Environment, Food & Rural Affairs.
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMP	Environmental Management Plan
ERL	Effect Range Low
ERM	Effect Range Median
ES	Environmental Statement
EUNIS	European Nature Information System
FEAST	Feature Activity Sensitivity Tool
FOCI	Feature of Conservation Interest
GMF	Geomagnetic Field
HRA	Habitats Regulations Appraisal
HVDC	High Voltage Direct Current
INNS	Invasive Non-Native Species
IPC	Infrastructure Planning Commission
JNCC	Join Nature Conservation Committee
LSE	Likely Significant Effect
MarESA	Marine Evidence based Sensitivity Assessment
MCCA	Marine Coastal Access Act
MCCIP	Marine Climate Change Impacts Partnership
MCZ	Marine Conservation Zone
MERMAN	Marine Environment Monitoring and Assessment National

Acronym	Definition
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
MD-LOT	Marine Directorate Licensing Operations Team
ncMPA	Nature Conservation Marine Protected Area
NIOZ	Koninklijk Nederlands Instituut voor Onderzoek der Zee
NMP	National Marine Plan
NPS	National Policy Statement
NTS	Non-Technical Summary
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PLGR	Pre-lay Grapnel Run
PLONOR	Pose Little or No Risk to the Environment
PMF	Priority Marine Feature
SAC	Special Areas of Conservation
SACO	Supplementary Advice on the Conservation Objectives
SFF	Scottish Fishermen's Federation
SSSI	Sites of Scientific Interest
UAV	Unmanned Area Vehicle
UK	United Kingdom

Units

Unit	Description
cm	Centimetres
km	Kilometre (distance)
Km2	Kilometre squared
m	Metres
mg/l	Milligrams per litre

Unit	Description
mm	Millimetre
m/s	Metres per second
M2	Metre squared
nm	Nautical mile (distance)
µT	Microtesla
µV/m	Microvolts per metre
V/m	volts per metre

8. Benthic Subtidal and Intertidal Ecology

8.1. Introduction

1. This chapter presents the assessment of the likely significant effects (as per the "Environmental Impact Assessment (EIA) Regulations"[1]) on the environment arising from the Cambois Connection (hereafter referred to as "the Project") Marine Scheme on benthic subtidal and intertidal ecology. Specifically, this chapter of the Marine Scheme Environmental Statement (ES) considers the potential impact of the Marine Scheme seaward of Mean High Water Springs (MHWS), during the construction, operation and maintenance, and decommissioning phases.

2. This assessment is informed by the following technical chapters:

- Volume 2, Chapter 3: EIA Methodology;
- Volume 2, Chapter 4: Stakeholder Consultation and Engagement;
- Volume 2, Chapter 5: Project Description;
- Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions; and
- Volume 2, Chapter 9: Fish and Shellfish Ecology.

3. This chapter summarises information contained within the Marine Protected Areas (MPA) and Marine Conservation Zone (MCZ) Assessment which accompanies this application; Volume 3, Appendix 8.1: Benthic Survey Report (Phase 1 and Phase 2); Volume 3: Appendix 8.2: Intertidal Survey Report.

4. This chapter should be read in conjunction with Volume 2, Chapter 9: Fish and Shellfish Ecology, Chapter 10: Offshore and Intertidal Ornithology and Chapter 11: Marine Mammals due to the predator-prey relationships that exist between benthic receptors and these groups.

8.2. Purpose of this Chapter

5. This chapter:

- Presents the existing environmental baseline established from desk studies, site-specific surveys and feedback obtained during technical engagement with stakeholders;
- Identifies any assumptions and limitations encountered in compiling the environmental information;
- Presents the potential environmental impacts on benthic subtidal and intertidal ecology arising from the Marine Scheme, and reaches a conclusion on the likely significant effects on benthic subtidal and intertidal ecology based on the information gathered and the analysis and assessments undertaken;
- Identifies where impacts are relevant to Scottish waters, English waters, or both. Where there is no separation of assessment of impacts, the assessment for the Marine Scheme (as a whole entity) applies to the Marine Scheme in each of Scottish waters and English waters separately; and

[1] For the Marine Scheme, this is the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended).

- Highlights any necessary monitoring and/or mitigation measures recommended to prevent, minimise, reduce, or offset likely significant adverse environmental effects of the Marine Scheme on Benthic Subtidal and Intertidal Ecology.

8.3. Study Area

6. The Benthic Subtidal and Intertidal Ecology Study Area is defined as the Marine Scheme boundary presented in Volume 4, Figure 8.1 where there is a direct interaction with the seabed. The Marine Scheme boundary encompasses the Berwick Bank Wind Farm (BBWF) array area and the Marine Scheme Offshore Export Cable Corridor, and references to these two areas are made throughout this chapter. Where appropriate, a larger impact area has been considered, for example when considering the advection and deposition of suspended sediment concentrations (SSC), and this has been clearly stated.

7. For the purposes of this chapter, and where appropriate, the baseline characterisation has been broken down into three discrete areas (Volume 4, Figure 8.1):

- Scottish waters: the northernmost area of the Marine Scheme, encompassing the section of the Marine Scheme within Scottish waters, including the area of seabed that overlaps with the BBWF array area;
- English offshore waters: the central area of the Marine Scheme which is located within English offshore waters; and
- English territorial waters: the southernmost area of the Marine Scheme located within English territorial waters up to MHWS.

8.4. Policy and Legislative Context

8. A summary of the policy and legislative provisions relevant to Benthic Subtidal and Intertidal Ecology are provided in Table 8.1 and Table 8.2 below.

Table 8.1Summary of legislation relevant to Benthic Subtidal and Intertidal Ecology

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the ES
Scotland and England (UK)		
The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended).	The Conservation of Offshore Marine Habitats and Species Regulations 2017 is the principal piece of secondary legislation that transpose the protection of marine species from the EU Habitats Directive into UK law, covering Scottish and English offshore waters. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 make amendments to the Habitats Regulations following the UK's exit from the European Union. It is through these regulations that provisions for the UK's National Site Network are outlined. The Regulatory Authority must consider the likely significant effects of a development on the qualifying features of European Sites, designated under these pieces of legislation.	All the relevant European sites have been identified in section 8.7.1.1, along with their proximity to the Marine Scheme. Details on the potential effects on European sites designated for benthic features are included within the Cambois connection: Habitats Regulation Assessment / Appraisal (HRA) Stage 1 Screening Report (BBWFL, 2023), provided to both Marine Directorate Licensing Operations Team (MD-LOT) and Marine Management Organisation (MMO) (as well as NatureScot and Natural England) in March 2023. This HRA Screening Report concluded that there were no potential pathways of Likely Significant Effects (LSE) on SACs designated for Annex I habitats. This is outlined in the Marine Scheme Report to Inform Appropriate Assessment (RIAA) which accompanies this application. The RIAA presents detail pertinent to the assessment of impacts on European sites (Report to Inform Appropriate Assessment (RIAA)).

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the ES
Marine and Coastal Access Act (MCCA) 2009	The Marine and Coastal Access Act (MCAA) 2009 makes provisions relating to marine functions and activities in both Scottish offshore waters (>12 nm) and English waters. The Act establishes provisions for the management of the marine environment and establishes the marine planning system. Provisions for the designation of Marine Conservation Zones (MCZs) in English waters and Nature Conservation Protected Areas (ncMPAs) in the Scottish Offshore region are included within this Act. When determining an application, the Regulatory Authority must consider whether developments are capable of affecting protected features of MPAs or MCZs (other than insignificantly).	All the relevant designated sites have been identified in section 8.7.1.1, along with their proximity to the Marine Scheme. The MPA and MCZ Assessment which accompanies this application assesses the significance of the effect of the Marine Scheme on ncMPAs and MCZs with Benthic Subtidal and Intertidal Ecology features.
Scotland		
Nature Conservation (Scotland) Act 2004	This Act places duties on public bodies in relation to the conservation of biodiversity and strengthens wildlife enforcement.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.
Marine Scotland Act (2010)	Scottish Ministers and public authorities must act in the best way to further sustainable development, including the protection and, where appropriate, enhancement of habitat health.	All relevant potential impacts on marine habitats important for benthic species associated with the construction, operation and maintenance and decommissioning of the Marine Scheme have been considered in section 8.12.
	The Marine (Scotland) Act 2010 provides the development of a marine spatial planning system, creating a framework for marine development and the creation of MPAs.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.
The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)	Commonly referred to as the Habitats Regulations, these regulations transpose Council Directive 92/43/EEC on the conservation of natural habitats and wild flora and fauna into UK (Scots) law. These regulations cover Scottish Territorial Waters < 12 nm.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the ES
The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019	This amends the Conservation (Natural Habitats, &c.) Regulations 1994 following the UK's exit from the European Union.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.
England		
Natural Environment and Rural Communities Act 2006	This Act makes provision for the public bodies which are concerned with the natural environment and rural communities. This Act makes provisions in connection with wildlife,, sites of special scientific interest (SSSI), and National Parks to provide flexible administrative arrangements for the functions of the environment.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.
The Conservation of Habitats and Species Regulations 2017	The Habitats Directive and the Birds Directive are transposed into law The Conservation of Habitats and Species Regulations 2017, applying to English territorial waters. The Regulatory Authority must consider the likely significant effects of a development on the qualifying features of European Sites, designated under this legislation.	All the relevant European sites have been identified in section 8.7.1.1, along with their proximity to the Marine Scheme. Details on the potential effects on European sites designated for benthic features are included within the Cambois connection: Habitats Regulation Assessment / Appraisal (HRA) Stage 1 Screening Report (BBWFL, 2023), provided to both MD-LOT and MMO (as well as NatureScot and Natural England) in March 2023. This HRA Screening Report concluded that there were no potential pathways of LSE on SACs designated for Annex I habitats. This is outlined in the Marine Scheme RIAA which accompanies this application and presents detail pertinent to the assessment of impacts on European sites.

Table 8.2 Summary of marine policy relevant to Benthic Subtidal and Intertidal Ecology

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
International		
The Convention for the Protection of the Marine Environment of the North East Atlantic ('OSPAR Convention'; 1992)	This legislative agreement regulates international cooperation on environmental protection in the North East Atlantic. The Convention has been ratified by 15 signatory nations. The OSPAR List of Threatened and/or Declining Species and Habitats was developed to identify species and habitats in need of protection.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
The Convention on the Conservation of European Wildlife and Natural Habitats ('the Bern Convention'; 1979)	The Bern Convention aims to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention), to increase co-operation between contracting parties, and to regulate the exploitation of migratory species listed in Appendix III.	All relevant habitats and species afforded protection under this legislative framework are considered as part of section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.
Scotland and England (UK)		
United Kingdom (UK) Marine Policy Statement (Department for Environment, Food and Rural Affairs (DEFRA), 2011)	The UK Marine Policy Statement provides a framework for preparing Marine Plans and taking decisions affecting the marine environment. The MPS aims to "Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets."	The assessment of impacts is provided in section 8.12 and considers the magnitude of impact and the sensitivity of Benthic Subtidal and Intertidal Ecology receptor to determine if the impact would result in a significant change from the baseline and if the effect on the relevant feature is likely to be significant.
	Paragraph 2.6.1 states that "Marine plan authorities should be mindful that, consistent with the high level marine objectives, the UK aims to ensure: • A halting and, if possible, a reversal of biodiversity loss with species and habitats operating as a part of healthy, functioning ecosystems; and • The general acceptance of biodiversity's essential role in enhancing the quality of life, with its conservation becoming a natural consideration in all relevant public, private and nongovernmental decisions and policies.	The assessment of impacts is provided in section 8.12 and considers the magnitude of impact and the sensitivity of benthic receptors to determine if the impact would result in a significant change from the baseline and if the effect on the relevant feature is likely to be significant.
UK post-2010 Biodiversity Framework	The UK Post-2010 Biodiversity Framework covers the period from 2011 to 2020, and was developed in response to two main drivers: the Convention on Biological Diversity's (CBD's) Strategic Plan for Biodiversity 2011-2020 and its five strategic goals and 20 'Aichi Biodiversity Targets', published in October 2010; and the EU Biodiversity Strategy (EUBS), released in May 2011. The Framework aims to set out a shared vision across the UK, facilitate cooperation and streamline UK-scale activity.	Habitats and species thought to be present in the Benthic Subtidal and Intertidal Ecology Study Area which are covered by the Framework are listed in section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors where an impact pathway exists.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
Scotland		
Scottish National Marine plan (NMP) (Scottish Government, 2015)	GEN 9 Natural Heritage: Development and use of the marine environment must: • Comply with legal requirements for protected areas and protected species; • Not result in significant impact on the national status of Priority Marine Features (PMF); and • Protect and, where appropriate, enhance the health of the marine area.	Protected areas, protected species and PMFs are identified in section 8.7. Section 8.12 assesses the significance of the effect of the Marine Scheme on benthic subtidal and intertidal ecology.
	GEN 10 Invasive Non-native species: Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	The potential for effects associated with non-native species on benthic species and habitats and their likely significance is assessed in section 8.12. As detailed in section 8.11, the Applicant will implement designed-in mitigation, such as the development and employment of an Environmental Management Plan (EMP), including a Marine Pollution Contingency and Control Plan and an Invasive Non-Native Species (INNS) management plan, outline version of which has been submitted as part of this application, please see Volume 5.
Scottish Priority Marine Features (PMF)	Scotland adopted a list of 81 PMFs in 2014, representing species and habitats on existing conservation lists that were assessed against a set of criteria, including the abundance of the feature in Scottish seas, the conservation status and the functional role played by the feature. Several Benthic Subtidal and Intertidal Ecology habitats and species are listed as PMFs.	Habitats and species thought to be present in the Benthic Subtidal and Intertidal Ecology Study Area that are PMFs are listed in section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all Benthic receptors, including PMFs, where an impact pathway exists.
England		
	Paragraph 2.6.8.1 states “An assessment of the effects of installing cable across the intertidal zone should include information, where relevant, about: • Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice; • Any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice; • Potential loss of habitat; • Disturbance during cable installation and removal (decommissioning);	Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives includes details on the route and landfall selection for the Marine Scheme. Section 8.12 assesses potential impacts on intertidal ecology receptors.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
National Policy Statement (NPS) for Renewable Energy Infrastructure (EN-3) 2011[2,3]	• Increased suspended sediment loads in the intertidal zone during installation; and • Predicted rates at which the intertidal zone might recover from temporary effects."	
	Paragraph 2.6.113 states "Where necessary, assessment of the effects on the subtidal environment should include: • Loss of habitat due to foundation type including associated sea bed preparation, predicted scour, scour protection and altered sedimentary processes; • Environmental appraisal of inter-array and cable routes and installation methods; • Habitat disturbance from construction vessels' extendible legs and anchors; • Increased suspended sediment loads during construction; and • Predicted rates at which the subtidal zone might recover from temporary effects."	The assessment of impacts is provided in section 8.12, including impacts related to loss or disturbance of habitat and increased suspended sediments. The assessment considers the magnitude of impact and the sensitivity of Benthic Subtidal and Intertidal Ecology receptors to determine if the impact would result in a significant change from the baseline and if the effect on the relevant feature is likely to be significant.
	Paragraph 2.6.119 states "Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures which the Infrastructure Planning Commission (IPC) (now the Planning Inspectorate) should expect the applicants to have considered may include:	Details on the measures adopted as part of the Marine Scheme are included in section 8.11.

[2] Whilst it is acknowledged that neither BBWF nor the Marine Scheme comprise or form part of an NSIP (please see Volume 2: Chapter 2: Policy and Legislative Context) , NPSs are however a statement of government intention relating, in this case, to renewable energy projects, therefore can be taken into consideration during the preparation of the Marine Scheme ES.

[3] A suite of draft revised Energy NPSs were published and consulted on by the UK Government in March 2023, and consultation closed on 23rd June. The consultation responses will be subject to consideration and the draft revised NPSs may now be revised before the NPSs are formally adopted. There is currently no date for the next stage of the review process and therefore this ES presents the current adopted NPSs which have been considered during the preparation of this ES. It is however noted by the Applicant that the new draft NPSs state that they may be material considerations in other applications which are not considered under the Planning Act (2008), this includes the Marine Scheme. Further detail on the consideration of the draft NPSs in this ES is provided in Volume 2 Chapter 2 Policy and Legislation.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	• Surveying and micrositing of the export cable route to avoid; • Adverse effects on sensitive habitat and biogenic reefs; • Burying cables at a sufficient depth, taking into account other constraints, to allow the sea bed to recover to its natural state; and • The use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures."	
	Paragraph 2.6.89 states "Where cumulative effects on intertidal habitats are predicted as a result of the cumulative effects of multiple cable routes, it may be appropriate for applicants of various schemes to work together to ensure that the number of cables crossing the intertidal zone are minimised and installation and decommissioning phases are coordinated to ensure that disturbance is also reasonably minimised."	An assessment of cumulative effects is included in section 8.14. The Applicant will engage with the operators of relevant nearby developments, plans and activities as required.
	Paragraph 2.6.120 states "Where cumulative effects on subtidal habitats are predicted as a result of the cumulative effects of multiple cable routes, it may be appropriate for applicants for various schemes to work together to ensure that the number of cables crossing the subtidal zone is minimised and installation / decommissioning phases are coordinated to ensure that disturbance is reasonably minimised."	An assessment of cumulative effects is included in section 8.14. The Applicant will engage with the operators of relevant nearby developments, plans and activities as required.
North East Inshore and North East Offshore Marine Plan (MMO, 2021)	NE-MPA-1: Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: A) Avoid; B) Minimise; or *C)* Mitigate adverse impacts, with due regard given to statutory advice on a ecologically coherent network.	Details on the potential effects on European sites designated for Benthic Subtidal and Intertidal Ecology are included within the Cambois connection: Habitats Regulation Assessment / Appraisal (HRA) Stage 1 Screening Report (BBWFL, 2023), provided to both MD-LOT and MMO (as well as NatureScot and Natural England) in March 2023. This HRA Screening Report concluded that there were no potential pathways of LSE on SACs designated for Annex I habitats. This is outlined in the Marine Scheme RIAA and MPA and MCZ Assessment which accompany this application. The MPA and MCZ Assessment assesses the significance of the effect of the Marine Scheme on MCZs and ncMPAs with benthic subtidal and intertidal ecology features.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	NE-MPA-2: Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network, will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change, and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: A) Avoid; B) Minimise; or C) Mitigate adverse impacts.	Details on the potential effects on European sites designated for Benthic Subtidal and Intertidal Ecology are included within the Cambois connection: Habitats Regulation Assessment / Appraisal (HRA) Stage 1 Screening Report (BBWFL, 2023), provided to both MD-LOT and MMO (as well as NatureScot and Natural England) in March 2023. This HRA Screening Report concluded that there were no potential pathways of LSE on SACs designated for Annex I habitats. This is outlined in the Marine Scheme RIAA and MPA and MCZ Assessment which accompany this application. The MPA and MCZ Assessment assesses the significance of the effect of the Marine Scheme on MCZs and ncMPAs with benthic subtidal and intertidal ecology features.
	NE-MPA-3: Where statutory advice states that a marine protected area site condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.	Details on the potential effects on European sites designated for Benthic Subtidal and Intertidal Ecology are included within the Cambois connection: HRA Stage 1 Screening Report (BBWFL, 2023), provided to both MD-LOT and MMO (as well as NatureScot and Natural England) in March 2023. This HRA Screening Report concluded that there were no potential pathways of LSE on SACs designated for Annex I habitats. This is outlined in the Marine Scheme RIAA and MPA and MCZ Assessment which accompany this application. The MPA and MCZ Assessment assesses the significance of the effect of the Marine Scheme on MCZs and ncMPAs with benthic subtidal and intertidal ecology features.
	NE-BIO-1: Proposals that enhance the distribution of priority habitats and priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: A) Avoid; B) Minimise; C) Mitigate adverse impacts so they are no longer significant; or	Protected habitats and species are identified in section 8.7. Section 8.12 assesses the significance of the effect of the Marine Scheme on benthic subtidal and intertidal ecology.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	D) Compensate for significant adverse impacts that cannot be mitigated.	
	NE-BIO-2: Proposals that enhance or facilitate native species or habitat adaptation or connectivity, or native species migration, will be supported. Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity, or native species migration, must demonstrate that they will, in order of preference: A) Avoid; B) Minimise; C) Mitigate adverse impacts so they are no longer significant; or D) Compensate for significant adverse impacts that cannot be mitigated	Section 8.12 assesses the significance of the effect of the Marine Scheme on benthic subtidal and intertidal ecology.
	NE-BIO-3: Proposals that conserve, restore or enhance coastal habitats, where important in their own right and/or for ecosystem functioning and provision of ecosystem services, will be supported. Proposals must take account of the space required for coastal habitats, where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will, in order of preference: A) Avoid; B) Minimise; C) Mitigate; or D) Compensate for net habitat loss.	Section 8.12 assesses potential impacts on intertidal ecology receptors.
	NE-INNS-1: Proposals that reduce the risk of introduction and/or spread of invasive non-native species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of invasive non-native species, particularly when: A) Moving equipment, boats or livestock (for example fish or shellfish) from one water body to another; and/or B) Introducing structures suitable for settlement of invasive non-native species, or the spread of invasive non-native species known to exist in the area.	The risk of introduction of INNS as a result of the colonisation of hard structures is assessed in section 8.12. As detailed in section 8.11, the Applicant will implement designed-in mitigation, such as the development and employment of an EMP, including a Marine Pollution Contingency and Control Plan and an INNS management plan.
	NE-CE-1: Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will, in order of preference: A) Avoid; B) Minimise; or C) Mitigate - adverse cumulative and/or in-combination effects so they are no longer significant.	An assessment of cumulative effects is included in section 8.14.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
English Features of Conservation Interest (FOCI)	FOCI are marine features that are particularly threatened, rare, or declining species or habitats. FOCI apply to English waters and are used in the process of identifying areas for designation as MCZs.	Habitats and species thought to be present in the Benthic Subtidal and Intertidal Ecology Study Area that are PMFs are listed in section 8.7.1.6. Section 8.12 assesses the significance of the effect of the Marine Scheme on all benthic receptors, including FOCIs, where an impact pathway exists.

8.5. Consultation and Technical Engagement

9. A summary of the key issues raised during consultation and technical engagement activities undertaken to date specific to Benthic Subtidal and Intertidal Ecology is presented in Table 8.3[4] below, together with how these issues have been considered in the production of this Benthic Subtidal and Intertidal Ecology chapter. Further detail is presented within Volume 2, Chapter 4: Stakeholder Consultation and Engagement.

[4] Where scoping comments from stakeholders and consultees has been restated and/or paraphrased by the regulators within Scoping Opinions, this is only referenced with regards to MD-LOT and MMO Scoping Opinions, for brevity and to reduce duplication.

Table 8.3 Summary of key consultation and technical engagement undertaken for the Marine Scheme relevant to Benthic Subtidal and Intertidal Ecology

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Relevant consultation and engagement undertaken to date			
September 2022	Natural England/MMO/Joint Nature Conservation Committee (JNCC)/ – response to Applicant's Benthic Survey Scope	Additional desktop data sources suggested, including new data on the JNCC's MPA mapper.	Desktop data sources are detailed in section 8.6.1 which includes the JNCC's MPA mapper. Further details are included in the MPA and MCZ Assessment which accompanies this application.
September 2022	Natural England – response to Applicant's Benthic Survey Scope	The most appropriate sampling methods are to be used dependent on ground and sea conditions.	Details on the survey methodology are included in Volume 3, Appendix 8.1: Benthic Survey Report.
		Single replicate sampling should be sufficient. However, multiple (three to five) replicates may be needed to provide statistical power for pre-construction monitoring although this would be needed closer to the time of construction.	Details on the survey methodology are included in Volume 3, Appendix 8.1: Benthic Survey Report. Single replicate grab samples were undertaken at 58 sampling stations at the Marine Scheme Offshore Export Cable Corridor and the BBWF Array Area. This feedback is noted for future pre-construction monitoring.
		Employing epibenthic trawls should not be necessary as long as other sample methods obtain sufficient data.	Noted.
		Imagery of burrow densities and identification of infauna from these burrow characteristics may assist with characterising the benthos.	Images of burrow densities were taken through DDV and identification of infauna was achieved through macrofaunal analysis of grab samples. Details on the survey methodology are included in Volume 3, Appendix 8.1: Benthic Survey Report.
		Any ocean quahog (*Arctica islandica*) that are brought up in grab samples should be appropriately measured and recorded before being returned to the sampling station alive.	Details on the survey methodology are included in Volume 3, Appendix 8.1: Benthic Survey Report.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
			One ocean quahog was recorded within the survey and the individual was returned to the sampling station alive.
		We would be grateful if you are able to share or publish the data collected and to provide us with estimates of the quantity of rock armour protection which may be necessary.	The survey data and results are available in Volume 3, Appendix 8.1: Benthic Survey Report. The Applicant would also be happy to upload this information to MEDIN to allow for further access. Details on cable protection requirements are included in Volume 2, Chapter 5: Project Description.
		We reiterate our advice that the Farnes East MCZ poses a high consenting risk, and all efforts should be made to avoid any damage to features within the site. Routing the cable outside the site will reduce this risk.	Details on the route selection process are included in Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives. The Farnes East MCZ has been avoided.
September 2022	NatureScot - response to Applicant's Benthic Survey Scope	We are content with the proposed methods, including that the sampling frequency is sufficient to characterise the EEC.	Noted.
		We note that eDNA was previously being considered in the Technical Note for Benthic Surveys in the Cambois Connection Export Cable Corridor (A-100742-S02-A-TECH-001 Rev 01) issued with the Marine Licence exemption request (issued 11/08/2022). From the current Offshore Benthic Survey Plan, our understanding is that eDNA techniques have not been taken forward. We would like to better understand the reasoning behind this decision – although still a novel technique, eDNA could provide further insight into the species and communities present within the ECC to better inform characterisation.	The technical Note for Benthic Surveys in the Cambois Connection Export Cable Corridor considered several survey methods for characterising the benthic baseline habitats within the Marine Scheme Offshore Export Cable Corridor. This included the use of eDNA sampling methods; however, this technique was not taken forward into the Benthic Survey Plan for the following reasons. Habitat classification purely using DNA-based methods is still very much in its infancy. If eDNA were extracted from sediment samples, it would contain some traces of the infaunal invertebrate taxa used to classify biotopes. However, as the majority of biological material would be meiofauna rather than macrofauna this would make up a relatively small proportion of the sequenced data, even using primers targeting the appropriate species. If near-benthic water eDNA were used, this might capture eDNA

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			emitted by the biotope taxa, likely with minimal input from infauna and dominated by epifauna and the spatial extent covered by the data would be difficult to accurately determine. The Benthic Survey Plan aimed to survey the Marine Scheme Offshore Export Cable Corridor using benthic grab and underwater video sampling methods. Taxonomic analysis of benthic macrofauna from the grabs provides a robust dataset on the infauna whilst underwater image analysis provides detailed epifauna data, both of which adequately provide site specific characterisation of the species and communities present in the Marine Scheme Offshore Export Cable Corridor. Given this; it is unlikely that eDNA analysis would have provided any additional data on the infauna or epifauna that was not already captured by the grab and underwater imagery sampling.
September 2022	MD-LOT – response to Applicant's Benthic Survey Scope	MD-LOT has no further comment to make following sight of the NatureScot advice of 27 September 2022.	Noted.
Consultation on the Marine Scheme: Scoping Opinion			
February 2023	NatureScot – Scoping Opinion	We are content with the proposed development study area as defined in section 8.3 and Figure 8-1, which comprises the Berwick Bank development site and Cambois Connection cable corridor.	Noted, the Benthic Subtidal and Intertidal Ecology Study Area is outlined in section 8.3.
		Section 8.4 captures key desktop datasets and reports, however it should also include and consider features' sensitivity to proposed activities using the FEAST – Feature Activity Sensitivity Tool as well as the information published in the Site Information Centres, especially the information in the Supplementary Advice on the Conservation Objectives (SACO), for the Firth of Forth Banks Complex ncMPA.	The FEAST tool and the SACO for the Firth of Forth Banks Complex ncMPA have been used to inform the assessment of impacts. Further details are included in section 8.12 and in the MPA and MCZ Assessment which accompanies this application.
		Section 8.5.2 incorrectly identifies the features that the Firth of Forth Banks Complex ncMPA is designated for. The Firth of Forth Banks Complex ncMPA is designated for ocean quahog aggregations, offshore subtidal sands and gravels, shelf banks	Details on the protected features of the Firth of Forth Banks Complex ncMPA are included in section 8.7.1.1 and in MPA and MCZ Assessment which accompanies this application. Desktop data sources are detailed in section 8.6.1 which

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		and mounds, and quaternary geology and geomorphology, including moraines representative of the Wee Bankie key geodiversity area. For clarification, edible crab and brittle stars are not designated features for this site. We expect the EIAR to make a clear assessment against all designated features of the Firth of Forth Banks Complex ncMPA, including ocean quahog. We understand that this may be a qualitative assessment.	includes the FEAST tool. Further details are included in MPA and MCZ Assessment which accompanies this application.
		Section 8.5.2 should be titled 'Designated Sites and protected features', since it is not only species that are protected within the sites, but also habitats.	Noted. Habitats and species of conservation importance are discussed in section 8.7.1.6.
		Furthermore, section 8.5.2 states that 'Ocean Quahog are noted as a feature of conservation importance within these designated sites however, there is insufficient data available to assess the potential impacts of the Marine Scheme on these aggregations.' There is at least enough information and evidence available to gauge the impact on this protected feature.	Impacts on ocean quahog as a designated feature of the Firth of Forth Banks Complex ncMPA and the Farnes East MCZ are assessed in MPA and MCZ Assessment which accompanies this application.
		We support the inclusion of Priority Marine Features (PMFs) and Annex I habitats, such as biogenic reefs (including *Sabellaria* reefs). However, in section 8.5.3, there appears to be confusion around PMFs. We advise that PMFs are present in both territorial and offshore waters, and that they are important outside of MPAs as well as within.	Offshore and inshore PMFs relevant to the Marine Scheme are detailed in section 8.7.1.6., including those outwith ncMPAs.
		We welcome the inclusion of the blue carbon assessment in section 8.5.4, and we are content that the potential for significant effects to blue carbon storage have been scoped out for further assessment.	Noted.
		Temporary loss or disturbance. This potential impact should be assessed for all designated features of the sites where an impact pathway has been identified, as opposed to only Annex I habitats as stated in Table 8-1.	The impact of temporary loss or disturbance on protected features within designated sites is assessed in MPA and MCZ Assessment which accompanies this application.
		Colonisation of hard structures. We welcome the inclusion of colonisation of hard structures to allow consideration of the potential changes in localised biodiversity. However, the introduction and spread of marine invasive non-native species (INNS) has been scoped out of Table 8-1. We disagree with this	The assessment of colonisation of hard structures is presented in section 8.12. This assessment considers the potential introduction and spread of INNS.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		and expect the introduction and spread of INNS to be scoped in and considered under the colonisation of hard structures.	
		We disagree with Table 8-1 and advise that impacts from EMF (and thermal load) should be scoped in for benthic receptors, due to existing high uncertainty about potential impacts. Benthic species directly on the seabed or in the seabed may come into close proximity to the cables and therefore localised impacts may occur, including attraction, repulsion or physical damage. We advise that this impact needs to be considered, even if only qualitatively.	An assessment of effects from EMF and thermal load exposure on benthic receptors is included in section 8.12.
		Table 8-1 doesn't capture changes in prey availability as a result of habitat loss or disturbance. More consideration is required in the EIAR to ensure that impacts to key prey species and their habitats from the wind farm are considered across all development phases for the Cambois Connection. Consideration should be given alone and in combination with the proposed Berwick Bank wind farm and other wind farms in the Forth and Tay area, particularly given the importance of this area for a number of prey species	The indirect effects on higher trophic levels from impacts on benthic receptors are detailed in section 8.15, including changes in prey distribution and abundance. Potential effects of changes to prey species to marine mammals and ornithology are assessed in Volume 2, Chapter 10: Offshore and Intertidal Ornithology and Volume 2, Chapter 11: Marine Mammals.
		Firth of Forth Banks Complex ncMPA is a composite site and the boundaries of each of the three areas reflect the presence and extent of the important features contained within them. All three areas within the ncMPA need to be considered with respect to the offshore subtidal sands and gravels feature, both alone and in-combination, as part of the assessment on the site. The EIAR should therefore include detailed information and figures on the potential impact to the three areas, as well as the overall MPA. We recommend a separate, more detailed map is presented for overlap of the Cambois Connection (without the Berwick Bank array) with the Firth of Forth Banks Complex ncMPA.	Potential effects on the Firth of Forth Banks Complex ncMPA are assessed in MPA and MCZ Assessment which accompanies this application. All three areas within the ncMPA have been considered and detailed maps have been presented.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		Additional detailed maps should also be included in the EIAR, showing the Firth of Forth Banks Complex ncMPA, particularly in relation to the Cambois Connection, Berwick Bank wind farm, Seagreen Alpha & Bravo wind farm and Seagreen 1A export cable. We also advise that further maps should be included which show the location of protected features within the MPA – please see JNCC mapper for further information.	
		As discussed above, the EIAR must consider the cumulative effect of key impacts such as habitat disturbance/loss from Berwick Bank wind farm in combination with the neighbouring wind farms in the Forth and Tay area, especially in relation to impacts across the Firth of Forth Banks Complex ncMPA as discussed above. It would be beneficial for the analysis to contain tables, or another format, to enable accurate assessment of the impact of the project alone and in combination with the neighbouring offshore wind projects, and any other relevant marine activities, which will occur in the Firth of Forth Banks Complex ncMPA. This will need to cover the three areas of the ncMPA, as well as overall for this composite site.	An assessment of cumulative effects is included in section 8.14. Cumulative effects on designated sites have been considered in the MPA and MCZ Assessment which accompanies this application.
		Where impact pathways have been identified and are scoped in, we advise that the full range of mitigation techniques and published guidance is considered and discussed in the EIAR.	Measures adopted a s part of the Marine Scheme are detailed in section 8.11 and relevant guidance for the assessment is listed in section 8.10. The requirement for additional mitigation is discussed in section 8.12 for each impact.
		We advise that the list of designed-in measures in section 8.6 should also include a Decommissioning Plan.	The Decommissioning Plan is included as designed in mitigation in Table 8.15.
		We agree that transboundary impacts are scoped out from further consideration in the EIAR.	Noted, transboundary impacts have not been considered within this Chapter, as detailed in section 8.16.
February 2023	MD-LOT / Scottish Ministers – Scoping Opinion	The Applicant sets out the study area and baseline data sources used regarding Benthic Subtidal and Intertidal Ecology receptors at section 8.3, 8.4 and 8.5 of the Scoping Report. The Scottish Ministers are broadly content with the proposed baseline data	Noted, the Benthic Subtidal and Intertidal Ecology Study Area is outlined in section 8.3.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		sources but advise that the additional data sets identified by NatureScot must be used in the assessment in the EIA Report.	Desktop data sources are detailed in section 8.6.1, which considers the feedback from NatureScot as outlined in the responses above.
		The NatureScot representation in respect of the designated features of the baseline environment detailed at section 8.5.2 of the Scoping Report must be implemented and considered in full in the EIA Report. The Scottish Ministers further highlight the NatureScot advice on priority marine features which should be considered in the EIA Report.	Habitats and species of conservation importance are discussed in section 8.7.1.6 (including PMFs) and the assessment of effects on the Firth of Forth Banks Complex ncMPA is included in the MPA and MCZ Assessment which accompanies this application.
		The Scottish Ministers agree with the impacts to be scoped in, however, would draw the Applicant's attention to representation from NatureScot in respect of the additional impact pathways to be considered in the EIA Report and need to scope in the potential impact on temporary loss or disturbance for all designated features of protected sites during the construction and decommissioning stages of the Proposed Works. The Scottish Ministers are in agreement that this should be fully considered in the EIA Report.	The impact of temporary loss or disturbance on protected features within designated sites is assessed in the MPA and MCZ Assessment which accompanies this application.
		The Scottish Ministers further advise that the potential of the Proposed Works to introduce and spread invasive non-native species should be scoped in to the EIA Report in line with NatureScot representation due to the increased movement of vessels and opportunities for hard structures to colonise.	The assessment of colonisation of hard structures is presented in section 8.12. This assessment considers the potential introduction and spread of INNS.
		The Scottish Ministers disagree with the Applicant's proposal to scope out electromagnetic field ("EMF") and thermal load effects on this receptor, which is a view supported by NatureScot and the Scottish Fishermen's Federation (SFF). Impacts from EMF from subsea electromagnetic cabling on benthic receptors should be scoped into the EIA Report for operation and maintenance stages of the Proposed Works.	An assessment of effects from EMF exposure on benthic receptors is included in section 8.12.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		As regards changes in prey species availability across all stages of the Proposed Works, the Scottish Ministers advise that further consideration is required in the EIA Report. This view is in line with NatureScot representation, which must be fully addressed by the Applicant.	The indirect effects on higher trophic levels from impacts on benthic receptors are detailed in section 8.15, including changes in prey distribution and abundance. The indirect effects on higher trophic levels from impacts on benthic receptors are detailed in Volume 2, Chapter 9: Fish and Shellfish Ecology, Chapter 10: Offshore and Intertidal Ecology and Chapter 11: Marine Mammals and Other Megafauna.
		With regard to the approach to assessment, the Scottish Ministers advise that all three areas of the Firth of Forth Complex ncMPA must be assessed with respect to the offshore subtidal sands and gravels feature, both alone and in-combination and direct the Applicant to the NatureScot representation for further detailed advice on the maps and level of detail that should be provided within the EIA Report.	Potential effects on the Firth of Forth Banks Complex ncMPA are assessed in the MPA and MCZ Assessment which accompanies this application. All three areas within the ncMPA have been considered and detailed maps have been presented.
		As regards mitigation, the Scottish Ministers agree with the NatureScot representation that the full range of mitigation techniques and published guidance should be considered and discussed in the EIA Report for impact pathways which have been scoped in. The Scottish Ministers further highlight NatureScot advice in respect of including a decommissioning programme within the suite of mitigation measures outlined by the Applicant at section 8.6.	Designed-in mitigation measures are detailed in section 8.11 and relevant guidance for the assessment is listed in section 8.10. The requirement for additional mitigation is discussed in section 8.12 for each impact. The preparation and employment of the Decommissioning Programme has been considered as a designed-in measure as detailed in Table 8.15.
		With regard to the cumulative impacts on benthic subtidal and intertidal receptors considered by the Applicant at section 8.8, the Scottish Ministers advise that the assessment must consider cumulative impacts in combination with the proposed Berwick Bank wind farm and neighbouring (consented) wind farms in the Forth and Tay area, with their associated export cables, especially in relation to impacts to the ncMPA. The Scottish Ministers direct the Applicant to the NatureScot representation for further advice on the presentation of information which should be implemented within the EIA Report.	An assessment of cumulative effects is included in section 8.14. Cumulative effects on designated sites have been considered in the MPA and MCZ Assessment which accompanies this application.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		The Scottish Ministers agree with the Applicant that transboundary impacts on Benthic Subtidal and Intertidal Ecology can be scoped out of the EIA Report as outlined at Table 16-1 of the Scoping Report.	Noted, transboundary impacts have not been considered within this chapter, as detailed in section 8.16.
March 2023	MMO – Scoping Opinion	The data sources identified in section 8.4 of the scoping report appear sufficient to inform the Preliminary Environmental Information Report (PEIR) and ES. The potential impacts from the project have been identified and presented in Table 8-1 of the scoping report and The MMO recommend that Table 8.1 is amended to include relevant information in the Assessment Method column for the potential impact to the benthic assemblage “increases suspended sediment concentrations and associated deposition” at the Operation and Maintenance phase of the project.	Noted. Details on the assessment methodology for increases SSCs and associated deposition in the operation and maintenance phase are included in section 8.12.
		The MMO welcome that impact assessments of nearby OWFs will be reviewed and site-specific benthic surveys comprising sediment sampling (infauna and particle size distribution analysis), seabed imagery (drop down video) and intertidal walkover surveys will be conducted to contribute to the baseline understanding for benthic ecology.	Noted, details on the data sources used to inform the assessment are presented in section 8.6.
		The MMO recommend you consider consulting the OneBenthic database to source additional datapoints (e.g., benthic grabs located within the cable export corridor) that may assist in the overall benthic characterisation.	Desktop data sources are detailed in section 8.6.1. Section 8.7 considers survey data obtained through OneBenthic. Furthermore, Volume 3, Appendix 8.1: Benthic Survey Report provides information on the survey design and methodology. The OneBenthic database (amongst other desk-based sources) was reviewed to determine the benthic grab and DDV sampling locations.
		The MMO agree with the rationale provided for impacts that have been scoped out. However, although impacts from the introduction of INNS have been scoped out at this stage, you recognise that cable protection is expected to be colonised by a variety of marine organisms. The MMO recommend that consideration is given to the potential colonisation of cable protection by INNS, particularly if the amount of cable protection	The assessment of colonisation of hard structures is presented in section 8.12. This assessment considers the potential introduction and spread of INNS.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		required is extensive and provides habitat that is otherwise not widespread.	
		The scoping report states that “Benthic subtidal and intertidal ecology surveys will be undertaken to collect site specific data”. While there are no specific methods proposed to collect the information required within the scoping report, these details must be provided to the MMO in advance of survey operations for consultation.	MMO, Nature Scot, Natural England and Cefas were consulted prior to the mobilisation of the benthic surveys in September 2022. Details on this consultation are provided above as well as stakeholder responses to the benthic survey scope and how the Applicant addressed these.
		The MMO recommend that detailed survey methods, including sample locations, are selected carefully to ensure the feature of interest can be robustly assessed. For example, the seabed imagery technique(s) proposed to assess the presence and extent of the protected features (such as Annex I reef and Arctica islandica) within the Farnes East MCZ should facilitate accurate identification and enumeration.	Details on the survey methodology are included in Volume 3, Appendix 8.1: Benthic Survey Report.
		It is unclear what the Assessment Method for the potential impact of “increases suspended sediment concentrations and associated deposition” at the Operation and Maintenance phase of the project refers to in Table 8.1 of the scoping report. The text included in the Assessment Method column discusses primary productivity and chemical concentrations rather than providing an assessment of the sensitivity of the benthic assemblage to the impact presented. This appears to be a repeat of the text used for the potential impact “Increased SSC and associated deposition (including mobilisation of potential contaminants)” at the Construction and Decommissioning phase of the development in the same table. The MMO recommend that this text is reviewed, and the appropriate Assessment Method is included.	Details on the assessment methodology for increases SSC and associated deposition in the operation and maintenance phase are included in section 8.12.
		A more detailed description of the mitigation measures will be provided in the EIA.	Measures adopted as part of the Marine Scheme are listed in section 8.11. The requirement for additional mitigation is discussed in section 8.12 for each impact.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		The Farnes East MCZ overlaps partly with the proposed export cable corridor. The MMO recommend that you consider the option to avoid installing cables within the Farnes East MCZ by routing the export cable within the scoping area, yet outside of the Farnes East MCZ.	Details on the route selection process are included in Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives. The Farnes East MCZ has been avoided.

8.6. Methodology to Inform Baseline

10. A mixture of desktop data sources and site-specific surveys, augmented by consultation, have been used to characterise the baseline for Benthic Subtidal and Intertidal Ecology, as described in the sections below.

11. NatureScot, Marine Directorate, Natural England, the MMO and JNCC were consulted on the approach to the site-specific surveys in September 2022, as detailed in section 8.5. Further details on the survey methods are included in Volume 3, Appendix 8.1: Benthic Survey Report and Volume 3, Appendix 8.2: Intertidal Survey Reporting.

8.6.1. Desktop Study

12. Information on Benthic Subtidal and Intertidal Ecology within the Benthic Subtidal and Intertidal Ecology Study Area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 8.4 below.

Table 8.4 Summary of key desktop studies and datasets

Title	Source	Year	Author
Berwick Bank Wind Farm Environmental Impact Assessment Report: Volume 2, Chapter 8: Benthic Subtidal and Intertidal Ecology, and, Volume 3, Appendix 8.1: Benthic Subtidal and Intertidal Ecology Technical Report	https://marine.gov.scot/node/23315	2022	BBWFL
Broad-scale Seabed habitat map for Europe (EUSeaMap)	https://emodnet.ec.europa.eu/en/seabed-habitats	2021	EMODnet
UK SeaMap 2018	https://jncc.gov.uk/our-work/marine-habitat-data-product-ukseamap/	2018	JNCC
Sectoral Marine Plan: Regional Locational Guidance	https://www.gov.scot/publications/sectoral-marine-plan-regional-locational-guidance/	2020	Scottish Government
OSPAR list of threatened and/or declining species and habitats	https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats	2008	OSPAR
Descriptions of Scottish Priority Marine Features (PMFs)	https://www.nature.scot/doc/naturescot-commissioned-report-406-descriptions-scottish-priority-marine-features-pmfs	2016	Tyler *et al.*
UK protected areas datasets for download	https://jncc.gov.uk/our-work/uk-protected-area-datasets-for-download/	2022	JNCC
Marine habitat data product: Habitats Directive Annex I marine habitats	https://jncc.gov.uk/our-work/marine-habitat-data-product-habitats-directive-annex-i-marine-habitats/	2018 - 2022	JNCC
National Marine Plan Interactive (NMPi)	https://marinescotland.atkinsgeospatial.com/nmpi/	2023	Marine Directorate
Magic Maps	https://magic.defra.gov.uk/magicmap.aspx	2023	DEFRA
Environmental baseline for Eastern Green Link 1	https://marine.gov.scot/data/marine-licence-application-segl-eastern-link-1-hvdc-cable-and-cable-protection-torness-hawthorn	2022	National Grid and Scottish Power

Title	Source	Year	Author
Environmental baseline for Eastern Green Link 2	https://marine.gov.scot/data/marine-licence-application-segleastern-link-2-hvdc-cable-and-cable-protection-peterhead-drax	2022	National Grid Electricity Transmission and Scottish and Southern Electric Networks Transmission (SSEN)
Environmental baseline for the BBWF EIA (in particular the survey results from the benthic surveys for the BBWF area)	https://www.berwickbank.com/planning-and-consent	2022	BBWF
Environmental baseline for Norway-UK Interconnector UK Marine Environmental Statement	https://northsealink.com/media/1196/p1568_rn3057-norway-uk-environmental-statement.pdf	2014	National Grid NSN Link Limited
Environmental baseline for the SeaGreen Alpha and Bravo EIA	https://marine.gov.scot/data/environmental-statement-volume-1-main-text-seagreen-alpha-and-bravo-offshore-wind-farms	2012	SSE
Environmental baseline for the Neart Na Gaoithe Offshore Wind Farm EIA (original design)	https://nngoffshorewind.com/resources/	2012	Mainstream Renewable Power
Blyth Offshore Demonstrator Project – post-construction benthic monitoring report	https://www.marinedataexchange.co.uk/	2019	Blyth Offshore Demonstrator Limited
JNCC MPA Mapper	https://jncc.gov.uk/mpa-mapper/	2023	JNCC
OneBenthic	https://rconnect.cefas.co.uk/onebenthic_dashboard/	2023	Cefas

8.6.2. Site-specific Surveys

13. To inform the Benthic Subtidal and Intertidal Ecology Chapter, site-specific surveys were undertaken, as agreed with NatureScot, Marine Directorate, Natural England, the MMO and Cefas. The location of the survey sample stations are shown in Volume 4, Figure 8.2.

14. A summary of the surveys undertaken to inform the benthic subtidal and intertidal ecology assessment of effects are outlined in Table 8.5 below.

Table 8.5 Summary of site-specific survey data

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
Cambois Connection Benthic Ecology Baseline – Phase 1 and Phase 2 Survey	Marine Scheme Offshore Export Cable Corridor extending from the BBWF array area to Landfall at Cambois	Benthic subtidal survey – including grab samples (0.1 m^2 mini-Hamon grab) at 58 locations within the Marine Scheme Offshore Export Cable Corridor to collect information on physical sediment characteristics and infauna. Subsamples were collected for Particle Size Analysis (PSA) and Total Organic Carbon (TOC) analysis. Grab samples (0.1 m^2 day grab) were also collected at a subset of 15 sampling stations for contaminants analysis, located in areas of finer sediment suitable for this analysis and closer to shore where higher contamination levels were expected. DDV transects using a Remotely Operation Vehicle (ROV) were conducted at 70 sampling locations to gather information on sediment conditions, seabed features and epifauna. Where potential reef features were encountered, assessments were made using current available guidance notes i.e., Gubbay (2007) and Limpenny *et al.* (2010) for potential *Sabellaria* reefs, and Golding *et al.* (2020) and Irving (2009) for potential cobble reefs.	Natural Power	2023	Natural Power (2023) (Volume 3, Appendix 8.1: Benthic Survey Report)
Cambois Connection Intertidal Survey	Two locations at the intertidal study area at Landfall: north and south of Cambois beach, Northumberland.	Visual survey to characterise and map the benthic habitats present across the intertidal zone associated with the cable Landfall area. The survey took place at two sites along Cambois Beach, Northumberland and involved the collection of aerial imagery accompanied by walkover surveys to gather detailed information on the benthic communities present for subsequent habitat / biotope mapping purposes. A comprehensive suite of images and target notes were collected across the full extent of the intertidal survey areas at each site between Mean Low Water Springs (MLWS) and MHWS.	Ocean Ecology	2022	Ocean Ecology (2023), (Volume 3, Appendix 8.2)
Benthic subtidal survey	BBWF array area and Offshore Export Cable Corridor into Branxton, East Lothian	This included combined DDV and grab samples (0.1 m^2 mini-hamon grab) at 92 locations, 15 additional DDV only transects and 15 epibenthic trawls. Day grabs samples were collected for sediment chemistry analysis at nine of the 92 sampling locations.	Ocean Ecology	2020	BBWFL (2022)

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
		Data collected as part of this survey has been used to inform the benthic ecology baseline for the Marine Scheme.			
Geophysical survey	Proposed export cable corridors (see Volume 4, Figure 5.2)	Geophysical study to establish bathymetry, seabed geology, morphology and sediments. The information that was obtained was Sub-bottom profiler data (SBP), Unmanned Aerial Vehicle (UAV) data using a senseFly eBeeX and Hull-mounted Norbit Winghead Multi-Beam Echo Sounder (MBES) data.	XOceanLtd.	2022	Xocean Ltd (2022)
Review of completed Xocean (2022) survey	Proposed export cable corridors (see Volume 4, Figure 5.2)	Review and reanalyses of Xocean (2022) geophysical survey.	Hydrofix Ltd	2023	Hydrofix ltd (2023)

8.7. Baseline Environment

8.7.1. Overview of Baseline Environment

15. This section characterises the baseline environment for Benthic Subtidal and Intertidal Ecology within the Benthic Subtidal and Intertidal Ecology Study Area, informed by a review of available literature, consultation and site-specific surveys.

16. Baseline surveys carried out by the Applicant to support the separate EIA and consenting process for the BBWF in 2019 – 2021 cover the northernmost extent of the Marine Scheme and have been used to inform the baseline characterisation for this section. Site-specific surveys for the Marine Scheme Offshore Export Cable Corridor carried out in 2022 (subtidal and intertidal) and 2023 (remaining DDVs for subtidal area) have been used to inform the baseline characterisation for the remaining sections of the Marine Scheme.

8.7.1.1. DESIGNATED SITES

17. The designated sites identified for the Benthic Subtidal and Intertidal Ecology are detailed in Table 8.6 and shown in Volume 4, Figure 8.3. A full assessment of the potential for the Project to hinder the conservation objectives of the sites is provided in the ncMPA/MCZ Assessment which accompanies this application.

Table 8.6 Designated Sites and Relevant Qualifying Features for Benthic Subtidal and Intertidal Ecology

Designated site	Closest distance to Marine Scheme (km)	Relevant qualifying benthic interest feature(s)
Firth of Forth Banks Complex ncMPA (including the Berwick Bank, Scalp and Wee Bankie, and Montrose Bank	Overlap with Berwick Bank (259.5 km^2 of ncMPA) and Scalp and Wee Bankie (102.2 km^2) 5.6 km NNW to Montrose Bank.	• Ocean quahog; • Offshore subtidal sands and gravels; • Shelf banks and mounds; and • Moraines.
Farnes East MCZ	0.18 km WSW	• Ocean quahog; • Seapen and burrowing megafauna; • Subtidal mixed sediments; • Subtidal mud; • Subtidal sand; • Subtidal coarse sediment; and • Moderate energy circalittoral rock.
Coquet to St Mary's MCZ	Overlap (4.4 km^2 of MCZ)	• Low energy intertidal rock; • Moderate energy intertidal rock; • High energy intertidal rock; • Intertidal mixed sediments; • Intertidal coarse sediment; • Intertidal sand and muddy sand; • Intertidal mud; • Intertidal underboulder communities; • Peat and clay exposures;

Designated site	Closest distance to Marine Scheme (km)	Relevant qualifying benthic interest feature(s)
		• Moderate energy infralittoral rock; • High energy infralittoral rock; • Moderate energy circalittoral rock; • Subtidal coarse sediment; • Subtidal sand; • Subtidal mixed sediments; and • Subtidal mud.

8.7.1.2. SUBTIDAL SEDIMENTS

18. The subtidal sediment types recorded at the Marine Scheme during the site-specific surveys are displayed in Volume 4, Figure 8.6. The site-specific DDV imagery indicate that sand and mud are dominant throughout the Marine Scheme Offshore Export Cable Corridor, interspersed with patches of coarser sediment. Furthermore, the PSA data demonstrates that sand is the most dominant sediment fraction in the Marine Scheme, although this varies by location, and a limited number of sample locations are dominated by either gravel or mud. Within the Marine Scheme Offshore Export Cable Corridor, a mud fraction was consistently present with a sediment composition of 4 – 59% mud (see Plate 8.1).

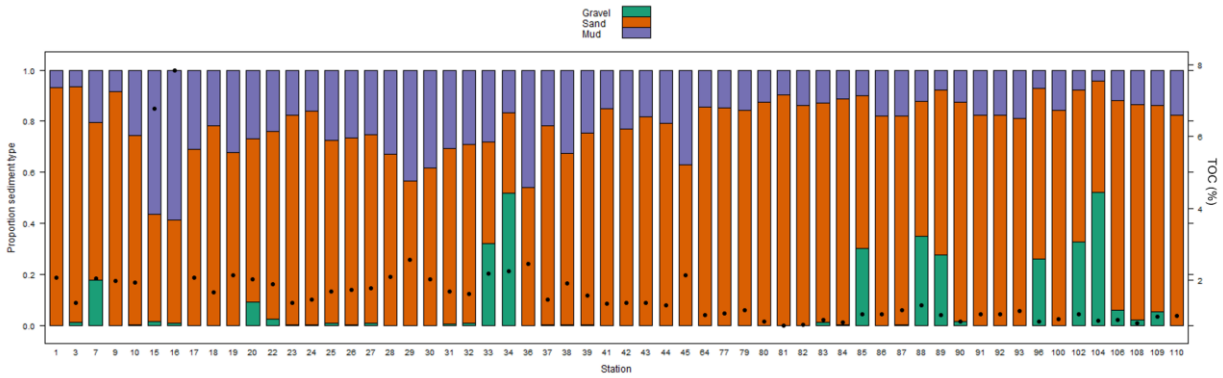

Plate 8.1 PSA and TOC at subtidal benthic grab sampling stations along the Marine Scheme Offshore Export Cable Corridor (Natural Power, 2023)

19. The site-specific data show that the following subtidal sediments are dominant in the Marine Scheme:

- Scottish waters:
  - Slightly gravelly sand and gravelly sand sediments dominate the Marine Scheme in the east of the BBWF array area, and coarser sandy gravel sediments are more prevalent in the west (BBWFL, 2022). In the south east, the muddy sandy sediments within the Marine Scheme Offshore Export Cable Corridor contain proportionally lower gravel content when compared to the BBWF array area (Natural Power, 2023).
- English offshore waters:
  - Muddy sand sediments are dominant. However, in the east of the Marine Scheme, just south of the England-Scotland border, sediment types are coarser and more varied. Within this zone, gravelly sand, sandy gravel, sand, gravelly muddy sand, and (gravelly) muddy sand and muddy sandy gravel were recorded in addition to the dominant

sediment type muddy sand. Where the Marine Scheme Offshore Export Cable Corridor merges into a single corridor, with a southward trend towards muddy sand sediments through to the 12 nm limit, and the sediment type is relatively homogenous within this zone (Natural Power, 2023).

- English territorial waters:
  - The sediment type is dominated offshore by muddy sand, comparable with English offshore waters. However, on the approach to the Landfall, two survey sample locations are associated with slightly higher fractions of gravel and are classified as gravelly muddy sand. The sediment types then transition first to (gravelly) sandy mud and sandy mud sediments, and then to sand sediments (Natural Power, 2023).

20. Further details are available in the BBWF Offshore Environmental Impact Assessment (BBWFL, 2022) and in Volume 3, Appendix 8.1: Benthic Survey Report.

21. OneBenthic5 is an open-access database for benthic survey data with coverage of the Benthic Subtidal and Intertidal Ecology Study Area. Sediment particle size data from 36 grab samples that overlap the Marine Scheme boundary were available to download via OneBenthic. However, the data from 30 of these samples were withheld, and therefore, only data from six samples were available for analysis. The six grab samples with available data were located within the south of the Marine Scheme boundary within or adjacent to the Coquet to St Mary's MCZ and were collected in 2014 and 2016. The 2014 survey consisted of a habitat verification survey to map the broadscale habitats of the MCZ, using 0.1 m2 mini-Hamon grabs for sediment characterisation (Claire et al., 2022). The 2016 survey used 0.1 m2 Day grab and Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ) corers and consisted of a mixture of revisits to sample locations previously surveyed during the 2014 survey and new sample locations to further characterise the mud features in the MCZ (Claire et al., 2022). These data show that the sediment fractions for the 2014 grab samples were approximately 47.5% mud (<0.063 mm), 46% sand (0.063 – 2 mm) and 1.8% gravel (> 2 mm). For the 2016 grab samples the sediment fractions were 3.8% mud, 95.6% sand and 0.5% gravel (OneBenthic database, 2020). These sediment characteristics are considered comparable to those recorded in the south of the Marine Scheme.

22. A desk-based review of EIA reports and monitoring reports for nearby developments (see Volume 2, Chapter 12: Other Sea Users) has also been undertaken to understand sediment characteristics from a regional perspective. The developments to the north and east of the BBWF array area, including Seagreen 1 and Seagreen 1A, Inch Cape, and Neart Na Gaoithe, report a mixture of sand and coarse sediments, such as gravelly sands, sandy gravels and slightly gravelly sand sediments as dominant, with smaller areas of muddy sediments (Seagreen, 2012; Inch Cape, 2011; EMU, 2010; Mainstream Renewable Power, 2012). This is consistent with the gravelly sand, sandy gravel and slightly gravelly sand observed within the part of the Marine Scheme which overlaps the BBWF array area. Developments further south that are adjacent to the Marine Scheme Offshore Export Cable Corridor include the Eastern Green Link 1, Eastern Green Link 2, North Sea Link power transmission cables and the Blyth Offshore Demonstrator Windfarm.

23. The site-specific surveys for Eastern Green Link 1, which runs parallel to the Marine Scheme in the west and crosses the Marine Scheme Offshore Export Cable Corridor in English territorial waters, recorded muddy sand as the dominant sediment type. A southward pattern of finer and muddier sediments was also recorded, and this corresponds to the transition to muddy sand sediments within the English waters of the Marine Scheme (National Grid and Scottish Power, 2022). Eastern Green Link 2, located 3 km east of the Marine Scheme, recorded sand and gravelly sediments and areas of muddy sand (National Grid and SSEN, 2022). The North Sea Link cables, make landfall approximately 0.6 km north of the proposed location for the Marine Scheme landfall and crosses the Marine Scheme Offshore Export Cable Corridor close to shore. The ES reported circalittoral

[5] https://rconnect.cefas.co.uk/onebenthic_dataextractiongrabcore/

muddy sand as being dominant on approach to the landfall, scattered with areas of circalittoral mixed sediment (National Grid NSN Link Limited, 2014). For the Blyth Offshore Demonstrator Project, approximately 2 km south of the Marine Scheme in English waters on approach to the Landfall, the 2018 post-construction surveys similarly recorded mud and sandy mud as the dominant sediment type, with a higher fraction of sand closer to shore (Blyth Offshore Demonstrator Limited, 2019). Again, this is considered to be generally consistent with the sediments recorded by the Marine Scheme site-specific surveys.

8.7.1.3. SEDIMENT CHEMISTRY

24. Four sediment samples within the part of the BBWF array area which overlaps the Marine Scheme and 14 samples from the rest of the Marine Scheme Offshore Export Cable Corridor were analysed for sediment chemistry (BBWF stations: 91, 92, 93, 94; Marine Scheme Offshore Export Cable Corridor: stations 1, 2, 3, 6, 8, 9, 13, 15, 19, 22, 23, 25, 26, and 30) (BBWFL, 2022; Natural Power, 2023). The subset of sample stations within the Marine Scheme Offshore Export Cable Corridor are situated in finer sediments where this analysis can be performed and in areas closer to shore where higher levels of contaminants would be expected (Natural Power, 2023). Consequently, the coverage of samples subjected to sediment chemistry analysis is focussed in English territorial waters, with limited coverage of English offshore or Scottish waters. As lower levels of contamination would be expected in offshore waters, the results of the sediment chemistry analyses for the BBWF surveys have been used to understand the sediment chemistry for the offshore areas of the Marine Scheme Offshore Export Cable Corridor.

25. The sediment chemistry analyses evaluated the concentrations of heavy metals, organotins, polychlorinated biphenyls and polycyclic aromatic hydrocarbons (PAHs) against Cefas Action Level 1 (AL1)/Action Level 2 (AL2) and the Canadian Sediment Quality Guidelines (CSQG; CCME, 2001). AL1 and AL2 give an indication of how suitable the sediments are for disposal at sea. Concentrations below AL1 are of no concern, while those above AL2 are considered unsuitable for disposal at sea. The Canadian Sediment Quality Guidelines provide a Threshold Effects Level (TEL), indicative of the minimal effect range at which adverse effects rarely occur, and probable effect level (PEL), indicative of the probable effect range within which adverse effects frequently occur, for each contaminant.

26. None of the sediment samples from the BBWF surveys exceeded AL1 / AL2 or the Canadian PEL thresholds. However, the Canadian TEL for arsenic was exceeded at five sample stations in the northwest of the part of the Marine Scheme which overlaps the BBWF array area (ST92, ST93, ST94, ST95 and ST96) (BBWFL, 2022). Within the Marine Scheme Offshore Export Cable Corridor, no heavy metals exceeded the relevant Cefas AL2 thresholds. However, at a limited number of stations, heavy metal concentrations marginally exceeded the Cefas AL 1 threshold. Concentrations of chromium and nickel were slightly above the AL1 threshold at stations 2 and 15, arsenic concentrations slightly exceeded AL1 threshold at station 13 and concentrations of chromium and lead exceeded Canadian TEL thresholds at station 15. Stations 1, 2 and 15 consistently exceeded the individual Canadian Interim Sediment Quality Guideline (ISQG) thresholds for all 13 PAHs with individual thresholds and stations 6, 8, 9 and 13 exceeded certain individual PAH thresholds (see Volume 3, Appendix 8.1: Benthic Survey Report). Total Hydrocarbon Content (THC) levels were generally low across the survey area. However, stations 1, 2 and 15 contained THC concentrations above Cefas AL1 (Natural Power, 2023).

27. Based on a desk-based review of EIAs for nearby developments, low contamination levels were recorded at Seagreen 1, Seagreen 1A, Neart Na Gaoithe, Inch Cape, Eastern Green Link 1, Eastern Green Link 2, and North Sea Link (Seagreen, 2012; Inch Cape, 2011; EMU, 2010; National Grid and Scottish Power, 2022; National Grid and SSEN, 2022; National Grid NSN Link Limited, 2014).

28. Further details on the sediment contamination are provided in Volume 3, Appendix 8.1: Benthic Survey Report.

8.7.1.4. SUBTIDAL MACROFAUNA AND BIOTOPES

8.7.1.4.1. Subtidal macrofauna

29. The infaunal analysis of 92 grab samples collected during the 2020 benthic subtidal surveys for the BBWF (including the BBWF array area and offshore export cable corridor to Skateraw) recorded 518 taxa, dominated by annelids, molluscs and crustaceans in terms of abundance, and molluscs and echinoderms in terms of biomass. Dendrodoa grossularia was the most abundant species followed by Sabellaria spinulosa (BBWFL, 2022). Natural Power (2023) recorded 4,254 individuals (273 unique taxa) across 58 infaunal samples in the Marine Scheme Offshore Export Cable Corridor. Overall, the most abundant species for the Marine Scheme Offshore Export Cable Corridor, in terms of number of individuals, were Amphiura filiformis, Amphiuridae and Scoloplos armiger. In terms of biomass, the nearshore sections of the Marine Scheme Offshore Export Cable Corridor were dominated by molluscs and annelids, and moving further offshore, sampling stations became dominated by echinoderms and molluscs. The variation in species composition between sampling stations within the Marine Scheme Offshore Export Cable Corridor was significantly positively correlated to Folk classifications, highlighting the importance of sediment type in the species assemblage and benthic community. Nevertheless, the species composition remains broadly similar across the various depths and sediment types, with Amphiura filiformis, Amphiuridae and Paramphinome jeffreysii characterising several species groups, suggesting that the subtidal biotopes are similar and/or transitional along the Marine Scheme Offshore Export Cable Corridor (Natural Power, 2023).

30. Epifaunal communities recorded by seabed imagery and epibenthic trawls during the 2020 BBWF surveys were dominated by crustaceans and cnidarians. The bryozoan Flustra foliacea was the most abundant species recorded by seabed imagery, and tube worms such as S. spinulosa or Spirobranchus sp. were also common. The epibenthic trawl analysis recorded 69 taxa, the most abundant being crustaceans in terms of taxa, and brown shrimp (Crangon crangon), in terms of individuals (BBWFL, 2022). Further south in the Marine Scheme Offshore Export Cable Corridor, epifauna was typically sparse and the most abundant taxa observed were brittle stars (Ophiuroidea). Burrows were observed in the muddier sediments, including some complex burrow systems from Nephrops, potentially representing the protected habitat ‘seapens and burrowing megafauna community’ (discussed further in section 8.7.1.6.1) (Natural Power, 2023).

31. Species diversity was highest in biotopes with coarse or mixed sediments or hard substrate in the BBWF array area (BBWFL, 2022). Conversely, although evenness and diversity values were relatively high and consistent across the Marine Scheme Offshore Export Cable Corridor, there was no discernible pattern identified of richness, number of individuals and species number by location (Natural Power, 2023).

32. Only one sample location with available faunal data on the OneBenthic database overlaps the Marine Scheme, and this is located within the part of the Marine Scheme which overlaps the BBWF array area. The sample was collated as part of a collaborative survey of the Firth of Forth Banks Complex in 2011 to understand the potential presence of ncMPA search features (JNCC, 2023). The data show that the bristle worms *Scoloplos armiger*, *Spiophanes bombyx* and *Ophelia borealis* were the most abundant species, all of which were also recorded within the site-specific surveys at the BBWF array area (OneBenthic database, 2020).

8.7.1.4.2. Subtidal biotopes

33. The predicted broad habitat types within the Marine Scheme from the EUSeaMap (2021) are presented in Volume 4, Figure 8.5. Offshore circalittoral sand and offshore circalittoral coarse sediment are predicted to be dominant in Scottish offshore waters and in the northern extent of English offshore waters. There is then a southward transition to offshore circalittoral mud which continues onto the section of the Marine Scheme located in the north of English territorial waters. Towards the Landfall, there is a mixture of offshore circalittoral mixed sediment, offshore circalittoral mud and circalittoral mud predicted, interspersed with patches of predicted circalittoral rock and biogenic reef. However, it worth noting that no biogenic reefs were identified during the site-specific

survey of the Marine Scheme Offshore Export Cable Corridor (discussed further in section 8.7.1.6.1 and Volume 3, Appendix 8.1: Benthic Survey Report).

34. The subtidal biotope map for the Marine Scheme is displayed in Volume 4, Figure 8.6, and further details are available in the survey report provided in Volume 3, Appendix 8.1: Benthic Survey Report. For the assignment of subtidal biotopes, infaunal and epifaunal survey results (and associated species groupings) were combined with subtidal sediment and physical characteristics. Where only DDV imagery was available, the biotope assigned based on DDV imagery alone was compared against geophysical data to determine sediment type. The biotopes at each sample location were then classified according to the Marine Habitat Classification for Britain and Ireland (Connor et al., 2004) and subsequently, a predicted biotope map was produced by combining biotope data with site-specific geophysical data (BBWFL, 2022; Natural Power, 2023). Further details on the methodology for biotope assignment and mapping are available in Volume 3, Appendix 8.1: Benthic Survey Report.

35. Overall, a mixture of muddy, sandy and mixed sediment biotopes were identified, transitioning from sand, coarse and mixed sediment biotopes in the north to muddier biotopes in the south and were considered to be typical of those found in the North Sea and the wider area (Volume 3, Appendix 8.1: Benthic Survey Report). The most dominant biotope recorded within the Marine Scheme Offshore Export Cable Corridor was '*Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud' (SS.Smu.Omu.PjefThyAfil) (Natural Power, 2023). The following key subtidal biotopes were recorded:

- Scottish waters:
  - The key biotopes within the east of the BBWF array area were identified as *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.Smu.CsaMu.AfilMysAnit) and *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.Ssa.CfiSa.Epus.OborApri). In the west of the BBWF array area, *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud is dominant alongside polychaete-rich deep *Venus* community in offshore mixed sediments (SS.SMx.Omx.PoVen) (BBWFL, 2022).
  - Within the Marine Scheme Offshore Export Cable Corridor, there is mixture of subtidal biotopes present, predominantly '*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand' (SS.Ssa.CfiSa.ApriBatPo) and to a lesser extent '*Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud' (SS.Smu.Omu.PjefThyAfil), and 'offshore circalittoral mixed sediment' (SS.SMx.Omx) in the west (Natural Power, 2023).
- English offshore waters:
  - Within English offshore waters, SS.Ssa.CfiSa.ApriBatPo and 'offshore circalittoral coarse sediment' (SS.SCS.OCS) are dominant in the north, transitioning to SS.Smu.Omu.PjefThyAfil interspersed with patches of mixed sediments, such as SS.SMx.Omx, 'circalittoral mixed sediments' (SS.SMx.CMx) and '*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment' (SS.SMx.CMx.KurThyMx), and *Thyasira* spp. and '*Ennucula tenuis* in circalittoral sandy mud' (SS.SMu.ScaMu.ThyEten) (Natural Power, 2023).
- English territorial waters:
  - Within English territorial waters, SS.SMu.OMu.PjefThyAfil is dominant in the muddier sediments further offshore and is interspersed with circalittoral mixed sediment (SS.SMx.CMx) with a transition to 'circallittoral sandy mud' sediments (SS.Smu.CsaMu) and SS.SMu.CSaMu.ThyEten. Closer to the Landfall, infauna-rich sand sediments are dominant including *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag),

'infralittoral muddy sand' (SS.SSa.IMuSa), interspersed with patches of rock, mainly 'soft rock communities' (CR.MCR) (Natural Power, 2023).

36. A desk-based review of EIAs and monitoring reports for nearby developments indicates that similar biotopes have been recorded in the wider regional area. The Seagreen 1 and Seagreen 1A developments, approximately 5 km from the Marine Scheme, were characterised by a mixture of coarse and mixed biotopes associated with polychaetes and bivalves (e.g. SS.SMx.OMx.PoVen and Moerella spp. with venerid bivalves in infralittoral gravelly sand (SS.SCS.ICS.MoeVen)) as well as 'Sabelleria spinulosa on stable circalittoral mixed sediment' (SS.SBR.PoR.SspiMx) (Seagreen, 2012). The key biotopes recorded during site-specific surveys for the Inch Cape array area, approximately 8 km north-west of the Marine Scheme, were muddy sand and gravel sediments with bivalves, such as Kurtiella bidentata and Thyasira spp. (SS.SMx.CMx.KurThyMx), and also Offshore circalittoral coarse sediment (SS.SCS.OCS) (Inch Cape Offshore Limited, 2011). For the Neart na Gaoithe array area, located 16 km west of the Marine Scheme, muddy habitats associated with Amphiura filiformis dominated, specifically SS.SMu.CSaMu.AfilNten, interspersed with coarse and sandy biotopes (e.g. circalittoral coarse sediment (SS.SCS.CCS) and offshore circalittoral sand (SS.SSa.OSa) (EMU, 2010).

37. Further south, for the Eastern Green Link 1 and 2 developments, a mixture of coarse, sand, mixed and sand-sediment biotopes were recorded (National Grid and Scottish Power Transmission 2022; National Grid and SSEN, 2022). The North Sea Link, which crosses the Marine Scheme Offshore Export Cable Corridor with a landfall 0.6 km to the north, also recorded SS.SSa.IMuSa.FfabMag with venerid bivalves and amphipods in infralittoral compacted fine muddy sand as being dominant on the approach to the Cambois Landfall, consistent with the Marine Scheme site-specific surveys (National Grid NSN Link Limited, 2014). A mixture of sandy and muddy sand biotopes were recorded during the 2018 Blyth Offshore Demonstrator Windfarm post-construction surveys, dominated by SS.SMx.CMx.KurThyMx and SS.SMu.CSaMu further offshore, and '*Nephtys cirrosa* and *Bathyporeia spp.*' in infralittoral sand (SS.Ssa.IfiSa.NcirBat) and SS.SSa.IMuSa.FfabMag closer to shoer (Blyth Offshore Demonstrator Limited, 2019). The biotopes recorded for the Marine Scheme are considered consistent with those already recorded for nearby developments (Natural Power, 2012).

8.7.1.5. INTERTIDAL ECOLOGY

38. The distribution of biotopes at the Landfall are displayed in Volume 4, Figure 8.3, and is based on the 2022 intertidal survey that was conducted at two intertidal sites north and south of Cambois Beach, Northumberland (Volume 3, Appendix 8.2: Intertidal Survey Reporting). Due to the homogenous nature of the intertidal habitats within the intertidal zone at Cambois Beach, these two survey locations were selected as being both representative of the habitats and features along the beachfront, and to also allow for a sufficient spatial extent of potential landfall locations along Cambois Beach at the time of survey. The south survey area overlaps with the Landfall. The EUNIS habitats identified during the survey are listed in Table 8.7.

Table 8.7 EUNIS habitats identified during the 2022 intertidal surveys (Ocean Ecology, 2023)

EUNIS habitat	South survey area	North survey area
A1.2 – Moderate Energy Littoral Rock	✓	✓
A2.1 – Littoral Coarse Sediment	✓	✓
A2.2 – Littoral Sand and Muddy Sand	✓	✓
B1.3 – Coastal dunes and sandy shores	✓	×

39. Littoral sand and muddy sand (A.2.2) was the dominant habitat type observed. There was a clear zonation across the majority of the south survey area from littoral sand and muddy sand at the lower shore, littoral coarse sediment (A2.1) at the mid-shore and coastal dunes and sandy shores (B1.3) at the upper shore. Some areas of moderate energy littoral rock (A1.2) were identified (installed for sea defence purposes) between areas of littoral sand and muddy sand and coastal dunes and sandy shores, supporting a sparse community of barnacles and fucoids. No notable

taxa (e.g. INNS or species of commercial value) were observed (Ocean Ecology, 2023). Details on the habitats and species of conservation importance observed during the intertidal survey are described in section 8.7.1.6. As described in Volume 3, Appendix 8.2: Intertidal Survey Reporting, the area of coastal dunes and sandy shores, which is a priority habitat under the UK Post-2010 Biodiversity framework, is located above MHWS and therefore is not considered further within this assessment.

40. A site-specific intertidal survey for the North Sea Link, covering a 250 m corridor, was undertaken at Cambois Beach, 0.5 km north of the Marine Scheme Landfall. The mid-shore was characterised as 'Amphipods and *Scolelepis* spp. in littoral medium-fine sand' (LS.LSa.MoSa.AmSco), whilst fewer amphipods were reported from the lower shore and was characterised as 'Polychaetes in littoral fine sand' (LS.LSa.FiSa.Po). No habitats or species of conservation importance were recorded during the North Sea Link intertidal surveys (National Grid NSN Link Limited, 2014).

8.7.1.6. HABITAT AND SPECIES OF CONSERVATION IMPORTANCE

41. Several habitats and species of conservation importance have been identified as potentially being present within the Benthic Subtidal and Intertidal Ecology Study Area, as outlined in Table 8.8.

Table 8.8 Assessment of species and habitats of conservation importance within the Marine Scheme based on site-specific survey data

Protected feature	Annex I habitat	OSPAR threatened and/or declining habitat or species	Priority Marine Feature (PMF)	UK Post-2010 Biodiversity Framework[6]
Subtidal sands and gravels			✓	✓
Deep sea muds			✓	✓
Seapens and burrowing megafauna		✓	✓	✓
Annex I reefs (bedrock, stony and biogenic)	✓			✓
Ocean quahog (*Arctica islandica*)		✓	✓	✓
Horse mussel beds (*Modiolus modiolus)*	✓	✓	✓	✓

8.7.1.6.1. Habitats

42. Several habitats recorded during the site-specific surveys were assessed further to understand their alignment with features of conservation importance.

8.7.1.6.1.1. Subtidal sands and gravels

43. Areas of the Marine Scheme are associated with circalittoral sand or coarse sediments (e.g. those contained within sublittoral sands and muddy sands SS.SSa and sublittoral coarse sediments SS.SCS). The most dominant of these biotopes is '*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand' (SS.SSa.CFiSA.EpusOborApri), mainly distributed in Scottish waters, and '*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand' (SS.SSa.CFiSa.ApriBatPo), mainly distributed in the north of English offshore waters in the Marine Scheme. These biotopes are contained within the priority habitat of 'subtidal sands and gravels', under the UK Post-2010 Biodiversity Framework. In addition, these biotopes are

[6] Habitats and Species under the UK Post-2010 Biodiversity Framework include Habitats of Principle Importance (HPI) and Species of Principle Importance (SPI) under Section 41 in England of the Natural Environment and Rural Communities (NERC) Act 2006 and habitats and species listed under Section 2(4) of the Nature Conservation (Scotland) Act 2004.

designated within the Farnes East MCZ as 'subtidal sand' and 'subtidal coarse sediments', and several SS.SSa habitats (e.g. SS.SSa.CFiSA.EpusOborApri) are categorised within the 'offshore subtidal sands and gravel' PMF feature in Scotland, and this habitat is designated within the Firth of Forth Banks Complex ncMPA. It should be noted that subtidal sands and gravel habitats are widespread in UK waters.

8.7.1.6.1.2. Mud habitats in deep water

44. Biotopes associated with muddy sand sediments (e.g. those contained within SS.SMu are widespread throughout the Marine Scheme, with the most dominant being '*Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud' (SS.SMu.CSaMu.AfilMysAnit) within the BBWF array area and '*Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud' (SS.SMu.OMu.PjefThyAfil) within the Marine Scheme Offshore Export Cable Corridor. These biotopes are contained within the 'Mud habitats and deep water' priority habitat under the UK Post-2010 Biodiversity Framework and the 'Offshore deep sea muds' PMF in Scotland. 'Subtidal mud' habitats are also designated within the Farnes East MCZ.

8.7.1.6.1.3. Annex I reef

Stony and bedrock reef

45. A cobble/stony reef assessment in the eastern and north-west regions of the BBWF array area concluded that most sample locations were classified as 'not a reef' based on criteria by Irving (2009) and Jenkins et al. (2015) on composition (% cover), elevation and extent. Station 38 was assigned an overall reefiness score of 'low potential reef' (BBWFL, 2022).

46. Within the Marine Scheme Offshore Export Cable Corridor, Annex I reef was identified from seabed imagery at five nearshore locations (stations 1, 4, 11, 12 and 14) and two offshore locations (34 and 88) Of these, two offshore stations were identified as 'low' potential stony reef (stations 34 and 88), two nearshore stations as bedrock reef (stations 4 and 12) and three nearshore stations as rocky reef (stations 1, 11 and 14). The biotope 'Flustra foliacea on slightly scoured silty circalittoral rock' (CR.MCR.EcCr.FaAlCr.Flu) was identified on the approach to Landfall through seabed imagery (station 4) and the final biotope soft rock communities (CR.MCR) was recorded at five nearshore stations (stations 17, 8, 11,12,14) as well as a single offshore stations (station 34) (Natural Power, 2023). Imagery was compared against criteria for Annex I reef developed from Irving (2009) and Godling et al., (2020) on composition, elevation, extent and biota and were assessed as meeting the criteria required to be considered as contributing to the UK National Site Network of qualifying reefs in terms of the Habitats Regulations, as shown on Volume 4, Figure 8.6.

Biogenic reef

47. Biogenic reefs are those created by animals and include reef-building worms such as the Ross worm (*Sabellaria spinulosa*) and horse mussel (*Modiolus modiolus*).

Sabellaria spinulosa

48. A single sample location (station 20) within the east of the BBWF array area was classified as having a 'low reefiness' score for a *S. spinulosa* reef assessment, based on criteria for elevation, patchiness and extent by Jenkins *et al.* (2015), Gubbay (2007) and Limpenny *et al*. (2010) (BBWFL, 2022). Furthermore, one sample location (station 88) recorded *S. spinulosa* individuals within the Offshore Export Cable Corridor. However, the abundances were low and not indicative of an Annex I reef (Natural Power, 2023).

[7] Station 1 was recorded as a mosaic of moderate energy circalittoral rock and *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag).

Horse mussel beds

49. Horse mussel aggregations can form biogenic reefs where they meet the following criteria: live adults are present, associated reef biota / communities are distinct from the surrounding habitat; and the extent of the horse mussel aggregation is greater than 25 m2 in extent (Morris, 2015). Horse mussel beds are an Annex I habitat if they form a biogenic reef, and are listed in the OSPAR list of threatened and/or declining habitat, as a PMF, as a FOCI for MCZs and on the UK post-2010 biodiversity framework.

50. Five of the epibenthic trawls for the BBWF array area recorded horse mussel at low densities (< 4 individuals per trawl, except for one trawl where 31 individuals were recorded) (BBWFL, 2022). No horse mussel beds were recorded through seabed imagery or through the infaunal analysis within the BBWF array area or the Marine Scheme Offshore Export Cable Corridor (Natural Power, 2023). Therefore, this habitat is not expected to be present within the Marine Scheme and is not considered further within this chapter.

8.7.1.6.1.4. Seapens and burrowing megafauna

51. A seapen and burrowing megafauna community assessment was also undertaken at stations where the seapen and burrowing megafauna biotope was indicated, in accordance with JNCC (2014), and the abundance of burrows was categorised using the SACFOR scale8. This habitat is listed on the OSPAR list of threatened habitats and species, as a PMF in Scotland, as a priority habitat under the UK post-2010 biodiversity framework, and as a protected feature of the Farnes East MCZ.

52. No seapen and burrowing megafauna communities were recorded from the BBWF array area. Nine locations (stations 2, 6, 7, 15, 16, 27, 28, 38 and 45) within the Marine Scheme Offshore Export Cable Corridor were assigned as SS.SMu.CFiMu.SpnMeg from seabed imagery alone, where burrows were observed at a density of >0.1 m^2 for burrows over 3 cm. Burrowing megafauna were observed at six sample locations and the seapen *Pennatula phosphorea* was observed at 34 sample locations (see Volume 3, Appendix 8.1: Benthic Survey Report). However, when considered alongside the sediment and infaunal data, no sample locations were classified as this protected habitat, because the PSA results recorded more coarser sediment than the fine muds required for seapen and burrowing megafauna community (Natural Power, 2023). However, it should be noted that sandy mud sediments were present in the Marine Scheme Offshore Export Cable Corridor, which are consistent with the range of sediment types that can support this habitat. Consequently, although the Marine Scheme is not expected to consist of prime habitat, the presence of seapens and burrowing megafauna communities cannot be ruled out at this stage.

8.7.1.6.2. Species

8.7.1.6.2.1. Ocean quahog

53. The benthic infaunal analysis and epibenthic trawl analysis for the BBWF array area recorded ocean quahog, a species designated within the Firth and Forth Banks Complex ncMPA, listed on the OSPAR list of threatened and/or declining species and habitats, as a PMF in Scotland and on the UK Post-2010 Biodiversity Framework. Ocean quahog were recorded at eight grab sample locations in the north of the BBWF array area (stations 26, 27, 50, 55, 77, 80, 82 and 106), one of which was located within the Firth of Forth Banks Complex ncMPA. Most recorded individuals were juvenile; however, two mature specimens were recorded in the north-east of the BBWF array area (BBWFL, 2022). Ocean quahog were also recorded in two epibenthic trawls at the east of the BBWF array area (BT07 and BT12). Single ocean quahog specimens were recorded at six sample

[8] SACFOR classification scale, S=Superabundant, A=Abundant, C=Common, F=Frequent, O=Occasional and R=Rare.

locations within the Marine Scheme Offshore Export Cable Corridor (stations 3, 19, 22, 31, 36 and 108) (Natural Power, 2023).

8.7.1.7. SUMMARY OF BASELINE AND KEY RECEPTORS

54. The key benthic receptors for consideration within this impact assessment are outlined in Table 8.9, alongside their assigned importance in accordance with section 8.10.2. The biotopes recorded within the Marine Scheme have been grouped into habitat complexes for the purposes of this assessment. Where sensitivities within the habitat complexes vary between the representative biotopes this has been highlighted. Species considered to be particularly sensitive to the impacts associated with cable construction and/or those of conservation importance have been assessed at species level. The assessment of effects for all other macrofauna is considered to form part of the assessment for the appropriate biotope.

Table 8.9 Summary and key receptors for Benthic Subtidal and Intertidal Ecology

Receptor	Representative biotope(s)	Importance	Justification	Location / Jurisdiction	
				Scotland	England
Subtidal receptors					
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.Ssa.CfiSa.EpusOborApri • SS.Ssa.OSa • SS.Ssa.Osa.OfusAfil • SS.SCS.OCS • SS.Ssa.CfiSa.ApriBatPo	Regional	• PMF in Scotland • UK Post-2010 Biodiversity Framework Priority Habitat • Qualifying feature of ncMPA and MCZ	✓	✓
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	Regional	• Common and widespread habitat • Qualifying feature of MCZ	✓	✓
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.Smu.OMu • SS.SMu.OMu.PjefThyAfil	Regional	• PMF in Scotland • UK Post-2010 Biodiversity Framework Priority Habitat • Qualifying feature of MCZ	✓	✓
Annex I reef: stony, bedrock and	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	National	• Annex I habitat • UK Post-2010 Biodiversity Framework Priority Habitat • Qualifying feature of MCZ	✓	✓

Receptor	Representative biotope(s)	Importance	Justification	Location / Jurisdiction	
				Scotland	England
Annex I *S. spinulosa* reef[9]	• SS.SBR.PoR.SspiMx	National	• Annex I habitat • UK Post-2010 Biodiversity Framework Priority Habitat • OSPAR threatened habitat	✓	X
Seapens and burrowing megafauna	• SS.SMu.CfiMu.SpnMeg	National	• Annex I habitat • UK Post-2010 Biodiversity Framework Priority Habitat • OSPAR threatened habitat	✓	✓
Ocean quahog	n/a	National	• PMF in Scotland • UK Post-2010 Biodiversity Framework Priority Habitat • OSPAR threatened species • Qualifying feature of ncMPA and MCZ	✓	✓
Intertidal receptors					
Intertidal rock	• A1.2 Moderate energy littoral rock	Regional	• Common and widespread habitat • Qualifying feature of MCZ	X	✓
Intertidal coarse sediment	• A2.1: Intertidal coarse sediment	Regional	• Common and widespread habitat • Qualifying feature of MCZ	X	✓
Intertidal sand and muddy sand	• A2.2: Intertidal sand and muddy sand	Regional	• Common and widespread habitat • Qualifying feature of MCZ	X	✓

[9] Although no sample locations within the BBWF array area and the Marine Scheme Offshore Export Cable Corridor were assigned as *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx), a single sample location within the BBWF (station 20) was assessed as being of low potential *S. spinuolsa* reef.

8.7.2. Future Baseline Scenario

55. In the absence of the Marine Scheme, the future benthic subtidal and intertidal ecology environment at the Marine Scheme is likely to experience changes associated with natural variation, climate change and non-climatic factors.

56. Evidence of long-term changes in North Sea benthos have been recorded through analyses of time-series data, including increased biomass, increased abundance of opportunistic and short-living species and decreased abundance of long-living sessile species. These long-term changes are likely a result of a combination of climatic (e.g. rising sea temperatures) and non-climatic factors (e.g. changes in fishing patterns and contamination), which may in fact interact and influence responses to climate change (Kroncke, 1995; 2011; Moore and Smale, 2020). The nature of this response will likely be dependent on species life-history traits (Moore and Smale, 2020).

57. Climate change is predicted to result in increased sea temperatures, changed ocean chemistry, sea-level rise, changed salinities and oceanographic patterns and an increased frequency of extreme events including storms and heatwaves (Hughes *et al*., 2018). The predicted rise in sea temperatures may result in an increased abundance of warm-water species and a decline in cold-water species, with associated shifts in abundances and species composition (Moore and Smale, 2020). For example, Hiddink *et al.* (2015) analysed infaunal invertebrate communities between 1986 and 2000 and recorded a range shift in species to colder and deeper waters. Evidence of increases in warmer-water species has also already been recorded for kelp (*Laminaria ochroleuca)* in the Western English Channel. In this area, *L. ochroleuca* has increased in abundance and distribution and now competes with *L. hyperborea* (Smale *et al.,* 2015).

58. Intertidal habitats species are also vulnerable to climate change and other factors (e.g. range shifts associated with rising sea temperatures). The predicted increased frequency in heatwaves may also result in tissue damage of fucoids in the high- and mid-shore, as was recorded for Pelvetia canaliculata, Fucus spiralis and Fucus vesiculosus following a summer heatwave event in 2018 in north-east and south-west England, North Wales and the Isle of Man. No large mortality events have been observed through long-term time-series data in the UK, and responses are likely to be site and species-specific (Mieszkowska et al., 2020).

59. Considering the above, it is possible that the benthic baseline described in section 8.7 may change over the operational life of the Marine Scheme. It is anticipated that these changes would occur regardless of whether the Marine Scheme proceeds.

60. Any changes that may occur during the design life of the Marine Scheme should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

8.7.3. Data Assumptions and Limitations

61. The desktop data sources used to inform this chapter are listed in Table 8.4. These data sources represent the most up-to-date desktop data to characterise the Benthic Subtidal and Intertidal Ecology baseline. These desktop data were augmented by site-specific surveys to ensure a robust and accurate baseline characterisation and impact assessment has been provided.

62. The limitations of the 2019 and 2020 site-specific surveys within the BBWF array area are outlined in BBWFL (2022) and include relocation of sample locations to minimise disruption to static fishing gear set on the seabed and to avoid nearby wrecks. 92% of grab samples were successfully carried out. However, some grab sample stations were abandoned due to insufficient sediment in areas of coarse or hard substrate or to avoid damaging Annex I reef. All grab samples were successfully recovered during the site-specific surveys of the Marine Scheme Offshore Export Cable Corridor for analysis of sediment chemistry and macrofauna (Natural Power, 2023).

63. The interpretation of data also has some limitations. For example, the biotopes displayed on the biotope maps represent approximate areas, rather than defined boundaries. This is because there

is generally an area between two benthic habitats where one biotope is transitioning into another. There are also limitations to interpolating data from discrete sample locations across a wider area. Despite this, the biotope maps do show the main biotopes within the Marine Scheme, and therefore, are an appropriate resource to inform the baseline characterisation.

8.8. Scope of the Assessment

8.8.1. Impacts Scoped into the Assessment

64. The following impact pathways have been scoped into the assessment, as agreed through the Scoping processes and follow up consultation with stakeholders and consultees[10]:

- Temporary habitat / species loss and disturbance (C&D and O&M)
- Increased SSC and associated sediment deposition (including mobilisation of potential contaminants) (C&D and O&M);
- Permanent benthic habitat / species loss (O&M);
- Colonisation of hard structures (including potential introduction and spread of Invasive Non-Native Species (INNS)) (O&M);
- EMF effects (O&M);
- Thermal emissions from operational cables (O&M); and
- Changes in physical processes from cable protection measures (O&M).

8.8.2. Impacts Scoped Out of the Assessment

65. Impacts scoped out of the assessment were agreed with key stakeholders through consultation following receipt of the Scoping Opinion from MD-LOT and MMO in February and March 2023, respectively. These are summarised below for completeness:

- Temporary increase in underwater noise on benthic species (C&D);
- Increased risk of introduction of INNS from the movement of vessels and equipment (C&D)11; and
- Accidental release of pollutants (C, O&M, D).

8.9. Key Parameters for Assessment

8.9.1. Maximum Design Scenario

66. The maximum design scenario(s) summarised here have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in Volume 2, Chapter 5: Project Description. Effects of greater adverse significance are not predicted to arise should any other development scenario other than that assessed here based on details within the Project Design Envelope (PDE) (e.g. different infrastructure layout), to that assessed here, be taken forward in the final design of the Marine Scheme.

[10] C = Construction, O&M = Operation and maintenance, D = Decommissioning

[11] Please note that the assessment of the introduction and spread of INNS during the operation and maintenance phase will be assessed under the assessment of colonisation of hard structures.

67. Table 8.10 presents the maximum design scenario for potential impacts on Benthic Subtidal and Intertidal Ecology during construction, operation and maintenance and decommissioning.

68. Site preparation works, in advance of construction, are predicted to commence in Q4 of 2026 and will continue until all installation activities have ceased. Landfall construction is expected to occur between Q4 of 2027 until Q4 of 2028. Export cable installation is expected to begin in Q3 2028 and is expected to last until Q4 of 2029. All activities associated with the Marine Scheme are predicted to conclude by the end of 2029. Until detailed design of the Marine Scheme is progressed and further refined pre-construction, this programme for the Marine Scheme as a whole is indicative and is subject to further refinement, but is used to inform assessment of construction phase impacts for the Marine Scheme.

Table 8.10 Maximum design scenario specific to Benthic Subtidal and Intertidal Ecology impact assessment

Potential Impact	Maximum Design Scenario (Marine Scheme whole)	Maximum Design Scenario (Scottish waters and English waters)	Justification
Construction and decommissioning			
Temporary benthic habitat / species loss or disturbance	Up to 18 km^2 of temporary habitat loss / disturbance due to: • Up to 18 km^2 of disturbance from installation of up to four Offshore Export Cables with seabed disturbance width of 25 m for cable installation and seabed preparation activities including Pre-lay Grapnel Run (PLGR), boulder clearance, route preparation, sea trials, seabed levelling and pre-installation trenching through harder sediment and cable laying and protection; • Up to 5,000 m^2 of disturbance from the temporary placement of up to five jack-up vessel deployments in the nearshore area; • Up to five exit pits, each 20 x 5 m, for up to four cable ducts (with one spare) due to trenchless cable installation at the Landfall; and • Maximum duration of the construction phase of up to 39 months.	**Scottish waters:** Up to 4 km^2 of temporary habitats loss / disturbance due to: • Installation of up to four Offshore Export Cables with seabed disturbance width of 25 m for cable installation and seabed preparation activities including PLGR, boulder clearance, route preparation, sea trials, seabed levelling and pre-installation trenching through harder sediment and cable laying and protection. **English waters:** Up to 14 km^2 of temporary habitats loss / disturbance due to: • Up to 14 km^2 of disturbance from installation of up to four Offshore Export Cables with seabed disturbance width of 25 m for cable installation and seabed preparation activities including PLGR, boulder clearance, route preparation, sea trials, seabed levelling and pre-installation trenching through harder sediment and cable laying and protection; • Up to 5,000 m^2 of disturbance from the temporary placement of up to five jack-up vessel deployments in the nearshore area; and • Up to five exit pits each 20 x 5 m, for up to four cable ducts (with one spare) due to trenchless cable installation at the Landfall; and	Maximum footprint which would be affected during the construction phases. Based on the assumption that the width of disturbance for seabed levelling at sandwaves (across 20% of the Marine Scheme) and all other seabed preparation activities encompasses subsequent cable installation as repeat disturbance. The maximum design scenario assumes that cable installation in the intertidal area will involve trenchless techniques only. It is assumed that the footprint of the exit punches associated with trenchless techniques (e.g. HDD) and jack-up vessel placements within the subtidal area are within the width of disturbance assumed for offshore export cables installation. The maximum design scenario for exit pits is based on up to four cables (with an allowance for one spare).
Increased SSC and associated sediment deposition (including mobilisation of potential contaminants)	• Seabed preparation: – Pre-lay grapnel run, boulder clearance, route preparation, sea trials (as required), and pre-installation trenching through harder sediment; – Seabed levelling at sandwaves across a width of 25 m, average height 5 m and clearance along approximately 20% of the Marine Scheme length (3.6 km^2). • Cable installation: – Offshore Export Cables length up to 720 km; – Installation using any of the following methods: ploughs (displacement and/or non-displacement), jetting machines, mechanical trenchers, MFE. Of these, MFE has been assumed as the worst case with regards to SSC; – Installation mobilises sediments from a 3 m deep and 2.5 m wide trench; and – Cable installation at the Landfall via trenchless technique with potential for drilling releases associated with trenchless techniques (e.g., HDD), up to 2,000 m^3 per HDD of which 1,900 m^3 is water and 100 m^3 is drilling mud / solids (e.g. bentonite), totalling 10,000 m^3 (9,500 m^3 water and 500 m^3 drilling mud / solids) for 5 drilling HDD bores (4 used and 1 contingency). HDDs will be drilled sequentially, so the fluids will be released in 5 separate releases of up to 2,000 m^3 i.e. the 10,000 m^3 will not be released in a single event. • Maximum duration of the construction phase of up to 39 months.	**Scottish waters:** • Seabed preparation: – Pre-lay grapnel run, boulder clearance, route preparation, sea trials (as required), and pre-installation trenching through harder sediment; – Seabed levelling at sandwaves across a width of 25 m, average height 5 m and clearance along approximately 20% of the Marine Scheme length in Scottish waters (0.8 km^2); • Cable installation: – Offshore export cables length up to 160 km; – Installation using any of the following methods: ploughs (displacement and/or non-displacement), jetting machines, mechanical trenchers, MFE. Of these, MFE has been assumed as the worst case with regards to SSC; – Installation mobilises sediments from a 3 m deep and 2.5 m wide trench. **English waters:** • Seabed preparation: – Pre-lay grapnel run, boulder clearance, route preparation, sea trials (as required), and pre-installation trenching through harder sediment; – Seabed levelling at sandwaves across a width of 25 m, average height 5 m and clearance along approximately 20% of the Marine Scheme length in English waters (2.8 km^2); • Cable installation: – Offshore export cables length up to 560 km; – Installation using any of the following methods: ploughs (displacement and/or non-displacement), jetting machines, mechanical trenchers, MFE.	Greatest volume of sediment released into the water column (see Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions). Cable installation by MFE has the greatest potential to increase suspended sediments as this method fluidises the sediment. In some areas, a trench depth of 3 m may not be achieved and therefore the assessment provides the upper bound in terms of suspended sediment and dispersion potential.

Potential Impact	Maximum Design Scenario (Marine Scheme whole)	Maximum Design Scenario (Scottish waters and English waters)	Justification
		Of these, MFE has been assumed as the worst case with regards to SSC; and – Cable installation at the Landfall via trenchless technique with potential for drilling releases associated with trenchless techniques (e.g., HDD).	
Operation and Maintenance			
Temporary benthic habitat / species loss or disturbance	• Repair / reburial activities: – Four cable repair events of up to 1 km each across the operation and maintenance phase; and	**Scottish waters:** • Repair / reburial activities; – Four cable repair events of up to 1 km each across the operation and maintenance phase; and – Four cable reburial events of up to 1 km each across the operation and maintenance phase. English waters: • Repair / reburial activities; – Four cable repair events of up to 1 km each across the operation and maintenance phase; and – Four cable reburial events of up to 1 km each across the operation and maintenance phase.	The maximum number of cable repair and reburial events result in the highest frequency and footprint of temporary benthic habitat / species loss or disturbance.
Increased SSC and associated sediment deposition	• Repair / reburial activities: – Four cable repair events of up to 1 km each across the operation and maintenance phase; and – Four cable reburial events of up to 1 km each across the operation and maintenance phase.	**Scottish waters:** • Repair / reburial activities; – Four cable repair events of up to 1 km each across the operation and maintenance phase; and – Four cable reburial events of up to 1 km each across the operation and maintenance phase. **English waters:** • Repair / reburial activities; – Four cable repair events of up to 1 km each across the operation and maintenance phase; and – Four cable reburial events of up to 1 km each across the operation and maintenance phase.	Greatest volume of sediment released into the water column (see Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions). The maximum number of cable repair and reburial events result in the highest frequency of increased SSC during the operation and maintenance stage.
Permanent benthic habitat / species loss	Up to 1.46 km^2 of permanent habitat loss due to: • Up to 1.41 km^2 of cable protection associated with up to 37.1 km of per cable (154.8 km in total) at a width of up to 9.5 m; • Total of up to 0.05 km^2 for five cable crossings and up to 200 m of cable requiring protection per crossing at a width of up to 12.5 m; and • Operation and maintenance phase of up 35 years.	**Scottish waters:** Up to 0.23 km^2 of permanent habitat loss due to: • Up to 0.23 km^2 of cable protection associated with 6 km of per cable (24 km in total) at a width of up to 9.5 m; • Operation and maintenance phase of up 35 years. **English waters:** Up to 1.24 km^2 of permanent habitat loss due to: • Up to 1.18 km^2 of cable protection associated with 31.1 km of per cable (124.4 km in total) at a width of up to 9.5 m; • Up to 0.05 km^2 of cable protection for five cable crossings at a width of up to 12.5 m; and • Operation and maintenance phase of up 35 years.	Maximum footprint which would be affected during the operation and maintenance phase. The total cable protection area and length for the Marine Scheme exceeds the sum of English and Scottish waters. This is due to the worst-case for the Marine Scheme as a whole being associated with the eastern option for the Marine Scheme Offshore Export Cable Corridor to avoid double counting of both routes for total length.
Colonisation of hard structures (including potential introduction and spread of INNS).	Up to 1.46 km^2 of permanent habitat loss due to: • Up to 1.41 km^2 of cable protection associated with up to 37.1 km of per cable (154.8 km in total) at a width of up to 9.5 m;	**Scottish waters:** Up to 0.23 km^2 of permanent habitat loss due to: • Up to 0.23 km^2 of cable protection associated with 6 km of per cable (24 km in total) at a width of up to 9.5 m; • Operation and maintenance phase of up 35 years.	Maximum footprint which would be affected during the operation and maintenance phase. The total cable protection area and length for the Marine Scheme exceeds the sum of English and Scottish waters. This is due to the worst-case for the Marine Scheme as a whole being associated

Potential Impact	Maximum Design Scenario (Marine Scheme whole)	Maximum Design Scenario (Scottish waters and English waters)	Justification
	• Total of up to 0.05 km^2 for five cable crossings and up to 200 m of cable requiring protection per crossing at a width of up to 12.5 m; and • Operation and maintenance phase of up 35 years.	**English waters:** Up to 1.24 km^2 of permanent habitat loss due to: • Up to 1.18 km^2 of cable protection associated with 31.1 km of per cable (124.4 km in total) at a width of up to 9.5 m; • Up to 0.05 km^2 of cable protection for five cable crossings at a width of up to 12.5 m; and • Operation and maintenance phase of up 35 years.	with the eastern option for the Marine Scheme Offshore Export Cable Corridor to avoid double counting of both routes for total length.
EMF and thermal load effects	• Presence of up to four 180 km long High Voltage Direct Current (HVDC) cables in a 320 kV symmetrical monopole arrangement or two 180 km long HVDC cables as a bipole arrangement at 525 kV; • Minimum target burial depth of 0.5 m; • Operation and maintenance phase of up 35 years.	**In Scottish waters:** • Presence of up to four 40 km long HVDC cables in a 320 kV symmetrical monopole arrangement or two 40 km long HVDC cables as a bipole arrangement at 525 kV; and • Minimum target burial depth of 0.5 m. **In English waters:** • Presence of up to four 140 km long HVDC cables in a 320 kV symmetrical monopole arrangement or two 140 km long HVDC cables as a bipole arrangement at 525 kV; and • Minimum target burial depth of 0.5 m.	Modelling completed for the Marine Scheme provides data on the level and attenuation of EMF for a symmetrical monopole configuration at 320 kV and a bipole configuration at 525 kV, assuming a horizontal separation distance of 25 m (further details are provided in Volume 2, Chapter 5: Project Description). The worst-case EMF level and attenuation is calculated for each HVDC cable as a worst-case under the assumption that a bundled arrangement will not be used. Based on this modelling, the maximum design scenario is associated with a bi-pole arrangement at 525 kV.
Changes in physical processes from cable protection measures	• Cable protection along 154.8 km of up to 1.5 m height and 9.5 m width; • Cable protection at crossings along 800 m of cable up to 2 m height and 12.5 m width; and • Operation and maintenance phase of up to 35 years.	**Scottish waters:** • Cable protection along 24 km of up to 1.5 m height and 9.5 m width; and • Operation and maintenance phase of up to 35 years. **English waters:** • Cable protection along 124.4 km of up to 1.5 m height and 9.5 m width; • Cable protection at crossings along 800 m of cable up to 2 m height and 12.5 m width; and • Operation and maintenance phase of up to 35 years.	Maximum cable protection hight, width and area would result in the largest obstruction to flow (see Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions).

8.10. Methodology for Assessment of Effects

8.10.1. Overview

69. The Benthic Subtidal and Intertidal Ecology assessment of effects has followed the methodology set out in Volume 2, Chapter 3: EIA Methodology. Specific to the assessment of Benthic Subtidal and Intertidal Ecology, the following guidance documents have also been considered:

- Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland – Terrestrial, Freshwater, Coastal and marine (CIEEM, updated April 2022);
- Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English waters to offshore wind farm cabling within Proposed Round 4 leasing areas (JNCC and Natural England, 2019);
- Nature Conservation Considerations and Environmental Best Practice for subsea cable for English Inshore and UK Offshore Waters (Natural England and JNCC, 2022);
- Defining and managing *Sabellaria spinulosa* reefs (Gubbay, 2007); and
- The identification of the main characteristics of Annex I stony reef habitats under the Habitats Directive (Irving, 2009).
- Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Golding, Albrecht, & McBreen, 2020);

70. In the absence of in situ Environmental Quality Standards for UK sediments, the following guidance documents have been used to inform a 'Weight of Evidence' (WoE) approach to the assessment of the potential impacts of the Marine Scheme on benthic receptors:

- Centre for Environment, Fisheries and Aquaculture Science (Cefas) Chemical Action Levels (MMO, 2014) (Reviewed 2020); and
- Canadian Sediment Quality Guidelines (Canadian Council of Ministers of the Environment, 2001) (applied to contaminants where no other regional threshold value is available) and the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life.

8.10.2. Impact Assessment Criteria

71. Determining the significance of effects is a two-stage process that involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 2, Chapter 3: EIA Methodology.

72. The criteria for defining magnitude in this chapter are outlined in Table 8.11 below.

Table 8.11 Definition of terms relating to the magnitude of an impacts

Magnitude of Impact	Definition
High	The impact occurs over a large spatial extent resulting in widespread, and/or long-term, permanent changes in baseline conditions or affects a proportion of a receptor population. The impact is very likely to occur and/or will occur at a high frequency or intensity.
Medium	The impact occurs over a local to regional spatial extent and/or a short- to medium-term change to baseline conditions or affects a moderate proportion of a receptor population. The impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	The impact is localised and/or temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population. The impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	The impact is highly localised and/or short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or a receptor population. The impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.

73. The criteria for defining sensitivity in this chapter are outlined in Table 8.12 below. The Marine Evidence based Sensitivity Assessment (MarESA) and the Feature Activity Sensitivity Tool (FeAST) have been drawn upon to support the assessment of sensitivity. MarESA sensitivity assessments are provided for a range of biotopes, whereas the FeAST tool focusses on features of ncMPAs, and is therefore, not relevant to all benthic receptors. The process for defining sensitivity in this chapter follows the MarESA and FeAST sensitivity assessments, which correlates resistance and recoverability to categorise sensitivity. The findings of the MarESA and FeAST sensitivity assessments are then considered alongside the value of the receptor for the judgement of overall sensitivity, as defined in Table 8.12.

Table 8.12 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 capability to 'absorb' or accommodate change and no ability to recover or adapt.
High	High importance and rarity, international and/or national receptor and very limited capability to 'absorb' or accommodate change without fundamentally altering the character of the receptor.
Medium	High or medium importance and rarity, regional receptor with some capacity to absorb or accommodate change without significantly altering character, however some damage to the receptor is anticipated to occur.
Low	Low or medium importance and rarity and the receptor is considered tolerant to change without significant detriment to its character; some limited or minor change may occur.
Negligible	Very low importance and rarity, local receptor and is tolerant to change with no effect on its fundamental character.

74. The significance of the effect upon Benthic Subtidal and Intertidal Ecology is determined by correlating the magnitude of the impact and the sensitivity of the receptor, as outlined in Table 8.13 below.

Table 8.13 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

75. Definitions for the significance of effect are provided in Table 8.13 . For the purposes of the Marine Scheme ES, any effect which is deemed to result in a significance or moderate or greater, is generally considered to be 'significant' in EIA terms and will require additional mitigation. Effects considered to be 'minor' or 'negligible' are generally considered to be 'not significant' in EIA terms.

Table 8.14 Assessment of consequence

Assessment Consequence	Description	Significance of Effect
Major Effects	Effects (beneficial or adverse) are likely to result in highly noticeable and long-term, or permanent impacts to the character of the baseline and which are likely to disrupt the function and/or status/value of a Benthic Subtidal and Intertidal receptor. These effects are a priority for mitigation in order to avoid or reduce the significance of the effect.	Significant
Moderate Effects	Effects (beneficial or adverse) are likely to result in noticeable and lasting impacts to the character of the baseline and which may cause degradation of the Benthic Subtidal and Intertidal receptor. These effects are a priority for mitigation in order to avoid or reduce the significance of the effect.	Significant
Minor Effects	Effects (beneficial or adverse) are likely to result in noticeable changes to baseline conditions, beyond the natural variation, but which are not anticipated to result in long-term degradation to the function or value of the Benthic Subtidal and Intertidal receptor. Such effects will not generally require additional mitigation but may be of interest to relevant stakeholders.	Not Significant
Negligible	Effects are anticipated to be likely indistinguishable from baseline conditions or within the natural level of variation. These effects do not require additional mitigation and are not anticipated to be a stakeholder concern.	Not Significant

76. In line with Scottish Ministers' Scoping Opinion, the assessment of impacts identifies where impacts are relevant to Scottish waters, English waters, or both. Where there is no separation of

assessment of impacts, the assessment for the Marine Scheme (as a whole entity) applies to the Marine Scheme in each of Scottish waters and English waters separately.

8.11. Measures Adopted as part of the Marine Scheme

77. As part of the project design process, a number of measures have been proposed to reduce the potential for impacts on Benthic Subtidal and Intertidal Ecology (see Table 8.15). These include measures which have been incorporated as part of the Marine Scheme design (referred to as 'designed in measures') and measures which will be implemented regardless of the impact assessment (referred to as 'tertiary mitigation'). As there is a commitment to implementing these measures, they are considered inherently part of the design of the Marine Scheme and have therefore been considered in the assessment presented in section 8.12 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 8.15 Measures adopted as part of the Marine Scheme (designed in measures & tertiary mitigation)

Mitigation Measure	Justification	Applicable Jurisdiction
Cable protection.	The use of cable protection will be minimised as far as practicable, and only used where required. Additional external cable protection (e.g. rock placement) will only be used where the minimum target burial depth cannot be achieved, for example in areas of hard ground or at third-party crossings. This will be informed by outputs from the Cable Burial Risk Assessment completed by the installation contractor(s) prior to the commencement of installation. Rock utilised in berms will be clean with low fines. Use of graded rock and 1:3 profile berms at areas of rock protection will reduce potential fishing gear snagging risk.	Scottish waters and English waters
Material for cable protection.	Where possible, cable protection will match up as much as possible with the existing hard substrate, in terms of size, shape and type of rock/ materials used in order to reduce habitat alteration	Scottish waters and English waters
Micro-routeing within the Marine Scheme.	Micro-siting within the Marine Scheme will be carried out to help avoid or minimise interactions with localised engineering and environmental constraints identified during pre-construction surveys.	Scottish waters and English waters
Route selection and avoidance	The route for the Marine Scheme has been specifically refined to avoid interactions with key designations, such as the Farnes East Marine Conservation Zone (MCZ). On the approach to the Landfall at Cambois, the route has been selected to minimise the footprint within European Sites such as the St Marys to Coquet MCZ. Nearshore routes with greater levels of interactivity with European Sites along the English and Scottish coast have been de-selected. Further detail on this is provided in Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives.	Scottish waters and English waters
Cable burial depth	Cables will be buried to a minimum target depth of 0.5 m and only protected using external protection (e.g., rock berms) where minimum target burial depth is not achieved or at third-party crossings. Application of target cable burial depth will reduce the potential for cable exposure from interactions between metocean regimes (e.g. wave, sand and currents) and will reduce interaction with fishing gear. Cable burial also reduces risk of interference with magnetic position fixing equipment.	Scottish and English waters
Landfall construction.	Trenchless techniques, such as Horizontal Directional Drilling (HDD) will be used at the Landfall for the construction of the Marine Scheme. Works associated with Landfall construction activities will avoid any works in the intertidal environment and will reduce the potential for sediment disturbance.	English waters
Pose Little or No Risk (PLONOR) substances.	During trenchless installation activities at Landfall, there will be an interface between the sea and the drilling fluids used to create the exit pits at the breakouts. Small quantities of drilling fluids may be discharged to the marine environment, however best practice mitigation will be implemented to reduce the amount of drill mud / cuttings released in the event of a release. To limit environmental damage, only biologically inert PLONOR listed drilling fluid will be used.	English waters

Mitigation Measure	Justification	Applicable Jurisdiction
Cable grouping.	Grouping cables of opposite polarity will result in deleterious interference between the EMFs from adjacent cables, which will further reduce the field EMF strengths resulting from the Marine Scheme. Furthermore, the design of the Marine Scheme will be further refined, informed by onward detailed engagement with the supply chain and various technical, practical, and commercial considerations. As part of this refinement, the cable configuration will be optimised and options to reduce EMF assessed. Beyond the configuration commitment detailed above, practical solutions for reducing EMF arising from the Offshore Export Cables may include reducing cable separation or adopting a bundled solution.	Scottish and English waters
Environmental Management Plan (EMP).	An EMP will be developed and employed to ensure potential release for pollutants will be reduced as far as practicable. This will include a Marine Pollution Contingency and Control Plan (MPCCP) and an Invasive and Non-Native Species Management Plan (INNSMP). An outline EMP has been provided as part of this application (Volume 5, Appendix 5.1) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish waters and English waters
Marine Pollution Contingency and Control Plan (MPCCP).	An MPCCP will be implemented to ensure that, in the unlikely event that a pollution event occurs, any spillage is reduced as far as reasonably practicable and effects on the environment are ideally avoided or reduced as far as reasonably practicable. Implementation of these measures will reduce the accidental release of contaminants from vessels as far as reasonably practicable, thus providing protection for marine life across all phases of the Marine Scheme. This will include but may not be limited to: designated areas for refuelling where spillages can be easily contained; storage of chemicals in secure designated areas in line with appropriate regulations and guidelines; only using substances approved on Cefas list under the Offshore Chemical Regulations (UK Government, 2002); double skinning of pipes and tanks containing hazardous substances; and storage of these substances in impenetrable bunds. This will control the potential release of contaminants from supply and service vessels. An outline MPCCP has been provided as part of this application (Volume 5, Appendix 5.1.A) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters
Invasive Non-Native Species Management Plan (INNSMP).	An INNSMP will be implemented to manage and reduce the risk of potential introduction and spread of INNS as far as reasonably practicable. The plan will include, but may not be limited to, measures to facilitate vessel compliance with the International Maritime Organisation (IMO) ballast water management guidelines (International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004) and adherence to the IMO guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines). It will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded. An outline INNSMP has been provided as part of this application (Volume 5, Appendix 5.1.B) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters

Mitigation Measure	Justification	Applicable Jurisdiction
Decommissioning Plan.	The aim of this plan is to adhere to the existing UK and international legislation and guidance, with decommissioning industry practice applied. Overall, 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 Marine Scheme, the maximum design scenario for the decommissioning phase has been considered in each of the assessments of effects.	Scottish and English waters
Cable Plan (CaP).	Suitable implementation and monitoring of cable protection through the Marine Scheme and adherence to a CaP. This will be produced and consulted on (in line with consent conditions) prior to installation and will include a detailed cable laying plan including geotechnical data, cable laying techniques and informed by a Cable Burial Risk Assessment (CBRA) which will include details on minimum target burial depths.	Scottish and English waters

8.12. Assessment of Impacts

78. The potential impacts arising from the construction, operation and maintenance, and decommissioning phases of the Marine Scheme are listed in Table 8.10 along with the maximum design scenario against which each impact has been assessed.

79. An assessment of the likely significant effects of the Marine Scheme on benthic receptors is provided below. Due to the use of trenchless installation techniques at the Landfall, there will be no physical overlap between the Marine Scheme construction activities and intertidal receptors. Therefore, the only effect of relevance to intertidal receptors from the Marine Scheme is considered to be increased SSC and associated deposition.

80. The MPA and MCZ Assessment which accompanies this application provides an assessment of the potential likely significant effects on the features of designated sites within the vicinity of the Marine Scheme, as identified in section 8.7.1.1.

8.12.1. Potential Effects During Construction

8.12.1.1. TEMPORARY HABITAT / SPECIES LOSS OR DISTURBANCE

81. During the construction phase, temporary habitat / species loss or disturbance may occur as a result of the following activities:

- Cable Landfall construction;
- Seabed preparation activities (including boulder clearance, seabed levelling, PLGR and pre-lay trenching);
- Cable installation activities (including trenching, laying, burial and protection); and
- Placement of jack-up vessels.

82. Temporary habitat disturbance/ loss of habitats or species encompasses any physical disturbance and temporary loss of benthic habitats and any physical damage to low-mobility benthic species.

83. Works associated with the Landfall in English waters, including the use of jack up barges and the excavation of exit pits, will also result in temporary seabed disturbance. However, as detailed in section 8.9.1, these activities will be located within the 25 m wide zone of disturbance for the route preparation and cable installation activities, so the overall area of disturbance will not be increased. As the Offshore Export Cables will be installed at the Landfall via trenchless techniques, there will be no direct disturbance on any benthic intertidal receptors, and therefore, they have not been considered further in this assessment.

8.12.1.1.1. Magnitude of impact

84. As described in section 8.9.1, up to 18 km2 of temporary habitat loss and disturbance may occur intermittently during the construction phase, over a period of 39 months. 4 km2 will take place in Scottish waters and 14 km2 will take place in English waters.

85. Seabed preparation activities may involve PLGR, boulder clearance, route preparation at sandwaves (i.e. seabed levelling), sea trials, and pre-installation trenching through harder sediment. Direct seabed disturbance during seabed preparations will occur within a 25 m wide corridor (per cable). Seabed levelling is assumed to occur across 20% of the Marine Scheme length, amounting to an area of 0.8 km2 being disturbed in Scottish waters and 2.8 km2 being disturbed in English Waters, the footprint of seabed levelling will also be wholly within the 25 m wide corridor, so this activity does not increase the overall footprint of disturbance.

86. To account for the use of displacement ploughs, which represent the installation tool with the widest disturbance swathe, disturbance from cable installation will occur over a 25 m width (per trench), as a worst-case has been assumed. The installation technique will likely vary along the Marine

Scheme, dependent on sediment type, and thus, techniques associated with a narrower disturbance swathe may also be used. As seabed preparation activities will take place ahead of cable installation, cable trenching and burial works take place within previously disturbed areas of seabed. Where burial cannot be achieved, cable protection will be used and this will result in permanent habitat loss which has been assessed separately in section 144.

87. A recent review of the effects of cable installation on subtidal sediments from over 20 UK offshore wind farms showed that sandy sediments recover rapidly following cable installation, with trenches infilling quickly following cable installation with no long-term effects. In coarse and mixed sediments and muddy sediments, remnant cable installation trenches were conspicuous for several years after installation. However, these remnant trenches constituted shallow depressions which were of limited depth (i.e. tens of cm) when compared against the surrounding seabed (RPS, 2019). Given the sediment type in the Marine Scheme area, there is likely to be some limited evidence of disturbance after installation activities have concluded.

88. In English waters, temporary disturbance will also result from the placement of jack-up vessels and Landfall construction activities. In the nearshore area, up to 5,000 m2 of habitat disturbance and loss will be associated with jack-up footprints, resulting from the compression of seabed sediments beneath spud cans. These depressions will infill over time, but may remain on the seabed for a number of years, as evidenced by monitoring studies of UK offshore wind farms (BOWind, 2008; EGS, 2011). Those associated with the Marine Scheme will be highly localised.

89. The Landfall construction may result in temporary disturbance at up to five exit pits, each 20 m x 5 m. Sediments may be displaced at the exit pits as a result of the exiting drill, potentially physically damaging some less mobile fauna. However, once again, this area of disturbance will be highly localised and temporary.

90. This disturbance activities will occur intermittently over a period of up 39 months during construction, inclusive of seabed preparation in advance of cable installation (18 months). These activities will not all occur at the same time, although some activities may overlap and occur simultaneously for a period of time. Given the intermittent nature of the activities, only a small area of seabed is expected to be disturbed at any one time. Furthermore, as described in section 8.11, micro-routeing within the Marine Scheme Offshore Export Cable Corridor will avoid or minimise interactions with sensitive benthic features such as Annex I reef.

91. As described above, in Scottish waters, temporary habitat loss and disturbance will result from seabed preparations and cable installation. The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be low.

92. In English waters, temporary habitat loss and disturbance will result from seabed preparations, cable installation, jack-up vessel placement and Landfall construction. The impact is predicted to be of regional spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in English waters is therefore considered to be low.

8.12.1.1.2. Sensitivity of the receptor

93. The sensitivity to temporary loss and disturbance of habitats and species varies between different benthic receptors, as presented in Table 8.16. These sensitivities have been assessed in relation to MarESA and FeAST tool pressures and benchmarks, including:

- Habitat structure changes – removal of substratum;
- Abrasion / disturbance of the surface of the substratum or seabed; and
- Penetration and/or disturbance of the substratum subsurface.

94. Soft sediments (e.g. subtidal sands and gravels) readily recover from penetration, abrasion and disturbance, and rapidly return to baseline conditions. Following construction, recovery of biotopes in disturbed areas would be expected if the sediment type is reflective of the baseline environment

(RPS, 2019). Sandy sediments recover over relatively short timescales (e.g. months to one to two years) (Newell *et al.,* 2004) and coarse, gravelly and mixed sediments generally show longer recovery timescales, usually within five years (Desprez, 2000; Newell *et al.,* 1998; Pearce *et al.,* 2007). Mud habitats in deep water are considered to have a slower recovery rate to disturbance due to the cohesive nature of this sediment, and hence, the sensitivity of this habitat type is higher than that of subtidal sands, gravels and subtidal mixed sediments.

95. The biotopes present in the Marine Scheme have a low to high sensitivity to the MarESA and FeAST pressures associated with temporary habitat / species loss and disturbance. Subtidal sands and gravels, subtidal mixed sediments and mud habitats in deep water are assessed as having a medium to high sensitivity to the relevant FeAST pressures and a medium sensitivity to the MarESA habitat structure changes – removal of substratum pressure. However, the degree to which particular examples of the habitat are sensitive to the pressure will be dependent on the species present.

96. The biotopes identified within the Marine Scheme are characterised by burrowing polychaetes and burrowing bivalves with some epifauna, with impacts expected to be restricted to a localised decline in species richness. The majority of infauna will be expected to burrow back into the sediment following displacement with only a small degree of mortality resulting from predation when exposed at the sediment surface. Larger fragile species are more likely to be damaged and therefore unable to borrow back into the sediment (Tillin et al., 2006).

97. It is expected that opportunistic species will be able to rapidly recolonise areas of disturbed seabed, and this rate of recolonisation will depend on the rate of recovery of the habitat (as outlined above) and the season of occurrence, amongst other factors. Longer-lived species with variable and episodic recruitment strategies (e.g. some venerid bivalves) may take longer to become re-established. However, considering the highly localised areas of disturbance associated with the Marine Scheme, the loss is not expected to result in a widespread loss of any biotope and no adverse effects on regional ecosystem functions or biodiversity are anticipated.

98. Subtidal sands and gravels and subtidal mixed sediments are deemed to be of low vulnerability, low to medium recoverability and regional value. The sensitivity is therefore considered to be low. Mud habitats in deep water are deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity is therefore considered to be medium.

99. The extent of stony / bedrock reef and S. spinulosa reef within the Marine Scheme is low, as outlined in section 8.7. Disturbance during the construction phase will primarily relate to abrasion of the surface of these habitats which may damage epifaunal communities, such as tube worms, bryozoans, hydroids, soft corals and sponges, and in areas of stony reef, any movement of cobbles or boulders may lead to further damage (Boulcott and Howell, 2011). Despite this, epifaunal communities are expected to recolonise quickly following abrasion via recruitment from adjacent non-affected areas. *S. spinulosa* reef habitats are judged to be of a medium sensitivity to the relevant MarESA pressures of temporary habitat / species loss and disturbance. *S. spinulosa* are vulnerable to surface abrasion which can damage the tubes of the worms and penetration and/or disturbance of the substratum subsurface is likely to damage and break-up tube aggregations leading to the loss of reef within the footprint of direct impact (Tillin *et al*., 2022).

100. Stony/reef habitats and S. spinulosa reef are deemed to be of medium vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be medium.

101. Seapens and burrowing megafauna communities are judged to be of a high sensitivity to the MarESA defined pressure of penetration and/or disturbance of the substratum subsurface and habitat structure changes, equating to removal of substratum. Removal of substratum could result in the loss of any resident seapens present should it meet the benchmark of the removal of 30 cm of sediment for this MarESA pressure (Hill et al., 2020). Similarly, penetrative activities are likely to disturb or lead to mortality of seapens and burrowed megafauna, making resistance and resilience low and sensitivity high. However, there is likely to be a degree of recovery over time once construction activities cease.

102. Ocean quahog are assessed to have a high sensitivity to the MarESA pressures associated with temporary habitat loss and disturbance and a low to high sensitivity to the relevant FeAST pressures. Ocean quahog are a low mobility species that live buried within the top few centimetres of sediments, and therefore, may be damaged by any surface or sub-surface abrasion or substratum loss. The resilience of ocean quahog aggregations, if experiencing significant mortality, is expected to be very low, due to the sporadic and variable nature of recruitment in bivalves (Tyler-Walters and Sabatini, 2017). However, only low numbers of ocean quahog were recorded within the Marine Scheme and the footprint of temporary loss or disturbance during the construction phase will be highly localised, particularly in comparison to the wide spatial distribution of this species and their available habitat.

103. Seapens and burrowing megafauna communities and ocean quahog are deemed to be of a high vulnerability, low recoverability and national value. The sensitivity is therefore considered to be high.

Table 8.16 Key receptor sensitivities to temporary habitat / species loss and disturbance

Representative biotope(s)		Sensitivity to defined MarESA and FeAST pressure			Overall (as defined in section 8.10.2)
		Abrasion / disturbance at the surface of the substratum or seabed	Penetration and/or disturbance of the substratum Subsurface	Habitat Structure Changes – Removal of Substratum	
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.Osa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	MarESA: Low FeAST (conitental shelf sands): Medium	MarESA: Low FeAST (continental shelf sands): Medium	MarESA: Medium FeAST (continental shelf sands): High	Low
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	MarESA: Low FeAST (continental shelf mixed sediments): Medium	MarESA: Low FeAST (continental shelf mixed sediments): High	MarESA: Medium FeAST(continental shelf mixed sediments): High	Low
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.SMu.OMu • SS.SMu.OMu.PjefThyAfil	MarESA: Medium FeAST (offshore deep sea muds): High	MarESA: Medium FeAST (offshore deep sea muds): High	MarESA: Medium FeAST (offshore deep sea muds): High	Medium
Annex I Reef: Stony/ bedrock	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: Low	MarESA: Not relevant	MarESA: Not relevant	Medium

Representative biotope(s)		Sensitivity to defined MarESA and FeAST pressure			Overall (as defined in section 8.10.2)
		Abrasion / disturbance at the surface of the substratum or seabed	Penetration and/or disturbance of the substratum Subsurface	Habitat Structure Changes – Removal of Substratum	
Annex I Reef: *Sabellaria spinulosa* reef	• SS.SBR.PoR.SspiMx	MarESA: Medium	MarESA: Medium	MarESA: Medium	Medium
Seapens and burrowing megafauna	• SS.SMu.CFiMu.SpnMeg	MarESA: Medium FeAST (burrowed mud): Medium	MarESA: High FeAST (burrowed mud): Medium	MarESA:High FeAST (burrowed mud): Medium	High
Ocean quahog	n/a	MarESA: High FeAST: Low	MarESA: High FeAST: High	MarESA: High FeAST: High	High

8.12.1.1.3. Significance of the effect

104. Overall, the magnitude of the impact in Scottish and English waters is deemed to be low.

105. The sensitivity of subtidal sands and gravels and subtidal mixed sediments is considered to be low. The effect will therefore be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

106. The sensitivity of mud habitats in deep water and stony / bedrock reef and S. spinulosa reef is considered to be medium. The effect will therefore be of minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

107. The sensitivity of ocean quahog and seapens and burrowing megafauna is considered to be high. The effect on these receptors will be of moderate adverse significance in the short term (i.e. within two years of completion of construction activities), but decreasing to minor adverse significance in the medium to long term as the sediments and communities are predicted to recover. The effect will therefore be of minor to moderate significance, according to the assessment matrix provided in Table 8.13. However, considering the recoverability of these receptors, including the high recruitment potential from populations across the wider region and the very minor proportion of habitat temporarily lost (18 km2), the final significance is considered to be minor adverse significance, for the Marine Scheme as a whole, and not significant in EIA terms.

108. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of temporary habitat / species loss or disturbance on the protected features or any ecological or geomorphological process on which depends the conservation of any protected features of the Firth of Forth Banks Complex ncMPA and the Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that the assessment concluded that there were no significant risks of any temporary habitat / species loss or disturbance during the construction phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.1.1.4. Secondary mitigation and residual effect

109. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.1.2. INCREASED SSC AND ASSOCIATED SEDIMENT DEPOSITION

110. Increases in SSC may occur during the construction phase as a result of seabed levelling and cable trenching and burial. The increases in suspended sediment may result in a sediment plume in the water column that is then deposited at a distance from the Marine Scheme. Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions, includes details of the predicted increases in SSC and subsequent deposition that have been used to inform this assessment. For the purposes of this assessment, the following activities have been considered:

- Cable Landfall construction;
- Potential releases of drilling fluids during Landfall construction in English waters;
- Seabed preparation activities (including boulder clearance, seabed levelling, sea trials, pre-lay grapnel runs and pre-lay trenching); and
- Cable installation activities (including trenching, laying, burial and protection).

111. Existing seabed habitats and communities may be temporarily disturbed by the suspension of sediments in the water column through the blocking of feeding apparatus and smothering of low mobility invertebrates and the deposition of the suspended sediments may result in localised changes to the sediment type and burial of epifauna.

112. This impact is consistent along the cable length therefore the following discussion is applicable to both Scottish and English waters.

8.12.1.2.1. Magnitude of impact

113. Seabed preparation activities will occur ahead of cable trenching and burial works. Seabed levelling will disturb seabed material within a 25 m corridor across an assumed 20% of the Marine Scheme with an average height of 5 m. It is unlikely that seabed levelling will be required on the approach to Landfall as sand waves in this area are not expected. However as this cannot be ruled out, the potential impacts on circalittoral and intertidal receptors are considered. The maximum deposition scenario is associated with seabed levelling by MFE. Similarly, the maximum design scenario for cable installation conservatively assumes installation by MFE for the full length of the Marine Scheme with a 2.5 m wide and 3 m deep trench for each cable. Increases in suspended sediments and sediment deposition would occur intermittently throughout the 39 month construction phase.

114. The greatest instantaneous increases in SSC will occur in the immediate vicinity of the construction activities. The extent of the sediment plume and associated deposition will depend on the nature of the sediment. As outlined in section 8.7.1.1, the Marine Scheme is characterised by several sediment types and is mainly dominated by coarser sands and gravels in the Scottish waters, with a southward transition to finer muddy sand sediments in the central and southern English waters. Coarse material would be expected to settle quickly, whereas finer sediments may create a more persistent plume and travel larger distances. It is estimated that SSC could locally increase by tens of thousands of mg/l, in very close proximity to the trench, with the SSC reducing with increasing distance from the disturbance. In Chapter 7: Offshore Physical Environment and Seabed Conditions it was determined that the majority of sediment disturbed (on average over 90%) would settle out in the immediate vicinity of the disturbance within the order of seconds. A smaller proportion of finer sediments (approximately 10%) could be carried in suspension as a plume. Movement of the plume will be related to the mean annual tidal excursion extent, which is approximately 5 km (in one direction and 10 km for both flood and ebb). The sediments within the plume are expected to settle out within a tidal cycle (i.e. after 12 hours), after which the plume will have dissipated.

115. By way of comparison, modelling of SSC was undertaken for the BBWF under the assumption of 25 m width of seabed levelling of an average height of 5 m (BBWFL, 2022). Peak maximum concentrations of 2,500 milligrams per litre (mg/l) were predicted associated with seabed levelling activities. As described in Chapter 7: Offshore Physical Environment and Seabed Conditions, increases in SSC associated with the active deposition phase are not directly quantified for the Marine Scheme activities, but are considered to be several orders of magnitude greater (i.e. over thousands of mg/l) than the background levels of <5 mg/l characteristic to the Marine Scheme. The high instantaneous SSC would reduce quickly with increasing distance from the disturbance, so that by at its widest extent would generally be less than 10 mg/l for both seabed preparations and cable installation.

116. The high SSC would also only be short-lived, on the order of minutes and reduce very quickly with increasing distance from the disturbance site as the sediment quickly dissipates and settles to the seabed. The maximum SSC deposition scenario is associated with seabed levelling by MFE, and this conservatively as the base case for all cable installation activities. As outlined in Chapter 7: Offshore Physical Environment and Seabed Conditions, under an assumed 5 m ejection height for seabed levelling, deposition thicknesses of fine sand of approximately 0.17 m may occur, covering an area of 3.11 km2 across the whole Marine Scheme, of which 0.69 km2 will be within Scottish waters and 2.42 km2 in English waters. Deposition of fine gravel sediments of thicknesses of approximately 0.4 m may occur over an area of 1.49 km2, across the whole Marine Scheme, of which 0.33 km2 is within Scottish waters and 1.16 km2 in English waters. This is also based on flow speeds being 0.4 m/s, as is typical of the Marine Scheme area.

117. The range of deposition thicknesses and extents, as presented in Volume 2, Chapter 7: Physical Environment and Seabed Conditions, is shown in Table 8.17 which covers of the primary sediment types which may occur across the Marine Scheme area. Deposition thickness and extent are inversely correlated; as deposit extent increases, the thickness is reduced. Current speeds will vary across the Marine Scheme and a conservative approach of faster flow speeds, i.e. ranging between 0.2 m/s and 0.6 m/s were applied to the analyses reported in Volume 2, Chapter 7: Offshore

Physical Environment and Seabed Conditions. Depositional extents based on the average speed, 0.4 m/s, are used here for the purposes of assessment of impacts to benthic receptors.

Table 8.17 Deposition extent and thickness associated with seabed levelling activities (undertaken by MFE)

Sediment type	Current speed (m/s)	Ejection height (m)	Deposition thickness (m)	Deposition extent (km^2) (whole Marine Scheme)	Deposition extent (km^2) (Scottish Waters)	Deposition extent (km^2) (English Waters)
Fine gravel	0.4	5	0.4	1.49	0.33	1.16
Coarse sand			0.3	3.09	0.69	2.40
Medium sand			0.3	3.11	0.69	2.42
Fine sand			0.17	3.11	0.69	2.42

118. The maximum design scenario for the installation of the cables assumes installation by MFE with a 2.5 m wide and 3 m deep trench for each cable. The calculation method for cable installation is slightly different to seabed levelling owing to the more rapid rate of MFE for cable installation. Due to the increased movement, the extent of deposition is instead described as distance travelled by sediment in the wake of the MFE equipment. Under the same assumed 5 m ejection height and flow speed parameters, the deposition of fine sand in thicknesses of approximately 0.03 m may occur for extents of up to 200 m in the wake of the installation activity. Deposition of coarser grained sediments (fine gravel) of 0.07 m thickness may occur over comparatively smaller extents of approximately 6.9 m (Table 8.18, and discussed further in Volume 2, Chapter 7: Physical Environment and Seabed Conditions).

Table 8.18 Deposition extent and thickness associated with cable installation (undertaken by MFE)

Sediment type	Current speed (m/s)	Ejection height (m)	Distance travelled (m)	Deposition thickness (m)
Fine gravel	0.4	5	6.9	0.07
Coarse sand			14.3	0.05
Medium sand			40	0.04
Fine sand			200	0.03

119. At the Landfall, seaward of Cambois beach, exit pits will be excavated at a minimum water depth of 10 mLAT. Excavated sediment may be side-cast into berms adjacent to each exit pit, and the impacts from the sediments released are assumed to be similar or less than that associated with trenching (further details available in Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions). As described in Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions, only a very small proportion of the plume may extend to the coast and potentially affect intertidal receptors, with the highest concentration remaining close to the disturbance site at 10 mLAT and deeper. Should the plume extend to the coast in relation to the flow axis, the SSC would be in the order of tens of mg/l, having been dissipated through natural dispersion with the flow. Deposition from the plume extent could therefore result in deposition in

the intertidal, however, this would be only millimetres of deposition that would largely be indiscernible from the background and natural variation.

120. At the Landfall in English waters, up to 10,000 m3 of drilling fluids may be released for five bores (four used and one contingency), resulting in increases of SSC at the release site. As outlined in Volume 2, Chapter 7: Physical Environment and Seabed Conditions, the SSC at the release site will disperse rapidly in the form of a plume with decreasing SSC with distance from the source and solids settling completely within 1.4 hours. The deposition of released drilling fluids will be up to 0.05 m thick in slower current speeds (0.1 m/s) with a plume extent of 500 m. At faster current speeds, associated with the fastest spring flow speeds, the deposition thickness reduces to 0.2 m with a plume that extends over a larger area of 3 km.

121. The depositional thicknesses and extents reported in Table 8.17 and Table 8.18 represent the extent of the possible range of SSC deposition. In reality, deposition will not be uniform and also will be temporary as deposited sediments will be reincorporated into the local sediment transport regime (see Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions). Furthermore, the sediments were found to be relatively uniform across the majority of the Marine Scheme area and representative of the surrounding area (BBWFL, 2022; Natural Power, 2023). Therefore, any deposition associated with disturbed sediments will likely be in keeping with the surrounding seabed. Consequently, the extent of compositional changes to the sediment type will be limited.

122. The resuspension of sediment may result in the release of sediment-bound contaminants, which could have detrimental effects on benthic receptors. As outlined in section 8.7.1.3, the sediment chemistry analyses for the Marine Scheme recorded low concentrations of contaminants (below Cefas AL1 thresholds and Canadian ISQG) across the majority of sampling locations, with the exception of a small number of sampling locations near to shore in proximity to the Port of Blyth with concentrations of arsenic, chromium, nickel that were slightly above Cefas AL1 threshold and/or Canadian ISQG thresholds. PAH and THC concentrations were elevated at stations 2 and 15 in the nearshore area, with individual PAH concentrations exceeding Canadian ISQG thresholds and THC levels exceeded the Cefas AL1 threshold (BBWFL, 2022; Natural Power, 2023). All concentrations were below Cefas AL2 (i.e. the threshold at which concentrations are considered unsuitable for disposal at sea).

123. Sediment bound contaminants are most often associated with sediments of a high fines content, especially clay and silt fractions. As described above, the potential dispersion of sediments is limited, and a rapid dilution of suspended particular matter is anticipated. The elevated contaminants levels were only recorded at sample stations over a short section of the Marine Scheme Offshore Export Cable Corridor in the nearshore area. In the context of natural disturbance of sediment during storm events that will also release sediment-bound contaminants, the potential mobilisation of sediment-bound contaminants during the construction phase of the Marine Scheme are not expected to result in a significant exceedance beyond baseline levels.

124. In Scottish waters, increases in suspended sediments may occur from seabed preparation activities and cable installation works. The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be low.

125. In English waters, increases in suspended sediments may occur from seabed preparation activities, cable installation works and Landfall construction. The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in English waters is therefore considered to be low.

8.12.1.2.2. Sensitivity of the receptor

126. The sensitivity of the key biotopes and species within the Marine Scheme are presented in Volume 4, Figure 8.6. These sensitivities have been assessed in relation to MarESA and FeAST tool pressures and benchmarks, including:

- Changes in suspended solids (water clarity);

- Smothering and siltation rate changes (light, < 5 cm deposition of fine material);
- Smothering and siltation rate changes (heavy, 5 – 30 cm deposition of fine material);
- Transition elements & organo-metal contamination; and
- Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water).

127. The biotopes recorded within the Marine Scheme range from being not sensitive to the MarESA pressures associated with increases in suspended sediments and subsequent deposition to having a medium sensitivity. The sensitivities to the relevant FeAST pressures range from not sensitive to high, and generally, the highest sensitivity for each biotope is associated with heavy smothering and siltation rate changes.

128. Subtidal sands and gravels and subtidal mixed sediments mainly support infaunal communities and to a lesser extent epifaunal crustaceans and echinoderms. These two habitats are assessed as having a low to medium sensitivity to increased suspended solids (water quality) and light or heavy level smothering and siltation according to the MarESA sensitivity assessments. The infaunal communities associated with these biotopes, by their very nature, have a degree of tolerance to short-term increases in suspended solids and low-level sediment deposition (Tillin, 2022). The FeAST tool assesses subtidal sands and gravels as having a high sensitivity to heavy smothering and siltation, depending on the species present. However, considering the results of the MarESA assessments, these biotopes are assessed to have a low vulnerability to this impact. Subtidal sands and gravels, and subtidal mixed sediments are thus deemed to be of low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

129. Mud habitats in deep water are assessed as not being sensitive to changes in suspended solids (water quality) or light smothering and siltation according to the MarESA sensitivity assessments. The sensitivity to heavy smothering and siltation is medium according to MarESA, and high under the FeAST tool. The FeAST tool also assesses the sensitivity of mud habitats in deep water to be high. However, it is noted that this depends on the species present. The mud biotopes representative of this habitat are characterised by burrowing species that have some tolerance to short-term sedimentation events and an ability to migrate upwards through depositions, depending on the cohesiveness of the sediment type (De-Bastos, 2016). Mud habitats are deemed to be of low vulnerability, high recoverability and local to regional value. The sensitivity is therefore considered to be negligible.

130. Aggregations of Sabellaria spinulosa were found in low abundances at a single sample location (station 20) in the BBWF array area and this area was assigned as low potential S. spinulosa reef. Stony / bedrock reef biotopes are assessed as not sensitive to increases in suspended solids (water clarity) and light smothering and siltation changes. Sessile species associated with these habitats, such as bryozoa, hydroids and tube-building polychaetes will be unable to avoid increases in suspended solids and associated deposition. However, some species will be less affected due to their height, which can reach up to 20 cm. Furthermore, these types of habitats are often located in high-energy environments subject to increased sediment transport, and therefore, a degree of tolerance to short-term increases in suspended sediments and subsequent deposition is expected (Stamp and Tyler-Walters, 2016). S. spinulosa reef habitats are not considered to be sensitive to increases in suspended solids or light smothering and siltation. Tube growth is in fact dependent on the presence of suspended particles and a tolerance to short-term periods of sediment deposition is expected with rapid recovery (Jackson and Hiscock, 2008). S. spinulosa reef are assigned a medium sensitivity to heavy smothering and siltation according to MarESA. However, rapid recovery following deposition events would be expected (Tillin et al., 2022).

131. Deposition of SSC may occur over the moderate energy circalittoral rock on the approach to Landfall, constituting rock and stony reef, and the two identified offshore areas of low grade stony reef. As a worst case, if seabed levelling activities occurred in immediate proximity to the these reef features, up to 0.17 m of sediment could be deposited on these features, and 0.07 m could be deposited as a result of cable trenching by MFE. Sandwave clearance activities are unlikely to be required on the approach to Landfall but cannot be ruled out in proximity to the offshore areas of stony reef. The depositional layer may remain for a period of weeks-months before being remobilised and redistributed by a combination of relatively low flow speeds in the area (0.2 to

0.6 m/s), and wave action. Heavy localised deposition would constitute a change to the physical character of the rocky reef biotopes and the inhabiting communities would be unlikely to recover until the sediment was redistributed. However, following mobilisation of the sediment, the biotopes would be expected to recover via recruitment from nearby unaffected habitats, over the course of 2-10 years (Readman, 2016). Stony / bedrock reef, is deemed to be of low vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be low.

132. Seapen and burrowing megafauna communities are assessed as not being sensitive to increased suspended solids (water clarity) and light or heavy smothering or siltation rate changes according to the MarESA sensitivity assessment. However, the FeAST tool considers this feature to have a low sensitivity to light and heavy smothering and a medium sensitivity to siltation rate changes. Species characteristic of this feature occur in deep, sheltered muddy habitats where the accretion rates are potentially high. Only P. phosphorea were recorded during the site-specific survey, and this species can burrow and move into and out of their own burrows. It is probable, therefore, that deposition of 40 cm of fine sediment will have little effect other than to temporarily suspend feeding and the energetic cost of burrowing (Hill et al., 2023). Seapens and burrowing megafauna communities are deemed to be of low vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be low.

133. Ocean quahog are assessed as not being sensitive to increased suspended solids (water clarity) and light or heavy smothering or siltation rate changes according to the MarESA sensitivity assessment. However, the FeAST tool considers ocean quahog to have a high sensitivity to heavy smothering or siltation rate changes. Ocean quahog use inhalant and exhalant siphons at the sediment surface for feeding and respiration, and therefore, may be vulnerable to smothering during periods of heavy sediment deposition. Nevertheless, ocean quahog have been shown to tolerate short-periods of sediment deposition of up to 41 cm in sandy sediments with no adverse effects on population growth or structure (Tyler-Walters and Sabatini, 2017). Ocean quahog are thus deemed to be of negligible vulnerability, low to medium recoverability and national value. The sensitivity is therefore considered to be low.

134. There are no MarESA assessments available for the intertidal biotopes identified during the intertidal walkover surveys (Ocean Ecology, 2023). Therefore, proxy habitats have been used to determine sensitivities to MarESA pressures.

135. All of the proxy intertidal biotopes were assessed as being not sensitive or having a low sensitivity to water clarity changes and light smothering and siltation rate changes. The proxy intertidal biotope for intertidal rock ('Fucus serratus on moderately exposed lower eulittoral rock' LR.MLR.BF.Fser) was assessed as having a high sensitivity to heavy smothering and siltation rate changes, as this may affect the ability of fucoid species to photosynthesis with consequences on growth and survival and reduce the success of Fucus embryos attachment (d'Avack and Gerrard, 2015). However, the MarESA benchmark for the smothering and siltation rage changes (heavy) is defined as up to 30 cm of material in a single discrete event. Such a level of deposition would only be expected through immediate proximity to levelling activities, which is highly unlikely to occur to intertidal receptors, as described in section 8.12.1.2.1. Rather, smothering and siltation changes are expected to be restricted to deposition via dispersal of sediment plumes.

136. Intertidal rock is deemed to be of a low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be low. Intertidal coarse sediment, including areas of potential stony reef, and intertidal sand and muddy sand are both deemed to be of a negligible vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

137. Assessments are not available for the MarESA pressures for contamination from transition elements and organo-metals or hydrocarbon and PAHs for all receptors except seapens and burrowing megafauna, which are assessed to have a high sensitivity to hydrocarbon and PAH contamination and transition elements and organo-metal contamination according to the MarESA pressure, and as being sensitive to hydrocarbon contamination by the FeAST tool (Hill et al., 2023). The FeAST tool assesses continental shelf sands, continental mixed sediments, offshore deep sea muds, burrowed bud and ocean quahog as being 'sensitive' to non-synthetic compound contamination. However, as outlined above, low contaminant levels were reported from the site specific survey (Natural Power, 2023) and the extent of any sediment deposition will be highly

localised. Deposited sediment will generally be in keeping with the surrounding area, and therefore, of a similar quality. Thus, it is anticipated that habitats and species will have some tolerance to small-scale changes in water and sediment quality from natural disturbance of sediment during storm events or periods of strong wave action.

Table 8.19 Key receptor sensitivities to temporary increases in suspended sediments and associated deposition

Receptor	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Changes in suspended solids (water clarity)	Smothering and siltation rate changes (light)	Smothering and siltation rate changes (heavy)	Non-synthetic compound contamination (inc. Heavy metals, hydrocarbons, produced water)	Overall (as defined in section 8.10.2)
Subtidal habitats						
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.Osa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	MarESA: Low FeAST (continental shelf sands): Not sensitive	MarESA: Low FeAST (continental shelf sands): Medium	MarESA: Medium FeAST (continental shelf sands): High	MarESA: Not assessed FeAST (continental shelf sands): Sensitive	Negligible
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	MarESA: Not sensitive to low FeAST (continental mixed sediments): Medium	MarESA: Not sensitive to low FeAST (continental mixed sediments): Not sensitive	MarESA: Low to medium FeAST (continental mixed sediments): Medium	MarESA: Not assessed FeAST (continental mixed sediments): Sensitive	Negligible
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten	MarESA: Not sensitive FeAST (offshore deep sea muds): Not exposed	MarESA: Not sensitive FeAST (offshore deep sea muds): High	MarESA: Medium FeAST (offshore deep sea muds): High	MarESA: Not assessed FeAST (offshore deep sea muds): Sensitive	Negligible

Receptor	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Changes in suspended solids (water clarity)	Smothering and siltation rate changes (light)	Smothering and siltation rate changes (heavy)	Non-synthetic compound contamination (inc. Heavy metals, hydrocarbons, produced water)	Overall (as defined in section 8.10.2)
	• SS.SMu.CSaMu.ThyEten • SS.SMu.OMu • SS.SMu.OMu.PjefThyAfil					
Annex I Reef: Stony/ bedrock	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: Not sensitive	MarESA: Not sensitive	MarESA: Low	MarESA: Not assessed	Low
Annex I Reef: *S. spinulosa* reef	• SS.SBR.PoR.SspiMx	MarESA: Not sensitive	MarESA: Not sensitive	MarESA: Medium	MarESA: Not assessed	Low
Seapens and burrowing megafauna communities	• SS.SMu.CFiMu.SpnMeg	MarESA: Not sensitive FeAST (burrowed mud): Low sensitivity	MarESA: Not sensitive FeAST (burrowed mud): Low sensitivity	MarESA: Not sensitive FeAST (burrowed mud): Medium sensitivity	MarESA: High FeAST (burrowed mud): Sensitive	Low
Ocean quahog	n/a	MarESA: Not sensitive FeAST: Not exposed	MarESA: Not sensitive FeAST: Not sensitive	MarESA: Not sensitive FeAST: High	MarESA: Not assessed FeAST: Sensitive	Low
Intertidal habitats						
Intertidal rock	A1.2 Moderate energy littoral rock[12]	MarESA: Low	MarESA: Low	MarESA: High	MarESA: Not assessed	Low

[12] This biotope is not present in MarESA and therefore the biotope LR.MLR.BF.Fser has been used as a proxy

Receptor	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure				Overall (as defined in section 8.10.2)
		Changes in suspended solids (water clarity)	Smothering and siltation rate changes (light)	Smothering and siltation rate changes (heavy)	Non-synthetic compound contamination (inc. Heavy metals, hydrocarbons, produced water)	
Intertidal coarse sediment	A2.1: Intertidal coarse sediment[13]	MarESA: Not sensitive	MarESA: Not sensitive	MarESA: Not sensitive	MarESA: Not assessed	Negligible
Intertidal sand and muddy sand	A2.2: Intertidal sand and muddy sand[14]	MarESA: Low	MarESA: Not sensitive	MarESA: Low	MarESA: Not assessed	Negligible

[13] This biotope is not present in MarESA and therefore the biotope LS.LCS.Sh.BarSh has been used as a proxy

[14] This biotope is not present in MarESA and therefore the biotopes LS.LSa.MoSa.AmSco and LS.LSa.FiSA.Po have been used as a proxy

8.12.1.2.3. Significance of the effect

138. Overall, the magnitude of the impact in Scottish and English waters is deemed to be low.

139. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be negligible. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

140. The sensitivity for stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna and ocean quahog is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

141. The sensitivity of intertidal rock is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme in English waters, which is not significant in EIA terms.

142. The sensitivity of intertidal coarse sediment and intertidal sand and muddy sand is considered to be negligible. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme in English waters, which is not significant in EIA terms.

143. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of temporary habitat / species loss or disturbance on the protected features of the Firth of Forth Banks Complex ncMPA, the Farnes East MCZ and the Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that, the assessment concluded that there were no significant risks of any increased SSC and associated deposition during the construction phase of the Marine Scheme hindering the achievement of the conservation objectives of these sites.

8.12.1.2.4. Secondary mitigation and residual effect

144. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2. Potential Effects During Operation and Maintenance

8.12.2.1. TEMPORARY HABITAT / SPECIES LOSS AND DISTURBANCE

145. Temporary habitat / species loss and disturbance may result from cable reburial and repair activities during the operation and maintenance phase. As described in section 8.9.1, the maximum design scenario across the Marine Scheme is for cable repair and reburial of up to 4,000 m (i.e. four cable repair and reburial events of up to 1,000 m each) over the operation and maintenance phase (35 years).

8.12.2.1.1. Magnitude of impact

146. The length of cable requiring repair or reburial in each case will be significantly less than the length of cable installed during the construction phase. Therefore, the magnitude of impact is also expected to be significantly lower than during construction. Considering the far reduced scale, the impacts of the operation and maintenance activities (i.e. cable repair and reburial) are predicted to be no greater than those for construction.

147. In Scottish waters, the impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be negligible.

148. In English waters, the impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in English waters is therefore considered to be negligible.

8.12.2.1.2. Sensitivity of the receptor

149. The sensitivity of the benthic receptors is as described previously for the construction phase in section 8.12.1.1 and Table 8.19.

8.12.2.1.3. Significance of the effect

150. Overall, the magnitude of the impact in Scottish and English waters is deemed to be negligible.

151. The sensitivity of subtidal sands and gravels and subtidal mixed sediments is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

152. The sensitivity of mud habitats in deep water, stony / bedrock reef and S. spinulosa reef is considered to be medium. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

153. The sensitivity of seapens and burrowing megafauna and ocean quahog is considered to be high. The effect will, therefore, be of minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

154. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of temporary habitat / species loss or disturbance, resulting from operation and maintenance activities, on the protected features of the Firth of Forth Banks Complex ncMPA, the Farnes East MCZ and the Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that, the assessment concluded that there were no significant risks of any temporary habitat / species loss and disturbance during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of these sites.

8.12.2.1.4. Secondary mitigation and residual effect

155. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.2. INCREASED SSC AND ASSOCIATED SEDIMENT DEPOSITION

156. Cable repair and reburial events may result in short-term increases in suspended sediments during the operation and maintenance phase. As described in section 8.9.1, the maximum design scenario across the Marine Scheme is for cable repair and reburial of up to 4,000 m (i.e. four cable repair and reburial events of up to 1,000 m each) over the operation and maintenance phase (35 years).

157. The increases in suspended sediment may result in a sediment plume in the water column that is then deposited at a distance from the Marine Scheme and impact benthic receptors as described in section 8.12.1.2.1.

8.12.2.2.1. Magnitude of impact

158. As described above for temporary habitat / species loss and disturbance during the operation and maintenance phase, the length of cable requiring repair or reburial in each case will be significantly less than the length of cable installed during the construction phase and the magnitude of impact is expected to be significantly lower than during construction. The sediment plumes and sedimentation footprints would be dependent on which section of the cable is being repaired and thus the sediment type. Considering the far reduced scale the impacts of the operation and maintenance activities (i.e. cable repair and reburial) are predicted to be no greater than those for construction.

159. In Scottish waters, the impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be negligible.

160. In English waters, the impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude in English waters is therefore considered to be negligible.

8.12.2.2.2. Sensitivity of the receptor

161. The sensitivity of the benthic receptors is as described previously for the construction phase in section 8.12.1.2.2 and Table 8.19.

8.12.2.2.3. Significance of the effect

162. Overall, the magnitude of the impact in Scottish and English waters is deemed to be negligible.

163. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be negligible. The effect will, therefore, be of negligible adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

164. The sensitivity for stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna and ocean quahog is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

165. The sensitivity of intertidal rock is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme in English waters, which is not significant in EIA terms.

166. The sensitivity of intertidal coarse sediment and intertidal sand and muddy sand is considered to be negligible. The effect will, therefore, be of negligible adverse significance, for the Marine Scheme in English waters, which is not significant in EIA terms.

167. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of increased SSC and associated sediment deposition on the protection features or any ecological or geomorphological process on which depends the conservation of any protected features of the Firth of Forth Banks Complex ncMPA, the Coquet to St Mary's MCZ and the Farnes East MCZ. Whilst this assessment does not form part of the EIA, it is noted that the assessment concluded that there were no significant risks of any increased SSC and association deposition during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.2.4. Secondary mitigation and residual effect

168. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.3. PERMANENT HABITAT / SPECIES LOSS

169. Permanent habitat loss will arise as a result of the placement of external cable protection, as described within the maximum design scenario (section 8.9.1). Cables will be buried wherever practicable however, where the target burial depth is not achieved, or in areas with cable crossings, cable protection may be required. This represents a localised habitat alteration and physical change to another seabed type. It should be noted that this habitat loss will initially occur during the construction phase however, the effects will continue to be realised through to the operation and maintenance phase.

170. As the Offshore Export Cables will be installed at the Landfall via trenchless techniques, there will be no impact on any intertidal receptors, and therefore, they have not been considered further in this assessment.

171. This impact is consistent along the cable length therefore the following discussion is applicable to both Scottish and English waters.

8.12.2.3.1. Magnitude of impact

172. As described in section 8.9.1, up to 1.46 km2 of cable protection (which includes the placement of rock) will be placed in association with the Marine Scheme as a whole. Of this total, up to 0.23 km2 will be located in Scottish waters and 1.23 km2 in English waters. This impact will be continuous throughout the 35-year operation and maintenance phase.

173. The cable protection requirements across the Marine Scheme have been estimated through an Initial Cable Burial Appraisal. As part of this assessment the Marine Scheme Offshore Export Cable Corridor has been divided into discrete sections for which protection zone categories have been applied, as shown in Volume 4, Figure 8.7.

174. Within Scottish waters, comprising the BBWF array area and the eastern and western branches of the Marine Scheme Offshore Export Cable Corridor, up to 15% of the cable length, equating to a maximum of 6 km per cable, is anticipated to require cable protection.

175. Similarly, within English waters, the eastern and western branches of the Marine Scheme Offshore Export Cable Corridor may require cable protection over a maximum of 15% of the cable length. The cable protection requirements then increase to the south in Zone 5, corresponding to areas of muddier and mixed sediments to a maximum of up to 45%. Further south, cable protection requirements again reduce in Zone 4 to a maximum of 35%, and a maximum of 25% in Zone 3 and Zone 2, corresponding to increased proportions of mud and sand. On the approach to Landfall, Zone 1, up to 35% of the cable length may require cable protection due to the increased presence of hard substrate. It is important to note that the sections of cable protection will not be installed as one section for each zone but instead in discrete and localised locations.

176. Of the 1.23 km2 worst-case footprint for English waters only, 0.05 km2 will be associated with cable protection required at up to five crossing locations. At cable crossings, the height and width of cable protection is assumed to be 2 x 12.5 m.

177. In Scottish waters, permanent habitat loss may result from installation of up to 0.23 km2 of cable protection where burial cannot be achieved. The impact is predicted to be of very local spatial extent in the context of the wider habitat extents, permanent duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low.

178. In English waters, permanent habitat loss will result from installation of up to 1.23 km2 of cable protection where burial cannot be achieved and at crossing locations. The impact is predicted to be of very local spatial extent in the context of the wider habitat extents, permanent duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low.

8.12.2.3.2. Sensitivity of the receptor

179. The sensitivity of the key biotopes and species within the Marine Scheme are presented in Table 8.20. These sensitivities have been assessed in relation to MarESA and FeAST tool pressures and benchmarks, including:

- Physical change to another seabed type.

180. The MarESA and FeAST sensitivity assessments consider the biotopes present in the Marine Scheme as being of a high sensitivity to physical change to another seabed type. In areas of cable protection, there will be damage or loss of infaunal and epifaunal species, along with the substratum beneath. In particular, in soft sediments, such as subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water, benthic organisms living on or near the surface of sediments will not be able to colonise the deposited hard substrate, and there may be a shift to more epifaunal communities. As shown on Volume 4, Figure 8.8, the cable protection requirements are anticipated to be greatest in English offshore waters where muddier biotopes are dominant, associated with the mud habitats in deep water receptor, interspersed with areas of subtidal mixed sediment. The requirement for cable protection is estimated to be lower in areas dominated by

subtidal sand and gravel biotopes, including in the north of the Marine Scheme Offshore Export Cable Corridor and in English territorial waters on the approach to the Landfall. Overall, the small spatial scale of the total long term habitat loss outlined above is not expected to undermine regional ecosystem functions or diminish biodiversity.

181. In areas of rocky habitat, cable protection may offer a similar habitat type to what is already present and there may be some recolonisation by epilithic species via recruitment from adjacent non-affected areas. In these instances, if similar epifaunal communities are present, this would not represent a permanent loss of habitat. However, it is acknowledged that as the composition of artificial hard substratum may differ from natural hard substratum, a change in the epifaunal benthic community may occur, ultimately resulting in a loss of a particular biotope over a highly localised area.

182. Ocean quahog are a burrowing species and the introduction of artificial hard substrate will remove the sedimentary habitat required by this species. However, it is important to highlight that the areas of permanent habitat loss will be highly localised, and that only low numbers of ocean quahog were recorded during the site-specific surveys. Thus, this would not represent a population level impact.

183. Overall, considering the highly localised nature of any discrete areas of permanent habitat loss, the loss is not expected to undermine regional ecosystem functions or diminish biodiversity. There may be highly localised losses of certain biotopes, however, alternative similar biotopes will be present in the wider area.

184. All benthic receptors are deemed to be of high vulnerability, low recoverability and local to national value. The sensitivity is therefore considered to be high.

Table 8.20 Key receptor sensitivities to permanent habitat / species loss

Receptor	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Physical change (to another seabed type)	Overall (as defined in section 8.10.2)
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.Osa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	MarESA: High FeAST (continental shelf sands): High	High
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	MarESA: High FeAST (continental mixed sediments): High	High
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.SMu.OMu	MarESA: High FeAST (offshore deep sea muds): High	High

Receptor	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Physical change (to another seabed type)	Overall (as defined in section 8.10.2)
	• SS.SMu.OMu.PjefThyAfil		
Annex I Reef: Stony / bedrock	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: High	High
Annex I Reef: *Sabellaria spinulosa* reef	• SS.SBR.PoR.SspiMx	MarESA: High	High
Seapens and burrowing megafauna	• SS.SMu.CFiMu.SpnMeg	MarESA: High FeAST (burrowed mud): High	High
Ocean quahog	n/a	MarESA: High FeAST: High	High

8.12.2.3.3. Significance of the effect

185. Overall, the magnitude of the impact in Scottish and English waters is deemed to be low and the sensitivity of the benthic receptors is considered to be high. The effect will, therefore, be of minor to moderate adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms. However, considering the spatial extent of the cumulative projects assessed, the highly conservative area of potential permanent habitat loss which will be minimised as far as practicable, the discrete nature of cable protection placement and the wide spatial distribution of available habitats across the region(s), the effect is considered to be minor adverse, which is not significant in EIA terms.

186. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of permanent habitat / species loss on the protected features of the Firth of Forth Banks Complex ncMPA and the Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that, the assessment concluded that there were no significant risks of any permanent habitat / species loss during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.3.4. Secondary mitigation and residual effect

187. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.4. COLONISATION OF HARD STRUCTURES

188. The introduction of hard infrastructure, such as cable protection, alters previously soft sediment habitat areas. Provision of novel hard substrate can result in colonisation by epilithic species and increases the habitat complexity and biodiversity of the area, as protective materials act as de facto artificial reefs (Degraer et al., 2020). Artificial reefs can also introduce preferred habitats for INNS, and therefore, indirectly facilitate the introduction and spread of INNS by acting as 'ecological stepping stones' (Adams et al., 2014).

189. As the Offshore Export Cables will be installed at the Landfall via trenchless techniques, there will be no impact on any intertidal receptors, and therefore, they have not been considered further in this assessment.

190. The environmental pressures associated with this impact are the same as those associated with long term subtidal habitat loss as the physical change (to another substratum type) pressure

involves the permanent loss of one marine habitat type with an equal creation of a different marine habitat type (Tillin and Tyler-Walters, 2015; 2014a,b). The relevant MarESA and FeAST pressures are therefore:

- Physical change (to another seabed type); and
- Introduction or spread of invasive non-indigenous species.

8.12.2.4.1. Magnitude of impact

191. As described in section 8.9.1, up to 1.46 km2 of cable protection is expected to be situated within the Marine Scheme during the operation and maintenance phase. Up to 0.23 km2 of this total may occur in Scottish waters and up to 1.23 km2 may occur in English waters. This is considered to constitute a negligible spatial extent in comparison to the distribution of the habitat types that characterise the region. This impact will be continuous throughout the 35-year operation and maintenance phase.

192. In areas of soft substrate, the introduction of new hard substrate will represent a shift in baseline conditions and a change in physical seabed type. This may produce some potentially beneficial effects, for example, increases in net-biodiversity and biomass. Monitoring studies at European Offshore Windfarms have recorded the establishment of new faunal communities and species on boulders, mattresses and scour protection (Lindeboom et al., 2011; Krone et al., 2013). The greatest potential effect will likely occur in areas of soft homogenous sediment, where the introduction of hard substrate represents a shift in baseline conditions. As outlined for permanent habitat/species loss in section 155, the areas associated with the greatest cable protection requirements are located in areas interspersed with subtidal mixed sediments and rocky substrate in English waters with lower requirements in sand and dominated sediments. Although the introduction of hard substrate may result in a change in the benthic community, this change will occur over highly localised and discrete areas.

193. De facto artificial reefs resulting from the introduction of new hard substrates may also be colonised by INNS (Adams et al., 2014). The novel habitat provided by external cable protection could play a role in providing stepping-stones for INNS, by which geographical barriers to species dispersal might be passed (Adams et al., 2014). To date, there has been mixed evidence from post-construction monitoring to suggest that hard structures provide new or unique opportunities for INNS which could facilitate their introduction (e.g. Linley et al., 2007). Furthermore, no spread of INNS caused by submarine cabling has yet been documented (Taormina et al., 2018).

194. No INNS were identified in the Benthic Subtidal and Intertidal Ecology Study Area through the BBWF array area or Marine Scheme Offshore Export Cable Corridor surveys (BBWFL, 2023; Volume 3, Appendix 8.1: Benthic Survey Report). Therefore, the risk of the spread of any existing INNS is considered to be low. Furthermore, the risk of spreading newly introduced INNS will be mitigated by minimising the use of cable protection as far as practicable and through the development and implementation of an INNS management plan, as outlined in section 8.11.

195. In Scottish waters, the impact is predicted to be of highly localised spatial extent in the context of the spatial distribution of subtidal sand habitat, permanent duration, continuous and irreversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

196. In English waters, the impact is predicted to be of highly localised spatial extent in the context of the wider habitats across the Marine Scheme and the region, permanent duration, continuous and irreversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

8.12.2.4.2. Sensitivity of the receptor

197. The MarESA and FeAST tool pressures and benchmarks relevant to the colonisation of hard substrates (and the potential increase in INNS) are:

- Physical change (to another seabed type); and
- Introduction or spread of INNS.

198. The sensitivity of the benthic receptors to physical change (to another seabed type) is assessed as high, as described section 8.12.2.3.2. Nevertheless, it is important to note that although the pressure / pathway for permanent habitat loss is the same as colonisation of hard substrate, the nature of the impact differs. Hard substrate will increase the structural complexity in areas of sedimentary biotopes, and these make up the vast majority of the Marine Scheme. This would result in a change in the existing environment, potentially altering predator-prey or competition interactions. Although this may have a beneficial effect in terms of increased biodiversity, as this represents a potential shift in the benthic community, this cannot be assumed.

199. The MarESA sensitivities to the introduction or spread of INNS for the key biotopes and species relevant to the Marine Scheme are presented in Table 8.21. The sensitivities range from not sensitive to high or not relevant. INNS may result in increased competition between non-native species and the community. Several of the subtidal sands and gravel and subtidal mixed biotopes are assessed as having a high sensitivity according to MarESA and FeAST, and this conclusion is mainly in relation to the potential spread of the slipper limpet (Crepidula fornicata) that outcompetes other bivalves across a range of sediments in the North Sea (Tillin and Rayment, 2022). However, in general, due to the mobile nature of this sediment, it is unsuitable for most INNS, consequently reducing the potential spread of INNS. All other biotopes within the Marine Scheme and ocean quahog are assessed as not being sensitive to the introduction of INNS or there is no evidence available.

200. Subtidal sands and gravels and subtidal mixed sediments are deemed to be of medium vulnerability, low recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

201. Mud habitats in deep water are deemed to be of low vulnerability, low recoverability and regional value. The sensitivity of the receptor is therefore, considered to be negligible.

202. Stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna and ocean quahog are deemed to be of low vulnerability, low recoverability and national value. The sensitivity of the receptor is therefore, considered to be low.

Table 8.21 Key receptor sensitivities to introduction of INNS

Habitat / species	Representative biotope(s)	Sensitivity to defined MarESA pressure Introduction or spread of INNS	Overall (as defined in section 8.10.2)
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.OSa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	MarESA: High FeAST (continental shelf sands): Medium	Medium
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx	MarESA: High FeAST (continental mixed sediments): High	Medium

Habitat / species	Representative biotope(s)	Sensitivity to defined MarESA pressure Introduction or spread of INNS	Overall (as defined in section 8.10.2)
	• SS.SMx.OMx.PoVen • SS.SMx.CMx		
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.SMu.OMu • SS.SMu.OMu.PjefThyAfil	MarESA: Not relevant or no evidence FeAST: Not assessed	Negligible
Annex I Reef: Stony / bedrock reef	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: No evidence	Low
Annex I Reef: *Sabellaria spinulosa* reef	• SS.SBR.PoR.SspiMx	MarESA: Not sensitive	Low
Seapens and burrowing megafauna	• SS.SMu.CFiMu.SpnMeg	MarESA: No evidence FeAST (burrowed mud): Not assessed	Low
Ocean quahog	N/A	MarESA: No evidence FeAST: Not assessed	Low

8.12.2.4.3. Significance of the effect

203. Overall, the magnitude of the impact in Scottish and English waters is deemed to be negligible.

204. The sensitivity of subtidal sands and gravels and subtidal mixed sediments is considered to be medium. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

205. The sensitivity of mud habitats in deep water is considered to be negligible. The effect will, therefore, be of negligible adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

206. The sensitivity of stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna, and ocean quahog is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

207. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of colonisation of hard structures on the protected features of the Firth of Forth Banks Complex ncMPA, Farnes East MCZ and Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that, the assessment concluded that there were no significant risks of the colonisation of hard structures during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.4.4. Secondary mitigation and residual effect

208. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.5. EMF EFFECTS

209. The operation of the Offshore Export Cables as outlined in section 8.9.1, will result in emission of localised EMFs. This could potentially affect the sensory mechanisms of certain benthic species.

210. The exposure of benthic organisms to EMF will vary with distance from the cables and will be influenced by distance between cables, cable insulation, and burial depth / cable protection height. As the Offshore Export Cables will be installed at the Landfall via trenchless techniques, there will be no impact on any intertidal receptors, and therefore, they have not been considered further in this assessment.

211. Modelling has been completed for the Marine Scheme on the level and attenuation of the EMF emissions (magnetic fields (i.e. B-fields) only) for both a symmetrical monopole configuration rated at 320 kV and a bipole configuration rated at 525 kV, as detailed in Volume 2, Chapter 5: Project Description. As iE fields are dependent on the B-field strength, B-fields are generally the main focus of potential impacts on the marine environment (Gill and Desender, 2020).

8.12.2.5.1. Magnitude of impact

212. EMF comprise electrical fields (E-fields), measured in volts per metre (V/m), and magnetic fields (B-fields), measured in microtesla (µT). B-fields penetrate most materials and so are emitted into the marine environment which can result in an induced electric field (iE-field). Comparatively, direct E-fields are blocked by conductive sheathing, and are not emitted from the cables. The Earth has its own natural geomagnetic field (GMF), with associated B and iE-fields, which species rely on for navigation (Winklhofer, 2009; Gill and Desender, 2020).

213. In the North Sea, background measurements of the magnetic field are approximately 50 µT, and the naturally occurring electric field in the North Sea is approximately 25 microvolts per metre (µV/m) (Tasker et al., 2010).

214. The strength of B-fields (and iE-fields) decreases rapidly in all directions with distance from the source due to field decay. Consequently, burying a cable results in a reduced B-field at the seabed as a result of field decay with distance from the cable (Nordmandeau et al., 2011; CSA, 2019; Hutchison et al., 2021).

215. B-fields associated with DC cables are higher than those associated with equivalent AC cables because DC cables transmit electricity using a static current (as opposed to alternating) which enables formation of a static EMF. In the case of AC cables, this alternating current results in varying EMF, therefore the B-field is weaker.

216. High level modelling has been completed for the Marine Scheme on the level and attenuation of the EMF emissions (B-fields only) for both a paired symmetrical monopole configuration rated at 320 kV (comprising 4 HVDC cables) and a bipole configuration rated at 525 kV (2 HVDC cables), as detailed in Volume 2, Chapter 5: Project Description.

217. As detailed in section 8.9.1, the maximum EMF strengths are associated with a bipole cable configuration rated at 525 kV. The four cable 320 kV symmetrical monopole configuration resulted in lower EMF strengths, but a wider footprint of elevated EMF levels given the additional two cables. The modelling estimates that:

- For the 525 kV bipole configuration including a pair of HVDC cables separated by 25 m and buried to a minimum depth of 0.5 m, the resulting EMF strength is approximately 658 µT. This is shown to decay with distance to the natural GMF strengths for the Marine Scheme (50 µT) at a distance of between 10-20 m from the cable, both vertically and horizontally and falls below the FeAST tool benchmark (section 8.12.2.5.2) within 10 m of the cables. In reality, it is likely that the cables will be buried to a greater depth than this in some areas with favourable ground conditions, where EMF strengths will dissipate to the GMF even more rapidly.
- For the 320 kV bipole configuration including four HVDC cables, separated by 25 m and buried to a minimum depth of 0.5 m, the resulting EMF strength is approximately 541 µT. This is shown to decay with distance to the natural GMF strength at a distance of between 10-20 m

from the cable, both vertically and horizontally and falls below the FEAST tool benchmark (section 8.12.2.5.2) within 5-10 m of the cables. In reality, it is likely that the cables will be buried to a greater depth than this in some areas with favourable ground conditions, where EMF strengths will dissipate to the GMF even more rapidly.

218. Although the burial of cables and other protective measures such as placement of cable protection are not considered to be effective ways to mitigate EMF effects on marine receptors, burial and cable protection separate the receptors from the cables, therefore reducing the EMF exposure (Copping et al., 2020). In addition, design parameters and installation methods are expected to conform to industry standard specifications, which include shielding technology to reduce the direct emission of EMFs.

219. As noted above, the extent of any increases in EMF associated with the Marine Scheme is very spatially limited and is not expected to result in a widespread effect on baseline conditions. The biotopes and species recorded within the Marine Scheme are considered to be fairly common, and therefore, the localised effects from EMF will only impact a small proportion of the available biotopes in the wider area.

220. In both Scottish and English waters, the impact is considered to be of highly localised spatial extent, long term duration, continuous and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude for the Marine Scheme as a whole is therefore considered to be negligible.

8.12.2.5.2. Sensitivity of the receptor

221. The relevant MarESA pressure for EMF is electromagnetic changes. The MarESA and FeAST tool benchmark for EMF changes is set as a change in the local E-field of 1 V/m or local B-field of 10 µT, due to anthropogenic means. However, no evidence is available in relation to this pressure for any of the biotopes within the Marine Scheme or ocean quahog.

222. Summaries of the current evidence of EMF effects on the marine environment is provided in Gill and Desender (2020) and Hutchison *et al* (2020). Overall, the effects of EMFs on benthic communities are considered to be not well understood and based on a limited number of studies. Recent studies suggest that benthic communities growing along cable routes are similar to those in nearby baseline areas, and where there are differences in species abundance, this is considered to be likely due to the physical presence of the cable and surface properties, rather than an EMF effect (Gill and Desender, 2020). Similarly, a recent review of the effects of EMF on invertebrates reported that no direct impact on individual survival has been identified in the literature (Hervé, 2021).

223. All benthic receptors are deemed to be of low vulnerability, high recoverability and of regional to national value. The sensitivity of all receptors is therefore, considered to be low.

8.12.2.5.3. Significance of the effect

224. Overall, the magnitude of the impact in Scottish and English waters is deemed to be negligible and the sensitivity of all benthic receptors is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

225. The MPA and MCZ Assessment which accompanies this application assesses the potential effects from EMF on the protected features of the Firth of Forth Banks Complex ncMPA and Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that the assessment concluded that there were no significant risks of EMF during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.5.4. Secondary mitigation and residual effect

226. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.6. THERMAL EMISSIONS FROM OPERATIONAL CABLES

227. Power cables in the marine environment generate and dissipate heat. Heat emitted into the sediment from the buried Offshore Export Cables has the potential to directly affect benthic receptors. Water has a high heat capacity, therefore thermal emissions from the Offshore Export Cables will not be able to heat the overlying seawater. Consequently, only sediments along the proposed cable route may be subject to potential heating.

8.12.2.6.1. Magnitude of impact

228. When electricity is transported, a certain amount dissipates as heat energy, potentially increasing the temperature at the cable surface and in the surrounding sediment. There is evidence that this heat (also known as thermal emissions) can occur from high voltage subsea cables and is detectable within the surrounding sediments (Meißner 2006; Taormina et al., 2018). However, Taormina et al. (2018) found that a maximum increase of 2.5°C occurs 50 cm directly below the cable whereas sediment temperature increases above the cables were reduced, due to the increasing influence of the seawater towards the seabed.

229. Emeana et al. (2016) found that heat transfer within sediments was dependent on sediment type, with coarse silts experiencing the greatest temperature change. However, this greatest difference was more localised to the source. In comparison, very coarse sediments had a lower temperature change but were affected over a greater distance. This is due to the increased interstitial space between coarser sediment particles. Considering the nature of the sediments within the Marine Scheme area, it is likely that the increase in temperature within the sediments will be highly localised to the source.

230. Thermal radiation can modify physical and chemical properties of the seabed, result in a development of microorganism communities and/or result in displacement of demersal mobile organism (Taormina et al., 2018). It is expected that the zone of influence from any thermal radiation will be limited to the immediate vicinity of each cable and that heat will dissipate relatively rapidly.

231. The extent of any increases in thermal emissions associated with the Marine Scheme is very spatially limited and is not expected to result in a widespread effect on baseline conditions. The biotopes and species recorded within the Marine Scheme are considered to be fairly common, and therefore, the localised effects from thermal emissions will only impact a small proportion of the available biotopes in the wider area.

232. In Scottish waters, the impact is considered to be of highly localised spatial extent, long term duration, continuous and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be negligible.

233. In English waters, the impact is considered to be of highly localised spatial extent, long term duration, continuous and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude in Scottish waters is therefore considered to be negligible.

8.12.2.6.2. Sensitivity of the Receptor

234. Similar to EMF, there is also a paucity of evidence on the potential effects of thermal emissions on invertebrates. The potential impact on the benthic community is therefore largely unknown (Boehlert & Gill, 2010; Taormina et al. 2018).

235. The relevant MarESA and FeAST tool pressure and benchmark for thermal emissions from operational cables is temperature increase (local). The benchmark for this pressure is a 5°C increase in temperature for one month period, or 2°C for one year. The sensitivity of the key biotopes and species within the Marine Scheme are presented in Table 8.22.

236. Subtidal sands and gravels, subtidal mixed sediments, mud habitats in deep water, stony / bedrock reef and S. spinulosa reef are all assessed as either being not sensitive to this pressure by MarESA or as having a low sensitivity. The FeAST tool assesses subtidal mixed sediments and mud habitats in deep water as having a medium sensitivity to this impact.

237. Subtidal sands and gravels, subtidal mixed sediments and mud habitats in deep water are deemed to be of low vulnerability, high recoverability and of regional value. The sensitivity is therefore considered to be low. Stony / bedrock reef and S. spinulosa reef are deemed to be of low vulnerability, high recoverability and national value. The sensitivity is therefore considered to be low.

238. Seapens and burrowing megafauna are assessed as having a medium sensitivity to temperature increases by MarESA and as having a low sensitivity by the FeAST tool. Seapens are considered to be resistant to long-term changes in temperature of up to 2°C but may be less resistant to temporary increases in temperature of up to 5°C (Hill et al., 2023). As described in section 8.12.2.6.1, available evidence on the highly localised temperature increases associated with operational cables indicates that these will be less than 2.5°C, and therefore, below the upper limit of resistance according to the benchmark for this pressure. Therefore, any seapens and burrowing megafauna in the immediate vicinity of the Offshore Export Cables are considered to have some resistance to the localised increases in temperature associated with the Offshore Export Cables. However, only low numbers of seapens and burrows indicative of this biotope were recorded within the Marine Scheme and thus any such fauna in the immediate vicinity of the Offshore Export Cables would represent a highly localised impact in comparison to disparate but widespread distribution of this biotope and it's available habitat.

239. Seapens and burrowing megafauna are deemed to be of low to medium vulnerability, low recoverability and national value. The sensitivity is therefore considered to be medium.

240. Although limited studies on thermal impacts are available for benthic receptors, there have been studies investigating de-oxygenation impacts on ocean quahog, which are highly tolerant to severe hypoxia and anoxia (Theede *et al.,* 1969, Diaz & Rosenberg, 1995; MarLIN, 2022b). Ocean quahog are assessed as having a medium sensitivity to temperature increases by MarESA and as having a high sensitivity by the FeAST tool. Severe increases in temperature may affect the spawning levels in ocean quahog, but juveniles can survive in temperatures as high as 20°C and adults 16°C (Merrill *et* al., 1969; Cargnelli *et al.,* 1999), far above the temperature increases that would be predicted as a result of the installed cables. Nevertheless, prolonged increases in temperature of up to 2°C may result in mortality and the resilience of this species to significant increases in mortality is low, due to the sporadic and variable nature of recruitment in bivalves (Tyler-Walters and Sabatini, 2017). However, only low numbers of ocean quahog were recorded within the Marine Scheme and the spatial extent of thermal emissions from operational cables during the operation and maintenance phase will be highly localised, particularly in comparison to the wide spatial distribution of this species and their available habitat.

241. Ocean quahog are deemed to be of a high vulnerability, low recoverability and national value. The sensitivity is therefore considered to be medium.

Table 8.22 Key receptor sensitivities to changes in thermal emissions from operational cables

Feature	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Temperatures increase – local	Overall (as defined in section 8.10.2)
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag	MarESA: Low	Low

Feature	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure Temperatures increase – local	Overall (as defined in section 8.10.2)
	• SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.OSa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	FeAST (continental shelf sands): Not assessed	
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	MarESA: Low FeAST (continental mixed sediments): Medium	Low
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.SMu.OMu • SS.SMu.OMu.PjefThyAfil	MarESA: Not sensitive to low FeAST (offshore deep sea muds): Medium	Low
Annex I Reef: Stony / bedrock reef	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: Low	Low
Annex I Reef: *Sabellaria spinulosa reef*	• SS.SBR.PoR.SspiMx	MarESA: Not sensitive	Low
Seapens and burrowing megafauna	• SS.SMu.CFiMu.SpnMeg	MarESA: Medium FeAST (burrowed mud): Low	Medium
Ocean quahog	n/a	MarESA: Medium FeAST: High	Medium

8.12.2.6.3. Significance of the effect

242. Overall, the magnitude of the impact in Scottish and English waters is deemed to be negligible.

243. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

244. The sensitivity for stony / bedrock reef and S. spinulosa reef is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

245. The sensitivity of seapens and burrowing megafauna and ocean quahog is considered to be medium. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

246. The MPA and MCZ Assessment which accompanies this application assesses the potential effects from thermal emissions from operational cables on the protected features of the Firth of Forth Banks Complex ncMPA and Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that the assessment concluded that there were no significant risks of thermal emissions from operational cables during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.6.4. Secondary mitigation and residual effect

247. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.2.7. CHANGES IN PHYSICAL PROCESSES FROM CABLE PROTECTION MEASURES

248. Alteration of seabed habitats may arise from the effects of changes to physical processes, including scour effects and changes in the sediment transport. This can change habitats, exclude some species from the immediate area and attract scour-resistant species. Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions includes details of the predicted changes in physical processes that have been used to inform this assessment.

249. As the Offshore Export Cables will be installed at the Landfall via trenchless techniques, there will be no impact on any intertidal receptors, and therefore, they have not been considered further in this assessment.

250. This impact is consistent along the cable length therefore the following discussion is applicable to both Scottish and English waters.

8.12.2.7.1. Magnitude of impact

251. The maximum design scenario for changes in physical processes from cable protection represents the maximum length, width and height of cable protection, required in areas of unfavourable ground conditions and at four crossing locations, as detailed in section 8.9.1. In Scottish waters, cable protection will be required along 24 km of cable up to a height of 1.5 m and 9.5 m width. In English waters, cable protection will be required along 124.4 km of cable up to a height of 1.5 m and 9.5 m width and also at five cable crossing up to a 200 m length, 2 m height and 12.5 m width per crossing.

252. As concluded in Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions, the presence of remedial cable protection is not predicted to alter water levels downstream of the protection. Therefore, there is no change to flow properties, which is still the case at the shallowest location within the Marine Scheme. With no variation in tidal flow speeds, the sands and gravels that comprise the majority of the seabed sediment across the Marine Scheme would not be disrupted. This evidence indicates that the sediments would not be disrupted by the presence of the remedial protection.

253. Waves observed across the Marine Scheme would exert an almost constant influence on the seabed at the potential shallowest placement of remedial protection, potentially moving coarse grained sediment. As the remedial cable protection would also be a porous structure, the material transported as bedload due to waves could potentially be trapped within the voids of the remedial

protection, meaning the structure could initially act as a localised sink for coarser sediments. With time and as the voids within the remedial protection fills or colonises with benthic communities, sediment previously deposited locally, would bypass, pass through, or overtop the protection. The remedial protection structure is therefore unlikely to cause any hindrance to the transport of coarse sediment in the medium to long-term.

254. The potential for changes to flow, waves and sediment transport are assessed fully in Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions. This assessment concludes that the presence of cable protection on the seabed will not ultimately impact the local wave and tidal regime across the Marine Scheme, and therefore, there will be no onward changes to the sediment transport regime.

255. Based on the applied water depths, the assumed rock size for cable protection and the representative spring and neap flow speeds that occur across the Marine Scheme, the assessment within Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions concludes there will be little to no development of edge scour. With the application of faster flow speeds of around 1 m/s, which are not representative of the Marine Scheme, there potential for edge scour would still be only in the order of centimetres, which would be indiscernible from the natural variation.

256. Overall, with the described potential effect of the protection acting as a localised sink in the short-term and sediment bypassing occurring in the medium to long-term, the potential for edge scour is considered unlikely with respect to the representative environmental conditions characteristic to the Marine Scheme.

257. The impact to benthic receptors is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

8.12.2.7.2. Sensitivity of the receptor

258. The relevant MarESA and FeAST tool pressures and benchmarks for changes in physical processes from cable protection measures include:

- Changes in local water flow (tidal current) / wave exposure (tidal current) changes – local; and
- Local wave exposure changes.

259. The MarESA and FeAST tool sensitivities for the pressures and benchmarks above are presented in Table 8.23. Subtidal mixed sediments, mud habitats in deep water and stony / bedrock and S. spinulosa reef habitats are judged to either be not sensitive or not exposed to the relevant MarESA and FeAST pressures for this impact. According to the FeAST tool, subtidal sands and gravels are judged to have a low sensitivity to wave exposure (tidal current) and subtidal mixed sediments have a low sensitivity to both relevant pressures. However, using MarESA to examine the specific biotopes, all subtidal sands and gravel and subtidal mixed sediments are judged to be not sensitive to both pressures as these biotopes occur in environments subject to naturally strong water flows or wave exposure (Tillin, 2016). Subtidal sands and gravels, subtidal mixed sediments, mud habitats in deep water and stony / bedrock reef and S. spinulosa reef are deemed to be not sensitive and of regional to national value. The sensitivity of the receptor is therefore, considered to be negligible.

260. Seapens and burrowing megafauna are assessed as having a high sensitivity to wave exposure (tidal current) changes according to MarESA and a medium sensitivity to local wave exposure changes and wave exposure (tidal current changes) according to FeAST. The seapens and burrowing megafauna biotope is found in low energy environments and an increase in flow can cause seapens to retract their tentacles and their stalks to retreat into the mud, therefore reducing their ability to feed (Hiscock, 1983). However, it is important to note that negligible changes in flow and waves are predicted to be caused by the Marine Scheme, and thus, the benchmark for this pressure is likely greater than the impact of the Marine Scheme. Seapens and burrowing

megafauna is deemed to be of high vulnerability, low recoverability, and of national value. The sensitivity of this receptor is therefore, considered to be high.

261. Ocean quahog are assessed as having a medium sensitivity to changes in local wave exposure and a low sensitivity to wave exposure (tidal current) changes, according to the FeAST tool. The evidence base behind the FeAST tool assessment for local wave exposure changes states that strong wave action may alter the sediments used by this species for burrowing and damage the inhalant and exhalant siphons to a degree which could compromise feeding success and growth. However, as above for seapens and burrowing megafauna, the benchmark for this pressure is likely greater than the impact of the Marine Scheme. Ocean quahog is deemed to be of low vulnerability, low recoverability and of national value. The sensitivity of this receptor is therefore, considered to be low.

Table 8.23 Key receptor sensitivities to changes in physical processes from cable protection

Feature	Representative biotope(s)	Sensitivity to defined MarESA and FeAST pressure		Overall (as defined in section 8.10.2)
		Changes in local water flow (tidal current) / wave exposure (tidal current) changes – local	Local wave exposure changes	
Subtidal sands and gravels	• SS.SCS.CCS • SS.SSa.IMuSa.FfabMag • SS.SSa.IMuSa • SS.SSa.CFiSa.EpusOborApri • SS.SSa.OSa • SS.SSa.OSa.OfusAfil • SS.SCS.OCS • SS.SSa.CFiSa.ApriBatPo	MarESA: Not sensitive FeAST (continental shelf sands): Low	MarESA: Not sensitive FeAST (continental shelf sands): Not sensitive	Negligible
Subtidal mixed sediments	• SS.SMx.CMx.KurThyMx / • SS.SMx.CMx.MysThyMx • SS.SMx.OMx • SS.SMx.OMx.PoVen • SS.SMx.CMx	MarESA: Not sensitive FeAST (continental mixed sediments): Low	MarESA: Not sensitive FeAST (continental mixed sediments): Low	Negligible
Mud habitats in deep water	• SS.SMu.CSaMu • SS.SMu.CSaMu.AfilKurAnit / SS.SMu.CSaMu.AfilMysAnit • SS.SMu.CSaMu.AfilNten • SS.SMu.CSaMu.ThyEten • SS.SMu.OMu • SS.SMu.OMu.PjefThyAfil	MarESA: Not sensitive FeAST (offshore deep sea muds): Not exposed	MarESA: Not sensitive FeAST (offshore deep sea muds): Not exposed	Negligible
Annex I Reef: Stony / bedrock reef	• CR.MCR • CR.MCR.EcCr.FaAlCr.Flu	MarESA: Not sensitive	MarESA: Not sensitive	Negligible
Annex I Reef: *Sabellaria spinulosa reef*	• SS.SBR.PoR.SspiMx	MarESA: Not sensitive	MarESA: Not sensitive	Negligible
Seapens and burrowing megafauna	• SS.SMu.CFiMu.SpnMeg	MarESA: High	MarESA: Not sensitive	High

Feature	Representative biotope(s)	Sensitivity to defined pressure	MarESA and FeAST	Overall (as defined in section 8.10.2)
		Changes in local water flow (tidal current) / wave exposure (tidal current) changes – local	Local wave exposure changes	
		FeAST (burrowed mud): Medium	FeAST (burrowed mud): Medium	
Ocean quahog	n/a	MarESA: Not sensitive FeAST: Low	MarESA: Not sensitive FeAST: Medium	Low

8.12.2.7.3. Significance of the effect

262. Overall, the magnitude of the impact for Scottish and English waters is deemed to be negligible.

263. The sensitivity of subtidal sands and gravels, subtidal mixed sediments, mud habitats in deep water and stony / bedrock reef and S. spinulosa reef is considered to be negligible. The effect will, therefore, be of negligible adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

264. The sensitivity of seapens and burrowing megafauna is considered to be high. The effect will, therefore, be of minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

265. The sensitivity of ocean quahog is considered to be low. The effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

266. The MPA and MCZ Assessment which accompanies this application assesses the potential effects of changes in physical processes from cable protection measures on the protected features of the Firth of Forth Banks Complex ncMPA and the Coquet to St Mary's MCZ. Whilst this assessment does not form part of the EIA, it is noted that the assessment concluded that there were no significant risks of any changes in physical processes from cable protection measures during the operation and maintenance phase of the Marine Scheme hindering the achievement of the conservation objectives of either of these sites.

8.12.2.7.4. Secondary mitigation and residual effect

267. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.12.3. Potential Effects During Decommissioning

268. At the end of the operation and maintenance phase of the Marine Scheme, the options for decommissioning works will be assessed, taking into consideration constraints (e.g. safety and liability) and the potential environmental impacts associated with decommissioning works.

269. The principal options for decommissioning include:

- Leaving the cable in-situ, trenched;
- Leaving the cable in-situ and providing additional protection;
- Remove sections of the cable that present a risk to other sea users; and

- Remove the cable entirely.

270. Should complete removal of the Offshore Export Cables be required, the significance of effect is considered to result in similar impacts to those assessment as part of the construction phase of the Marine Scheme. Impacts are anticipated to be of similar or lower magnitude to the construction phase (depending on the decommissioning option selected). Complete removal of the Offshore Export Cables represents the most significant adverse effects, and therefore if the other decommissioning options were to be progressed, they would have no more significant adverse effects. Some cable protection may be left in situ as it may not be practical to remove.

271. Overall, the magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be low to high, depending on the impact (see section 8.12.1). The effects during decommissioning will, therefore, range from **negligible to minor adverse significance** to **minor adverse significance**.

8.13. Proposed Mitigation and Monitoring

272. No significant effects on benthic receptors were identified, as such no secondary mitigation or monitoring is proposed.

8.14. Cumulative Effects Assessment

8.14.1. Methodology

273. The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Marine Scheme together with other relevant plans, developments, and activities. Cumulative effects are therefore the complete set of effects arising from the Marine Scheme together with the effects from a number of different developments, on the same receptor or resource. Please see Volume 2, Chapter 3: EIA Methodology for detail on CEA methodology.

274. The developments selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise and the development of a ‘long list’ of cumulative developments relevant to the Marine Scheme (see Volume 3, Appendix 3.2). Each development has been considered on a case by case basis for screening in or out of this Chapter’s assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved, to create the ‘short list’ as summarised in Table 8.24. This approach was agreed during Scoping and further consultation and technical engagement undertaken with consultees, as detailed in Table 8.3.

275. The ‘short list’ has taken into account a 10 km zone of influence around the Marine Scheme to capture potential overlapping maximum tidal excursion extents from the nearby developments. Developments have been considered where there is a spatial overlap with this 10 km zone of influence and a temporal overlap with the Marine Scheme and its programme. For the avoidance of doubt, the ‘short list’ does not include any currently operational developments – these have been considered as part of the baseline characterisation.

276. The specific projects scoped into the CEA for Benthic Subtidal and Intertidal Ecology, are outlined in Table 8.24 and shown on Volume 4, Figure 8.9.

277. It should be noted that the Marine Scheme and the BBWF are both being developed by Berwick Bank Wind Farm Ltd., however they are separate projects and hence BBWF is included in this assessment of cumulative effects.

278. It is appropriate to consider the Landfall area in further detail in the context of the Cambois Connection Onshore Scheme. Based on the maximum design scenario for the Marine Scheme, a trenchless technique, such as HDD, will be deployed to bring the Offshore Export Cables ashore via ducts that will be installed from a point landward of MHWS to an exit point at least 250 m seaward of MLWS, thus completely bypassing the intertidal area. All construction works and

infrastructure associated with the Onshore Scheme will be above MHWS, and landward of the dune system on Cambois beach, and therefore there is no potential for any interaction with the intertidal area. Given there will be no construction works associated with the Onshore Scheme within the intertidal area, there is no potential for any direct effects on intertidal species. Therefore, the Onshore Scheme is not considered further within this CEA. Further detail on the Onshore Scheme is provided in Volume 2, Chapter 5 Project Description.

Table 8.24 List of other developments considered within the CEA for Benthic Subtidal and Intertidal Ecology

Development/Plan	Status	Distance from Benthic Subtidal and Intertidal Ecology Study Area (km)	Description of Development /Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Marine Scheme
BBWF	In planning	0	Offshore wind farm	2025 – 2033	2033 onward (35 year operational life)	Construction phase of Marine Scheme overlaps with development's timeline and spatially. O&M phases will also overlap
Eastern Green Link 1	In planning	0	Transmission infrastructure	2024 to 2027	2027 onward (50 year operational life)	Construction phase of Marine Scheme overlaps with development's timeline and spatially. O&M phases will also overlap
Blyth Demonstration Phase 2 (&3) Cable Corridor	Consented	0	Transmission infrastructure	Completed by 2025	Assumed to be consistent with Blyth Demonstrator Offshore Wind Farm – Phase 2	Construction phase of Marine Scheme overlaps with O&M phase of the development. O&M phases will overlap.
Blyth Demonstrator Offshore Wind Farm – Phase 2	Consented	1	Offshore wind farm	Completed by 2025	Current lease secured until 2050	Construction phase of Marine Scheme overlaps with the O&M phase of the development. O&M phases will overlap.
Eastern Green Link 2	In planning	3	Transmission infrastructure	2026 to 2029	2029 onward (~40 year operational life)	Construction phase of Marine Scheme overlaps with development timeline. O&M phases will overlap.
Seagreen 1	Under construction	5	Offshore wind farm	2022 to 2023	25 year operational life	O&M phases will overlap.
Inch Cape Offshore Wind Farm	Consented	8	Offshore windfarm	2022 to 2025	50 year operational life	O&M phases will overlap.
Inch Cape and OFTO	Consented – pending variation	10	Transmission infrastructure	2022 to 2025	50 year operational life	O&M phases will overlap.

8.14.2. Cumulative Effects Assessment

279. An assessment of the likely significance of the cumulative effects of the Marine Scheme, together with other relevant plans, projects, developments and activities upon benthic receptors arising from each identified impact is given below.

280. An assessment of the cumulative effects upon ncMPA and MCZ designated feature receptors is provided in the ncMPA / MCZ Assessment which accompanies this application.

281. It is not possible to provide separate assessments for Scottish and English waters, as this level of granularity is not provided for the cumulative developments that span across these two jurisdictions (e.g. Eastern Green Link 1 and 2). Therefore, the CEA here pertains to the Marine Scheme as a whole, unless otherwise stated.

8.14.2.1. POTENTIAL EFFECTS DURING CONSTRUCTION

8.14.2.1.1. Temporary habitat / species loss and disturbance

282. All developments listed in Table 8.24 which met the CEA criteria may result in some temporary habitat and species loss and/or disturbance. These developments have been considered cumulatively in the following sections.

8.14.2.1.1.1. Magnitude of impact

283. The area of temporary habitat loss associated with the construction phase of the Marine Scheme and the five cumulative developments with construction phases that overlap the Marine Scheme is quantified as 155.97 km^2, as detailed in Table 8.25. The construction of Seagreen 1, the Inch Cape Wind Farm, Blyth Demonstrator Offshore Wind Farm - Phase 2 and Blyth Demonstration Phase 2 (&3) Cable Corridor developments will have ceased when the Marine Scheme construction commences. Therefore, the cumulative habitat loss associated with Seagreen 1 and Inch Cape Wind Farm, Blyth Demonstrator Offshore Wind Farm - Phase 2, and Blyth Demonstration Phase 2 (&3) Cable Corridor with the Marine Scheme is considered within the assessment of permanent habitat / species loss.

Table 8.25 Area of cumulative temporary habitat loss

Development	Location	Area of temporary habitat loss (km^2)	Source
Marine Scheme	Scottish and English waters	18	Section 8.9.1
BBWF	Scottish waters	113.97	SSE Renewables (2022)
Eastern Green Link 1	Scottish and English waters	8.8	National Grid and Scottish Power (2022)
Eastern Green Link 2	Scottish and English waters	15.2	National Grid and SSEN (2022)
Total		**155.97 km^2**	

284. The cumulative project with the greatest extent of spatial and temporal overlap is the BBWF, given that the Marine Scheme wholly overlaps the BBWF array area and that construction activities in the BBWF array area are expected to occur between 2025 and 2033. Therefore, there is potential for temporary habitat loss and disturbance resulting from activities associated with the BBWF such as seabed preparation, foundation installation (for turbines and OSPs/OCSPs), and cable installation (inter array, interconnector and export cables) to occur at the same time as installation of the Marine Scheme. As a worst-case, up to 160 km of the Offshore Export Cables could be located in Scottish waters and thus be installed within the BBWF array area, equating to 4 km^2 of temporary

disturbance. On a precautionary basis, this would assume the same area is subjected to temporary disturbance from both BBWF and the Marine Scheme.

285. Overall, with the exception of disturbance associated with BBWF, the areas of temporary habitat loss for the other projects included in Table 8.25 above are unlikely to temporally coincide with Marine Scheme activities. Construction timelines occur over a number of years when activity will be occurring across a wide area therefore the potential for activities to coincide is limited. Regarding temporary habitat disturbance within the BBWF array area, given the Marine Scheme cable installation activities will continually progress along the lengths of the Export Cable Corridor, the duration of the habitat disturbance within the BBWF array area will be limited both in the context of the wider construction timelines and the spatial extent of the area of habitat loss or disturbance associated with the Marine Scheme which will only affect a highly localised and discrete part of the wider BBWF array area.

286. The scale of the developments in Table 8.25 is not necessarily equivalent to the Marine Scheme. For example, the Eastern Green Link 2 development involves installation of three cables (two HVDC and one fibre optic), each approximately 436 km in length. The area of temporary habitat loss associated with this development proximal to the Marine Scheme will be proportionately a much smaller area (and not the total of 15.2 km2).

287. Additionally, the habitat types disturbed by other developments will not all be the same as those within the Marine Scheme. Therefore, the area of temporary habitat and species disturbance or loss is small in the context of the wider available habitat throughout the North Sea. Furthermore, as described in section 8.7, the subtidal sediments present in the Marine Scheme are considered to be consistent with the wider area in which the cumulative developments will be located, and would be expected to show a degree of recovery following disturbance impacts.

288. The cumulative impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low for the whole Marine Scheme.

8.14.2.1.1.2. Sensitivity of receptor

289. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 8.12.1.1.2. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

290. Subtidal sands and gravels and subtidal mixed sediments are deemed to be of low vulnerability, low to medium recoverability and regional value. The sensitivity is therefore considered to be low.

291. Mud habitats in deep water are deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity is therefore considered to be medium.

292. Stony / bedrock reef habitats are deemed to be of medium vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be medium.

293. S. spinulosa reef are deemed to be of a high vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be high.

294. Seapens and burrowing megafauna and ocean quahog are deemed to be of a high vulnerability, low recoverability and national value. The sensitivity is therefore considered to be high.

8.14.2.1.1.3. Significance of effect

295. Overall, the magnitude of the cumulative impact is deemed to be low for the whole Marine Scheme.

296. The sensitivity of subtidal sands and gravels and subtidal mixed sediments is considered to be low. The cumulative effect will therefore be of **negligible to minor adverse significance** which is not significant in EIA terms.

297. The sensitivity of mud habitats in deep water and stony / bedrock reefs is considered to be medium. The cumulative effect will therefore be of minor adverse significance which is not significant in EIA terms.

298. The sensitivity of *S. spinulosa* reef, seapens and burrowing megafauna and ocean quahog is considered to be high. The cumulative effect will therefore be of minor to moderate significance, according to the assessment matrix provided in Table 8.13. However, similarly to the assessment of significance for the Marine Scheme alone in section 8.12.1.1.3, based on expert judgement, the final significance is considered to be **minor adverse significance** due to the low extents of these biotopes within the Marine Scheme and the widespread distribution of available habitat in this region.

8.14.2.1.1.4. Secondary mitigation and residual effect

299. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.1.2. Increased SSC and associated sediment deposition

300. All developments listed in Table 8.24 which met the CEA criteria may result in some temporary increases in SSC and subsequent sediment deposition and the potential resuspension of contaminants. These developments have been considered cumulatively in the following sections.

8.14.2.1.2.1. Magnitude of impact

301. The assessment of temporary increases in SSC and associated deposition for the Marine Scheme alone is provided in section 8.12.1.2.3. Overall, it is anticipated that the sediment plume will remain within the extent of a tidal ellipse (around 2.5 km), and that the plume will settle within a tidal cycle (i.e. after 12 hours), as per Volume 2, Chapter 7: Offshore Physical Environment and Seabed Conditions. The extent of sediment deposition from seabed levelling will occur over a maximum area of 1.24 km2 and the maximum extent of significant sediment deposition in the wake of installation activity is 200 m. Therefore, the extent of deposited sediment is very small.

302. At the Landfall, up to 10,000 m3 of drilling fluids may be released for five bores (four used and one spare), but these are expected to disperse rapidly on the tide due to the same processes which will disperse the suspended sediments created by the Marine Scheme. The plume would remain within 3 km and settle out within 1.4 hours.

303. The Blyth Demonstration Phase 2 windfarm, Blyth Demonstration Phase 2 (&3) Cable Corridor, Seagreen 1 and Inch Cape Wind Farm and OFTO developments will be operational at the time of Marine Scheme construction. The construction phase of the Marine Scheme may overlap with that of BBWF, and the Eastern Green Link 1 and Eastern Green Link 2 cables. As the cumulative developments with construction phases that overlap with the Marine Scheme are located further offshore (approximately 10 nm for Eastern Green Link 1), there is a very limited potential for cumulative impacts on intertidal receptors within English waters or any potential interaction with the SSC and associated deposition from the release of drilling fluids at the landfall.

304. As discussed previously, the cumulative project with the maximum extent of temporal and spatial overlap is the BBWF, given that the Marine Scheme wholly overlaps with the BBWF array area boundary and construction programmes also overlap. Based on the information presented in the BBWF EIA, seabed preparation and construction activities including foundation installation (for turbines and OSPs/OCSPs) and installation of inter-array, interconnector and export cable, will result in increased SSCs.

305. Suspended sediment modelling was undertaken for BBWF. The modelling determined that the SSC would be highest in the immediate vicinity of the activity. For instance, releases associated with wind turbine generator drilling showed the SSC within the plume was less than 5 mg/l and dropped to even lower levels within a very short distance, typically less than 500 m. Plumes dissipated within a few tidal cycles (BBWFL, 2022).

306. For cable installation as part of BBWF, a comparable activity to those associated with the Marine Scheme, the BBWF modelling outputs indicated average SSC along the route ranged between 50 mg/l and 500 mg/l. Associated average sedimentation peaks at 0.5 mm to 1.0 mm. One day after cessation of operations this maximum increased to 10-30 mm. However, it was noted that this deposition only accounts for a very small area and deposition thicknesses are considerably reduced with distance from the location of cable installation (BBWFL, 2022).

307. The supporting environmental documentation for the Eastern Green Link 1 development predicted a maximum extent of SSC (i.e. a plume) would reach 1.4 km from the site of disturbance. Comparatively, coarse sand (typical of the majority of the sediments along the development cable route), were expected to travel up to 200 m. Additionally, the environmental appraisal report anticipated that measurable change in SSC will be limited to the bottom 5 m of the water column (National Grid and Scottish Power, 2022).

308. The supporting environmental documentation for the Eastern Green Link 2 development predicted that most sediment types would settle within approximately 1.5 km from the point of disturbance. The exception to this is fine silts (which form a very small proportion of the sediment at the Eastern Green 2 locations) which may remain in suspension for several days, settling on the seabed at up to 4.3 km from the point of disturbance. Therefore, the environmental appraisal report concludes that there will be no significant increases in SSC at a distance beyond 1.5 km (National Grid and SSEN, 2022).

309. Equivalent information is not available for the Blyth Demonstrator Offshore Wind Farm - Phase 2 and the Blyth Demonstration Phase 2 (&3) Cable Corridor developments. However, it can be assumed that the impact from these developments would be less than, or equal to, the BBWF outputs.

310. As the BBWF findings indicate, suspended sediment is readily reincorporated to the local sediment transport regime (over the course of a few tidal cycles; BBWFL, 2022). With the exception of BBWF, cumulatively, it is unlikely that there will be considerable spatial or temporal overlap between the Marine Scheme and these other developments that would result in elevated cumulative SSC.

311. Should activities coincide between multiple developments, as is likely between the Marine Scheme and BBWF, elevated SSC will last a matter of hours to days. Deposition thicknesses associated with increased SSC as part of BBWF in combination with the Marine Scheme will be on the scale of centimetres and will generally be highly localised to the site of disturbance.

312. Overall, it is considered that cumulatively, it is unlikely that there will be considerable temporal overlap between the increased SSC from the Marine Scheme and other developments that would significantly elevate SSC and subsequent deposition levels. If activities were to coincide between multiple developments, the impacts will be highly localised, as outline above, and last a matter of hours to days.

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

8.14.2.1.2.2. Sensitivity of receptor

314. The sensitivities of benthic receptors are detailed in section 8.12.1.2.2. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

315. Subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water are deemed to be of low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

316. Stony / bedrock reef, S. spinulosa reef, and seapens and burrowing megafauna are deemed to be of low vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be low.

317. Ocean quahog are deemed to be of negligible vulnerability, low to medium recoverability and national value. The sensitivity is therefore considered to be low.

318. Intertidal rock is deemed to be of a low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be low.

319. Intertidal coarse sediment and intertidal sand and muddy sand are both deemed to be of a negligible vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

8.14.2.1.2.3. Significance of effect

320. Overall, the magnitude of the cumulative impact is deemed to be low for the whole Marine Scheme.

321. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be negligible. The cumulative effect will, therefore, be of negligible to minor adverse significance, which is not significant in EIA terms.

322. The sensitivity for stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna and ocean quahog is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, which is not significant in EIA terms.

323. The sensitivity of intertidal rock is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, which is not significant in EIA terms.

324. The sensitivity of intertidal coarse sediment and intertidal sand and muddy sand is considered to be negligible. The cumulative effect will, therefore, be of **negligible to minor adverse significance**, which is not significant in EIA terms.

8.14.2.1.2.4. Secondary mitigation and residual effect

325. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2. POTENTIAL EFFECTS DURING OPERATION AND MAINTENANCE

8.14.2.2.1. Temporary habitat / species loss and disturbance

326. All developments listed in Table 8.24 which met the CEA criteria may result in some temporary habitat / species loss and disturbance during the operation and maintenance phase of the Marine Scheme. These developments have been considered cumulatively in the following sections.

8.14.2.2.1.1. Magnitude of impact

327. All cumulative developments listed in Table 8.24 will be operational during the operation and maintenance phase of the Marine Scheme. Any temporary habitat / species loss and disturbance will be spatially and temporarily limited, and therefore, cumulative effects from these developments are anticipated to be lesser than those assessed for the construction phase.

328. The cumulative project with the greatest extent of temporal and spatial overlap is the BBWF, given that both the Marine Scheme wholly overlaps with the array area boundary. Construction activities in the BBWF array area are expected to occur between 2025 and 2032 and therefore will overlap with the Marine Scheme. It is therefore likely that there will be temporary habitat loss resulting from activities associated with the BBWF, such as seabed preparation including seabed levelling, foundation installation (for turbines and OSPs/OCSPs), installation of inter array cables, interconnector cables and export cables (connecting to the Branxton landfall).

329. The cumulative impact of temporary species/ habitat loss and disturbance is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

8.14.2.2.1.2. Sensitivity of the receptor

330. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 8.12.1.1. The sensitivities provided below are consistent with the sensitivities assessed for the Marine Scheme alone.

331. Subtidal sands and gravels and subtidal mixed sediments are deemed to be of low vulnerability, low to medium recoverability and regional value. The sensitivity is therefore considered to be low.

332. Mud habitats in deep water are deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity is therefore considered to be medium.

333. Stony/reef habitats and S. spinulosa reef are deemed to be of medium vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be medium.

334. Seapens and burrowing megafauna communities, and ocean quahog are deemed to be of a high vulnerability, low recoverability and national value. The sensitivity is therefore considered to be high.

8.14.2.2.1.3. Significance of the effect

335. Overall, the magnitude of the cumulative effect is deemed to be negligible.

336. The sensitivity for subtidal sands and gravels and subtidal mixed sediments is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

337. The sensitivity for mud habitats in deep water, stony / bedrock reef and S. spinulosa reef is considered to be medium. The cumulative effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

338. The sensitivity for seapens and burrowing megafauna and ocean quahog is considered to be high. The cumulative effect will, therefore, be of **minor adverse significance**, for the Marine Scheme as a whole, which is not significant in EIA terms.

8.14.2.2.1.4. Secondary mitigation and residual effect

339. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2.2. Increased SSC and associated sediment deposition

340. All developments listed in Table 8.24 which met the CEA criteria may result in some temporary increases in SSC and subsequent deposition during the operation and maintenance phase of the Marine Scheme. These developments have been considered cumulatively in the following sections.

8.14.2.2.2.1. Magnitude of impact

341. All cumulative developments listed in Table 8.24 will be operational phase during the operation and maintenance phase of the Marine Scheme. Any increases in SSC will be spatially and temporarily limited, and therefore, cumulative effects from these developments are anticipated to be lesser than those assessed for the construction phase.

342. The cumulative impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

8.14.2.2.2.2. Sensitivity of receptor

343. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 8.12.2.2.2. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

344. Subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water are deemed to be of low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

345. Stony / bedrock reef, S. spinulosa reef and seapens and burrowing megafauna are deemed to be of low vulnerability, medium recoverability and national value. The sensitivity is therefore considered to be low.

346. Ocean quahog are deemed to be of negligible vulnerability, low to medium recoverability and national value. The sensitivity is therefore considered to be low.

347. Intertidal rock is deemed to be of a low vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be low.

348. Intertidal coarse sediment and intertidal sand and muddy sand are both deemed to be of a negligible vulnerability, high recoverability and regional value. The sensitivity is therefore considered to be negligible.

8.14.2.2.2.3. Significance of effect

349. Overall, the magnitude of the cumulative effect is deemed to be negligible.

350. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be negligible. The cumulative effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

351. The sensitivity for stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna and ocean quahog is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, which is not significant in EIA terms.

352. The sensitivity of intertidal rock is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, which is not significant in EIA terms.

353. The sensitivity of intertidal coarse sediment and intertidal sand and muddy sand is considered to be negligible. The cumulative effect within English waters will, therefore, be of **negligible adverse significance**, which is not significant in EIA terms.

8.14.2.2.2.4. Secondary mitigation and residual effect

354. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2.3. Permanent habitat / species loss

355. All developments listed in Table 8.24 which met the CEA criteria may result in some permanent habitat and species loss and/or disturbance. These developments have been considered cumulatively in the following sections.

8.14.2.2.3.1. Magnitude of impact

356. The area of permanent habitat loss associated with the Marine Scheme and the seven other developments has been quantified as 16.75 km^2, as detailed in Table 8.26. It is important to note that the areas are likely worst-case estimates which have been used in the respective environmental assessment processes. Therefore, these areas are likely to be overestimates.

357. The area of permanent habitat loss associated with the Blyth Demonstration Phase 2 (&3) Cable Corridor is unknown. However, given the cable is proportionally much shorter than the Marine Scheme (approximately 10 km), it is assumed that the quantity of rock protection required will be comparatively considerably smaller.

Table 8.26 Area of cumulative permanent habitat loss

Development	Location	Area of permanent habitat loss (km^2)	Source
Marine Scheme	Scottish and English waters	1.46	Section 8.9.1
BBWF	Scottish waters	7.80	SSE Renewables (2022)
Eastern Green Link 1	Scottish and English waters	0.73	National Grid and Scottish Power (2022)
Blyth Demonstrator Offshore Wind Farm – Phase 2	English waters	0.06	EDF Renewables (2020)
Blyth Demonstration Phase 2 (&3) Cable Corridor	English waters	Unknown	EDF Renewables (2020)
Eastern Green Link 2	Scottish and English waters	2.0	National Grid and SSEN (2022)
Seagreen 1	Scottish waters	2.23	Seagreen (2012)
Inch Cape Wind Farm and OFTO	Scottish waters	2.47	Inch Cape Offshore Limited (2011)
Total		**16.75 km^2**	

358. The northern part of the Marine Scheme wholly overlaps with the BBWF array area. Therefore, both projects will overlap spatially for the duration of their operational period (35 years). With regard to permanent habitat loss, where additional cable protection is required along sections of the Marine Scheme Offshore Export Cables occurring within the BBWF array area, this will contribute to habitat loss associated with the presence of wind farm infrastructure e.g. foundations, scour protection, and any additional protection e.g. rock required along the inter-array cables, interconnector cables and the Branxton export cables.

359. It was identified in the BBWF EIA (BBWFL (2022), that the presence of wind farm infrastructure and additional cable protection could lead to long term habitat loss of up to 7.8 km2. It was concluded that potential effects on benthic receptors would be minor. Considered cumulatively with the Marine Scheme, the total cumulative habitat loss would represent only a small proportion of habitat in the benthic and intertidal ecology study area.

360. As for the Marine Scheme, it is unlikely that areas of external protection will be continuous in the same area, as only discrete sections of cable are likely to require protection. Therefore, the quantity of hard substrate likely to coincide with the cumulative zone of influence will be much smaller than what is reported in Table 8.26. Given the variation in seabed habitats and substrate types throughout the North Sea, it is unlikely that the cumulative permanent habitat loss resulting from the Marine Scheme and the other developments detailed in Table 8.26.

361. Furthermore, given the variation in biotopes and substrate types throughout the North Sea, it is unlikely that these rock quantities will all affect the same habitat types. Overall, the area of habitat loss is very small in the context of the wider available habitat. The cumulative impact is predicted to be of local spatial extent in the context of the wider habitat extents, permanent duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

8.14.2.2.3.2. Sensitivity of receptor

362. The sensitivities of benthic receptors are detailed in section 8.12.2.3.2. The sensitivity for the cumulative effects assessment is consistent with the sensitivities for the Marine Scheme alone. All

benthic receptors are deemed to be of high vulnerability, low recoverability and regional to national value. The sensitivity is therefore considered to be high.

8.14.2.2.3.3. Significance of effect

363. Overall, the magnitude of the cumulative effect is deemed to be low and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor to moderate adverse significance**, which is not significant in EIA terms. However, considering the spatial extent of the cumulative projects assessed, the highly conservative area of potential habitat loss which will be minimised as far as practicable, the discrete nature of cable protection placement and the wide spatial distribution of available habitats across the region(s), the cumulative effect is considered to be **minor adverse**, which is not significant in EIA terms.

8.14.2.2.3.4. Secondary mitigation and residual effect

364. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2.4. Colonisation of hard structures

365. All developments listed in Table 8.24 which met the CEA criteria may introduce additional hard substratum which may be colonised by benthic organisms. These developments have been considered cumulatively in the following sections.

8.14.2.2.4.1. Magnitude of impact

366. As described in Table 8.26 the Marine Scheme and the other seven developments considered for the CEA may result in 16.75 km2 of permanent habitat creation. For the BBWF, Blyth Demonstrator Offshore Wind Farm – Phase 2 and Seagreen 1, colonisation of hard substrate may result from wind turbine generator foundations, offshore substation foundations (if required), scour protection and cable protection. For Eastern Green Link 1, Eastern Green Link, the Blyth Demonstration Phase 2 (&3) Cable Corridor and the Inch Cape Offshore Wind Farm and OFTO, colonisation of hard substrate may result from cable protection presence only.

367. As noted for cumulative permanent habitat / species loss, areas of hard substrate are expected to be in discrete areas and the area within the cumulative zone of influence for the Marine Scheme will be significantly less than the total of 16.75 km2.

368. The cumulative impact is predicted to be of highly localised, discrete spatial extents in the context of the widespread distribution of softer sediment habitats, permanent duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

8.14.2.2.4.2. Sensitivity of receptor

369. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 8.12.2.4.2.

370. Subtidal sands and gravels and subtidal mixed sediments are deemed to be of medium vulnerability, low recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

371. Mud habitats in deep water are deemed to be of low vulnerability, low recoverability and regional value. The sensitivity of the receptor is therefore, considered to be negligible.

372. Stony / bedrock reef, *S. spinulosa* reef, seapens and burrowing megafauna, and ocean quahog are deemed to be of low vulnerability, low recoverability and national value. The sensitivity of the receptor is therefore, considered to be low.

8.14.2.2.4.3. Significance of effect

373. Overall, the magnitude of the cumulative effect is deemed to be low.

374. The sensitivity of subtidal sands and gravels and subtidal mixed sediments is considered to be medium. The cumulative effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.

375. The sensitivity of mud habitats in deep water is considered to be negligible. The cumulative effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

376. The sensitivity of stony / bedrock reef, S. spinulosa reef, seapens and burrowing megafauna, and ocean quahog is considered to be low. The cumulative effect will, therefore, be of **negligible to minor adverse significance**, which is not significant in EIA terms.

8.14.2.2.4.4. Secondary mitigation and residual effect

377. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2.5. EMF effects

378. All developments listed in Table 8.24 which met the CEA criteria may result in localised increases in EMF. These developments have been considered cumulatively in the following sections.

8.14.2.2.5.1. Magnitude of impact

379. Cables within the BBWF boundary and associated with the Blyth Demonstration development will be buried as far as practicable. The BBWF development assumes a minimum burial depth of 0.5 m (BBWFL, 2022) and the worst-case assumption for the Blyth Demonstration development is stated as 1 m (Narec, 2013). For the Eastern Green Link 1 and Eastern Green Link 2 transmission infrastructure, the minimum target burial depth is quoted as 0.6 m (National Grid and Scottish Power, 2022 & National Grid and SHE Transmission, 2022). Given these burial depths and the use of cable protection measures where cable crossings are required, EMF levels are anticipated to remain as being highly localised.

380. While the length of some cables, for instance Eastern Green Link 2 at 436 km, is considerably longer than the Marine Scheme, the impacts along the cables will be diffuse and limited to the immediate vicinity of the cable in question. Consequently, the potential for cumulative EMF effects is limited to areas where the Marine Scheme directly overlaps with other cables.

381. Given the overlap with the BBWF array area, it is likely that the Marine Scheme Offshore Export Cables and BBWF cables (inter array, interconnector and export) will be in close proximity for this section of the Marine Scheme, however it is assumed that there will not be any crossings of the BBWF cables. While there is potential for some cumulative impact between the Marine Scheme and BBWF, the extent of EMF effects will be within close proximity of the source, likely within 10-20 m prior to decaying to natural GMF (as is the case for the Marine Scheme; section 208). Therefore, even when other development cables are in close proximity to the Marine Scheme the extent of impact is limited. Consequently, the magnitude of impact is considered to be the same as for the Marine Scheme assessment alone.

382. The cumulative impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

8.14.2.2.5.2. Sensitivity of receptor

383. The sensitivities of benthic receptors are detailed in section 8.12.2.5.2. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

384. All Benthic Subtidal and Intertidal Ecology receptors are deemed to be not sensitive and of regional to national value. The sensitivity of the receptor is therefore, considered to be negligible.

8.14.2.2.5.3. Significance of effect

385. Overall, the magnitude of the cumulative effect is deemed to be negligible and the sensitivity of all Benthic Subtidal and Intertidal Ecology receptors is considered to be negligible. The cumulative effect will, therefore, be of **negligible adverse significance**, which is not significant in EIA terms.

8.14.2.2.5.4. Secondary mitigation and residual effect

386. No Benthic Subtidal and Intertidal Ecology secondary mitigation is considered necessary because the likely cumulative effect in the absence of secondary mitigation is not significant in EIA terms.

8.14.2.2.6. Thermal emissions from operational cables

387. Owing to the nature of the impact, developments which may act cumulatively with the Marine Scheme are BBWF, Eastern Green Link 1, and the export cable associated with the Blyth Demonstration Phase 2 (&3) development due to the spatial overlap of these developments within the Marine Scheme and the possibility for operational timelines to coincide.

8.14.2.2.6.1. Magnitude of impact

388. Thermal emissions from operational cables are expected to be highly localised (section 226). The three developments which may result in cumulative impact are assumed to be buried as far as practicable or adequately protected. Considering the high heat capacity of water and the depth of burial proposed for the three developments, the potential for heat to be emitted beyond the immediate seabed is low.

389. Furthermore, the potential for cumulative thermal emissions will be limited to the location of cable crossings. Given the overlap with the BBWF array area, it is likely that the Marine Scheme Offshore Export Cables and BBWF cables (inter array, interconnector and export) will be in close proximity for this section of the Marine Scheme, however it is assumed that there will not be any crossings of the BBWF cables. Therefore, there is potential for some cumulative impact between the Marine Scheme and BBWF. However, the extent of sediment heating will be limited to the immediate vicinity of the source (as is the case for the Marine Scheme; section 208). Therefore, even where other development cables are in close proximity to the Marine Scheme the resultant elevated thermal emissions are extremely limited.

390. The cumulative impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

8.14.2.2.6.2. Sensitivity of the receptor

391. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 226. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

392. Subtidal sands and gravels, subtidal mixed sediments and mud habitats in deep water are deemed to be of low vulnerability, high recoverability, and regional value. The sensitivity is therefore considered to be low. Stony / bedrock reef and S. spinulosa reef are deemed to be of low vulnerability, high recoverability, and national value. The sensitivity is therefore considered to be low.

393. Seapens and burrowing megafauna are deemed to be of low to medium vulnerability, high recoverability, and national value. The sensitivity is therefore considered to be medium.

394. Ocean quahog are deemed to be of a high vulnerability, low recoverability, and national value. The sensitivity is therefore considered to be medium.

8.14.2.2.6.3. Significance of the effect

395. Overall, the magnitude of the cumulative effect is deemed to be negligible.

396. The sensitivity for subtidal sands and gravels, subtidal mixed sediments, and mud habitats in deep water is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

397. The sensitivity for stony / bedrock reef and S. spinulosa reef is considered to be low. The cumulative effect will, therefore, be of negligible to minor adverse significance, for the Marine Scheme as a whole, which is not significant in EIA terms.

398. The sensitivity of seapens and burrowing megafauna and ocean quahog is considered to be medium. The cumulative effect will, therefore, be of **negligible to minor adverse significance**, for the Marine Scheme as a whole, which is not significant in EIA terms.

8.14.2.2.6.4. Secondary mitigation and residual effect

399. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.2.7. Changes in physical processes from cable protection measures

400. All developments listed in Table 8.24 which met the CEA criteria may result in changes in flows and waves as a result of the presence of infrastructure. These developments have been considered cumulatively in the following sections.

401. It is not possible to provide separate assessments for Scottish and English waters, as this level of granularity is not provided for the cumulative developments that span across these two jurisdictions (e.g. Eastern Green Link 1 and 2). Therefore, the assessment here pertains to the Marine Scheme as a whole.

8.14.2.2.7.1. Magnitude of impact

402. As noted for the assessment of the Marine Scheme alone, only very limited change in flows, waves or sediment transport are anticipated as a result of the presence of cable protection for the Marine Scheme.

403. Other developments within the cumulative zone of influence may include permanent infrastructure in the water column. BBWF predict that tidal flow will accelerate in the immediate vicinity (200 m) of permanent structures, including wind turbine generators, offshore substation platforms and cable protection, by up to 2% of peak flows. Changes in wave climate were predicted to represent less than 1% of baseline significant wave height and only highly localised (less than 300 m) changes in sediment transport and residual current (BBWFL, 2022). Seagreen 1 predicted no material change on the physical environment as a result of the presence of infrastructure (Seagreen, 2012).

404. For the Eastern Green Link 1, Eastern Green Link 2, and the Inch Cape Wind Farm OFTO, the only pathway for effect would be from cable protection measures which represent a small profile on the seabed. Therefore, only minimal effects on flows, waves and sediment transport systems would be anticipated.

405. The cumulative impact is predicted to be of highly localised spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be negligible.

8.14.2.2.7.2. Sensitivity of receptor

406. The sensitivities of Benthic Subtidal and Intertidal Ecology receptors are detailed in section 8.12.2.7.2. The sensitivities provided below are consistent with the sensitivities for the Marine Scheme alone.

407. Subtidal sands and gravels, subtidal mixed sediments, mud habitats in deep water and stony / bedrock reef and S. spinulosa reef are deemed to be not sensitive and of regional to national value. The sensitivity of the receptor is therefore, considered to be negligible.

408. The seapens and burrowing megafauna biotope is deemed to be of high vulnerability, low recoverability, and of national value. The sensitivity of this receptor is therefore, considered to be high.

409. Ocean quahog is deemed to be of low vulnerability, low recoverability and of national value. The sensitivity of this receptor is therefore, considered to be low.

8.14.2.2.7.3. Significance of effect

410. Overall, the magnitude of the cumulative effect is deemed to be negligible.

411. The sensitivity of subtidal sands and gravels, subtidal mixed sediments, mud habitats in deep water and stony / bedrock reef and S. spinulosa reef is considered to be negligible. The cumulative effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

412. The sensitivity of seapens and burrowing megafauna is considered to be high. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms according to the assessment matrix provided in Table 8.13.

413. The sensitivity of ocean quahog is considered to be low. The cumulative effect will, therefore, be of **negligible to minor adverse significance**, which is not significant in EIA terms.

8.14.2.2.7.4. Secondary mitigation and residual effect

414. Given that there are no likely significant effects in EIA terms, secondary mitigation is not required.

8.14.2.3. POTENTIAL EFFECTS DURING DECOMMISSIONING

415. At the end of the operation and maintenance phase of the Marine Scheme, the options for decommissioning works will be assessed, taking into consideration constraints (e.g. safety and liability) and the potential environmental impacts associated with decommissioning works.

416. The principal options for decommissioning include:

- Leaving the cable in-situ, trenched;
- Leaving the cable in-situ and providing additional protection;
- Remove sections of the cable that present a risk to other sea users; and
- Remove the cable entirely.

417. Should complete removal of the cable be required, the cumulative significance of effect is considered to result in similar cumulative effects to those assessment as part of the cumulative construction phase of the Marine Scheme. Impacts are anticipated to be of similar magnitude (depending on the decommissioning option selected).

418. Overall, the magnitude of the cumulative impact is deemed to be negligible to low, and the sensitivity of the receptor is considered to be low to high. The cumulative effect will, therefore, be of **negligible to minor adverse** to **minor adverse significance**.

8.14.3. Proposed Monitoring

419. No benthic monitoring to test the predictions made within the assessment of likely significant cumulative effects on benthic ecology is considered necessary.

8.15. Inter-Related Effects

420. Inter-related effects are the potential effects of multiple impacts, affecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different phases of the Marine Scheme (i.e. interaction of impacts across construction, operation and maintenance, and decommissioning), as well as the interaction between impacts on a receptor within a Marine Scheme phase. A description of the likely inter-related effects arising from the Marine Scheme on Benthic Subtidal and Intertidal Ecology is provided below.

421. All phases of the Marine Scheme have the potential to impact various benthic receptors. Impacts relating to EMF and thermal emissions, colonisation of hard structures, and changes in physical processes will only occur during the operation and maintenance phase. Therefore, there will be no combined effect with the construction or decommissioning phases.

422. Temporary habitat loss/disturbance and increases in suspended sediment and associated deposition during operation and maintenance may occur in the same areas as construction and decommissioning. However, the majority of habitat disturbance and loss and / or sediment disturbance during the construction phase will be temporary and localised, with a recovery of the seabed once construction activities have ceased. Therefore, there is considered to be a limited potential for an interaction between the habitat loss and disturbance and / or sediment disturbance during the construction, operation and maintenance and decommissioning phases to result in a greater effect than when each phase is assessed in isolation.

423. During the operation and maintenance phase, the spatial extent associated with permanent habitat / species loss, EMF and thermal emissions, and colonisation of hard structures will be similar and receptors may be affected by these impacts simultaneously. However, considering the highly localised extent of these effects, the combined effect of these impacts during the operation and maintenance phase is not expected to result in a greater effect than the assessment of these impacts in isolation.

424. The assessment of effects on benthic receptors is also of relevance to higher trophic levels, such as fish and shellfish ecology, marine mammals and ornithology. These effects are considered fully within the relevant chapters of this ES.

425. These inter-related effects as described above are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phases. Therefore, these inter-related effects would not be significant in EIA terms.

8.16. Transboundary Effects

426. Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

427. There is no potential for transboundary impacts upon benthic receptors due to construction, operation and maintenance and decommissioning of the Marine Scheme. The potential impacts are localised and are not expected to affect other EEA states. Therefore, transboundary effects for benthic receptors do not need to be considered further.

8.17. Summary of Impacts, Mitigation Measures, Likely Significant Effects and Monitoring

428. Information on Benthic Subtidal and Intertidal Ecology within the Benthic Subtidal and Intertidal Ecology Study Area was collected through a desktop review, site-specific surveys and consultation. Table 8.27 presents a summary of the potential impacts, mitigation measures and the conclusion of likely significant effects in EIA terms in respect to Benthic Subtidal and Intertidal Ecology. The impacts assessed include:

- Construction and decommissioning:
  - Temporary habitat / species loss and disturbance;
  - Increased SSC and associated deposition;
- Operation and maintenance:
  - Temporary habitat / species loss and disturbance;
  - Increased SSC and associated deposition;
  - Permanent habitat / species loss;
  - Colonisation of hard structures;
  - EMF effects;
  - Thermal emissions from operational cables; and
  - Changes in physical processes from cable protection measures.

429. Overall, it is concluded that there will be no likely significant effects arising from the Marine Scheme during the construction, operation and maintenance or decommissioning phases.

430. Table 8.28 presents a summary of the potential cumulative impacts, mitigation measures and the conclusion of likely significant effects on Benthic Subtidal and Intertidal Ecology in EIA terms. The cumulative effects assessed include:

- Construction and decommissioning:
  - Temporary habitat / species loss and disturbance;
  - Increased SSC and associated deposition;
- Operation and maintenance:
  - Temporary habitat / species loss and disturbance;
  - Increased SSC and associated deposition;
  - Permanent habitat / species loss;
  - Colonisation of hard structures;
  - EMF effects;
  - Thermal emissions during from operational cables; and
  - Changes in physical processes from cable protection measures.

431. Overall, it is concluded that there will be no likely significant cumulative effects from the Marine Scheme alongside other developments/plans.

Table 8.27 Summary of potential likely significant environmental effects, mitigation and monitoring

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
Temporary habitat / species loss or disturbance during construction									
Scottish and English waters	✓	×	✓	Low	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – medium Stony / bedrock reef habitats – medium *S. spinulosa* reef – medium Seapens and burrowing megafauna – high Ocean quahog – high	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – minor adverse Stony / bedrock habitats – minor adverse *S. spinulosa* reef – minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Increased SSC and associated sediment deposition during construction									
Scottish and English waters	✓	×	✓	Low	Scottish and English waters: • Subtidal sands and gravels – negligible • Subtidal mixed sediments – negligible • Mud habitats in deep water – negligible • Stony / bedrock reef habitats – low	Scottish and English waters: • Subtidal sands and gravels – negligible to minor adverse • Subtidal mixed sediments – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					• S. spinulosa reef – low • Seapens and burrowing megafauna – low • Ocean quahog – low English waters only (intertidal receptors): • Intertidal rock – low • Intertidal coarse sediment – negligible • Intertidal sand and muddy sand – negligible	• Mud habitats in deep water – negligible to minor adverse • Stony / bedrock reef habitats – negligible to minor adverse • *S. spinulosa* reef – negligible to minor adverse • Seapens and burrowing megafauna – negligible to minor adverse • Ocean quahog – negligible to minor adverse English waters only (intertidal receptors): • Intertidal rock – negligible to minor adverse • Intertidal coarse sediment – negligible to minor adverse • Intertidal sand and muddy sand –			

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
						negligible to minor adverse			
Temporary habitat / species loss or disturbance during operation and maintenance									
Scottish and English waters	✓	×	✓	Negligible	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – medium Stony / bedrock reef habitats – medium *S. spinulosa* reef – medium Seapens and burrowing megafauna – high Ocean quahog – high	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible to minor adverse Stony / bedrock habitats – negligible to minor adverse *S. spinulosa* reef - negligible to minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Increased SSC and associated sediment deposition during operation and maintenance									
Scottish and English waters	×	✓	×	Negligible	Scottish and English waters: • Subtidal sands and gravels – negligible • Subtidal mixed sediments – negligible • Mud habitats in deep water – negligible	Scottish and English waters: • Subtidal sands and gravels – negligible adverse • Subtidal mixed sediments – negligible adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					• Stony / bedrock reef habitats – low • S. spinulosa reef – low • Seapens and burrowing megafauna – low • Ocean quahog – low English waters only (intertidal receptors): • Intertidal rock – low • Intertidal coarse sediment – negligible • Intertidal sand and muddy sand – negligible	• Mud habitats in deep water – negligible adverse • Stony / bedrock reef habitats – negligible to minor adverse • *S. spinulosa* reef – negligible to minor adverse • Seapens and burrowing megafauna – negligible to minor adverse • Ocean quahog – negligible to minor adverse English waters only (intertidal receptors): • Intertidal rock – negligible to minor adverse • Intertidal coarse sediment – negligible to minor adverse • Intertidal sand and muddy sand – negligible adverse			

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
Permanent habitat / species loss									
Scottish and English waters	×	✓	×	Low	Subtidal sands and gravels – high Subtidal mixed sediments – high Mud habitats in deep water – high Stony / bedrock reef – high *S. spinulosa* reef – high Seapens and burrowing megafauna – high Ocean quahog – high	Subtidal sands and gravels – minor adverse Subtidal mixed sediments – minor adverse Mud habitats in deep water – minor adverse Stony / bedrock reef – minor adverse *S. spinulosa* reef – minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Colonisation of hard structures									
Scottish and English waters	×	✓	×	Low	Subtidal sands and gravels – medium Subtidal mixed sediments – medium Mud habitats in deep water – negligible Stony / bedrock reef – low *S. spinulosa* reef – low Seapens and burrowing megafauna – low Ocean quahog – low	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible adverse Stony / bedrock reef – negligible to minor adverse *S. spinulosa* reef – negligible to minor adverse Seapens and burrowing megafauna – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
						Ocean quahog – negligible to minor adverse			
EMF effects									
Scottish and English waters	×	✓	×	Negligible	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – low Stony / bedrock reef – low *S. spinulosa* reef - low Seapens and burrowing megafauna – low Ocean quahog – low	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible to minor adverse Stony / bedrock reef – negligible to minor adverse *S. spinulosa* reef - negligible to minor adverse Seapens and burrowing megafauna – negligible to minor adverse Ocean quahog – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Thermal emissions from operational cables									
Scottish and English waters	×	✓	×	Negligible	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – low Stony / bedrock reef – low *S. spinulosa* reef – low Seapens and burrowing megafauna – medium	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible to minor adverse Stony / bedrock reef – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					Ocean quahog – medium	*S. spinulosa* reef - negligible to minor adverse Seapens and burrowing megafauna – negligible to minor adverse Ocean quahog – negligible to minor adverse			
Changes in physical processes from cable protection measures									
Scottish and English waters	×	✓	×	Negligible	Subtidal sands and gravels – negligible Subtidal mixed sediments – negligible Mud habitats in deep water – negligible Stony / bedrock reef – negligible *S. spinulosa reef* – negligible Seapens and burrowing megafauna – high Ocean quahog – low	Subtidal sands and gravels – negligible adverse Subtidal mixed sediments – negligible adverse Mud habitats in deep water – negligible adverse Stony / bedrock reef – negligible adverse *S. spinulosa* reef – negligible adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Table 8.28 Summary of likely significant cumulative environment effects, mitigation and monitoring

Description of Impact	Phase C	O	D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
Temporary habitat / species loss or disturbance during construction									
Scottish and English waters	✓	×	✓	Low	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – medium Stony / bedrock reef habitats – medium *S. spinulosa* reef – high Seapens and burrowing megafauna – high Ocean quahog – high	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – minor adverse Stony / bedrock habitats – minor adverse *S. spinulosa* reef – minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Increased SSC and associated sediment deposition during construction									
Scottish and English waters	✓	×	✓	Negligible	Scottish and English waters: • Subtidal sands and gravels – negligible • Subtidal mixed sediments – negligible • Mud habitats in deep water – negligible	Scottish and English waters: • Subtidal sands and gravels – negligible to minor adverse • Subtidal mixed sediments – negligible to minor adverse • Mud habitats in deep water – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C O D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
			• Stony / bedrock reef habitats – low • S. spinulosa reef – low • Seapens and burrowing megafauna – low • Ocean quahog – low English waters only (intertidal receptors): • Intertidal rock – low • Intertidal coarse sediment – negligible • Intertidal sand and muddy sand – negligible	• Stony / bedrock reef habitats – negligible to minor adverse • *S. spinulosa* reef – negligible to minor adverse • Seapens and burrowing megafauna – negligible to minor adverse • Ocean quahog – negligible to minor adverse English waters only (intertidal receptors): • Intertidal rock – negligible to minor adverse • Intertidal coarse sediment – negligible to minor adverse • Intertidal sand and muddy sand – negligible to minor adverse			
Temporary habitat / species loss and disturbance during operation and maintenance							
Scottish and English waters	✓ × ✓	Negligible	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – medium Stony / bedrock reef habitats – medium	Subtidal sands and gravels – negligible to minor adverse Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					S. spinulosa reef – medium Seapens and burrowing megafauna – high Ocean quahog – high	Stony / bedrock habitats – negligible to minor adverse *S. spinulosa* reef – negligible to minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse			
Increased SSC and associated sediment deposition during operation and maintenance									
Scottish and English waters	×	✓	×	Negligible	Scottish and English waters: • Subtidal sands and gravels – negligible • Subtidal mixed sediments – negligible • Mud habitats in deep water – negligible • Stony / bedrock reef habitats – low • S. spinulosa reef – low • Seapens and burrowing megafauna – low • Ocean quahog – low	Scottish and English waters: • Subtidal sands and gravels – negligible adverse • Subtidal mixed sediments – negligible adverse • Mud habitats in deep water – negligible adverse • Stony / bedrock reef habitats – negligible to minor adverse • *S. spinulosa* reef – negligible to minor adverse • Seapens and burrowing megafauna – negligible to minor adverse • Ocean quahog – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					English waters only (intertidal receptors): • Intertidal rock – low • Intertidal coarse sediment – negligible • Intertidal sand and muddy sand – negligible	English waters only (intertidal receptors): • Intertidal rock – negligible to minor adverse • Intertidal coarse sediment – negligible adverse • Intertidal sand and muddy sand – negligible adverse			
Permanent habitat / species loss									
Scottish and English waters	×	✓	×	Low	Subtidal sands and gravels – high Subtidal mixed sediments – high Mud habitats in deep water – high stony / bedrock reef – high *S. spinulosa* reef – high Seapens and burrowing megafauna – high Ocean quahog – high	Subtidal sands and gravels – minor adverse Subtidal mixed sediments – minor adverse Mud habitats in deep water – minor adverse stony / bedrock reef – minor adverse *S. spinulosa* reef – minor adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Colonisation of hard structures									
Scottish and English waters	×	✓	×	Low	Subtidal sands and gravels – medium Subtidal mixed sediments – medium	Subtidal sands and gravels –minor adverse Subtidal mixed sediments – minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

Description of Impact	Phase C	O	D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
					Mud habitats in deep water – negligible Stony / bedrock reef habitats – low *S. spinulosa* reef – low Seapens and burrowing megafauna – low Ocean quahog – low	Mud habitats in deep water – negligible to minor adverse Stony / bedrock reef – negligible to minor adverse *S. spinulosa* reef – negligible to minor adverse Seapens and burrowing megafauna – negligible to minor adverse Ocean quahog – negligible to minor adverse			
EMF effects									
Scottish and English waters	×	✓	×	Negligible	Subtidal sands and gravels – low Subtidal mixed sediments – low Mud habitats in deep water – low Stony / bedrock reef – low *S. spinulosa* reef – low Seapens and burrowing megafauna – low Ocean quahog – low	Subtidal sands and gravels – negligible adverse Subtidal mixed sediments – negligible adverse Mud habitats in deep water – negligible adverse Stony / bedrock reef – negligible adverse *S. spinulosa* reef - negligible adverse Seapens and burrowing megafauna – negligible adverse Ocean quahog – negligible adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.
Thermal emissions									
Scottish and English waters	×	✓	×	Negligible	Subtidal sands and gravels – low	Subtidal sands and gravels – negligible to minor adverse	No secondary mitigation is	N/A	There is no requirement for additional mitigation

Description of Impact	Phase C O D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
			Subtidal mixed sediments – low Mud habitats in deep water – low Stony / bedrock reef – low *S. spinulosa* reef – low Seapens and burrowing megafauna – medium Ocean quahog – medium	Subtidal mixed sediments – negligible to minor adverse Mud habitats in deep water – negligible to minor adverse Stony / bedrock reef – negligible to minor adverse *S. spinulosa* reef - negligible to minor adverse Seapens and burrowing megafauna – negligible to minor adverse Ocean quahog – negligible to minor adverse	considered necessary		over and above the pre-defined designed in measures.
Changes in physical processes from cable protection measures							
Scottish and English waters	× ✓ ×	Low	Subtidal sands and gravels – negligible Subtidal mixed sediments – negligible Mud habitats in deep water – negligible Stony / bedrock reef – negligible *S. spinulosa* reef – negligible Seapens and burrowing megafauna – high Ocean quahog – low	Subtidal sands and gravels – negligible adverse Subtidal mixed sediments – negligible adverse Mud habitats in deep water – negligible adverse Stony / bedrock reef – negligible adverse *S. spinulosa* reef – negligible adverse Seapens and burrowing megafauna – minor adverse Ocean quahog – negligible to minor adverse	No secondary mitigation is considered necessary	N/A	There is no requirement for additional mitigation over and above the pre-defined designed in measures.

8.18. References

Adams, T., Miller, R., Aleynik, D., & Burrows, M. (2014). Offshore marine renewable energy devices as stepping stones across biogeographical boundaries. Journal of Applied Ecology, 330-338.

BBWFL (2022). Berwick Bank Wind Farm Environmental Impact Assessment Report: Volume 2, Chapter 9: Fish and Shellfish Ecology.

Boulcott, P. & Howell, T.R.W., 2011. The impact of scallop dredging on rocky-reef substrata. Fisheries Research (Amsterdam), 110 (3), 415-420.

BOWind (2008). Barrow Offshore Wind Farm Post Construction Monitoring Report. First annual report.
Claire, D., Silburn, B. and Murray, J (2022). Coquet to St Mary's Marine Conservation Zone (MCZ): A study of a UK Subtidal mud feature. NECR364. Natural England.

Canadian Council of Ministers of the Environment. (2001). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Retrieved from https://www.pla.co.uk/Environment/Canadian- Sediment-Quality-Guidelines-for-the-Protection-of-Aquatic-Life.

Cargnelli, L.M., Griesbach, S.J., Packer, D.B. & Weissberger, E., 1999a. Essential fish habitat source document: Ocean quahog, Arctica islandica, life history and habitat characteristics. NOAA Technical

Memorandum, NMFS-NE-148, 12pp.

CIEEM. (2018, and updated April 2022). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Version 1.1. Winchester: artered Institute of Ecology and Environmental Management.

Clean Seas and Environmental Monitoring Programme (2019). Winter Nutrient Concentrations 2007-2019. Available online at: https://marine.gov.scot/sma/content/clean-seas-environment-monitoring-programme-csemp-winter-nutrient-concentrations-2007-2019.

Connor, D.W., Allen, J.H, Golding, N., Howell, K.L., Lieberknecht, L.M., Northern, K.O. & Reker, J.B. (2004). The Marine Habitat Classification for Britain and Ireland Version 04.05. JNCC, Peterborough - www.jncc.gov.uk/MarineHabitatClassification.

Copping, A. E., et al., 2020. Potential Environmental Effects of Marine Renewable Energy Development – The State of the Science. Journal of Marine Science and Engineering. 8 (11), 879.

d'Avack, E.A.S., & Garrard, S. L. 2015. Fucus serratus on moderately exposed lower eulittoral rock. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/103

De-Bastos, E.S.R. 2016. Paramphinome jeffreysii, Thyasira spp. and Amphiura filiformis in offshore circalittoral sandy mud. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/1109.

Degraer, S., Carey, D., Coolen, J.W.P, Hutchison, Z.L., Kerckhof, F., Rumes, B., and Vanaverbeke, J. (2020). Offshore wind farm artificial reefs affect ecosystem structure and functioning - a synthesis. Oceanography, 33: 48 – 57.

Department for Environment, Food and Rural Affairs (DEFRA) (2011). UK Marine Policy Statement. Available at: https://www.gov.uk/government/publications/uk-marine-policy-statement. Accessed on: February 2023.

Desprez, M. (2000). Physical and biological impact of marine aggregate extraction along the French coast of the Eastern English Channel: Short-and long-term post-dredging restoration. ICES Journal of Marine Science 57(5):1428-1438.

Diaz, R.J. & Rosenberg, R., 1995. Marine benthic hypoxia: a review of its ecological effects and the behavioural responses of benthic macrofauna. Oceanography and Marine Biology: an Annual Review, 33, 245-303.

EDF Renewables (2020). Blyth Offshore Demonstration Project Phase 2 – Supporting Environmental Information. Available online at: https://marinelicensing.marinemanagement.org.uk/mmofox5/fox/live/.

EGS (2011). Lynn and Inner Dowsing Offshore Wind Farms Post-Construction Survey Works (2010) Phase 2 – Benthic Ecology Survey Centrica Contract No. CREL/C/400012, Final Report. p.184.

Emeana, C.J., Hughes, T, Dix, Justin., Gernon, T., Henstock, T., Thompson, C. & Pilgrim, J.A. (2016). The thermal regime around buried submarine high voltage cables. *Geophysical Journal International*. 206. 10.1093/gji/ggw195.

EMU (2010). Naert Na Gaoithe proposed offshore wind farm, benthic ecology characterisation survey, final report, a report for Neart na Gaoithe Offshore Wind Ltd. Report no. 09/J/1/03/1483/0943.

EUSeaMap (2021). Broad-scale Seabed habitat map for Europe (EUSeaMap). Available online at: https://emodnet.ec.europa.eu/en/seabed-habitats.

Gill, A.B. and Desender, M. (2020). 2020 State of the Science Report, Chapter 5: Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices. Available online at: https://www.osti.gov/servlets/purl/1633088 [Accessed 25/02/2023].

Golding, N., Albrecht, J., & McBreen, F. (2020). Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef. Peterborough: Joint Nature Conservation Committee.

Gubbay, S. (2007). Defining and managing Sabellaria spinulosa reefs: Report of an interagency workshop. JNCC report.

Hervé,L. (2021). An evaluation of current practice and recommendations for environmental impact assessment of electromagnetic fields from offshore renewables on marine invertebrates and fish, A dissertation submitted the Department of Civil & Environmental Engineering, University of Strathclyde.

Hiddink, JG., Burrows, MT., & García Molinos, J. (2015). Temperature tracking y North Sea benthic invertebrates in response to climate change. Global Change Biology Vol 21 (1) https://doi.org/10.1111/gcb.12726.

Hill, J.M., Tyler-Walters, H.,, Garrard, S.L., & Watson, A., 2023. Seapens and burrowing megafauna in circalittoral fine mud. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/131.

Hiscock, K. (1983). Water movement. In Sublittoral ecology. The ecology of shallow sublittoral benthos (ed. R. Earll & D.G. Erwin), pp. 58-96. Oxford: Clarendon Press.

Hughes, S.L., Hindson, J., Berx, B., Gallego, A. and Turrell, W.R. (2018) Scottish Ocean Climate Status Report 2016. Scottish Marine and Freshwater Science Vol 9 No 4, 167pp. DOI: 10.7489/12086-1.

Hutchison, Z.L., D.H. Secor, and A.B. Gill. 2020. The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. Oceanography 33(4):96–107,

Inch Cape Offshore Limited (2011). Offshore Environmental Statement, Volume 1B: Biological Environment, Chapter 12 Benthic Ecology.

Irving, R. (2009). Identification of the Main Characteristics of Stony Reef Habitats under the Habitats Directive. Summary of an Inter-Agency Workshop 26-27 March 2008. Joint Nature Conservation Committee, JNCC Report No. 432, 28pp.

Jackson, A. & Hiscock, K. 2008. Sabellaria spinulosa Ross worm. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/species/detail/1133.

Jenkins, C., Eggleton, J. Albrecht, J., Barry, J., Duncan, G., Golding, N. and O'Connor, J. (2015). North Norfolk Sandbanks and Saturn Reef cSAC/SCI management investigation report. JNCC/Cefas Partnership Report, No. 7.

JNCC (2014). JNCC clarifications on the habitat definitions of two habitat Features of Conservation Importance (FOCI). Peterborough, UK.

JNCC (2023). Completed Seabed Surveys. Available online at: https://jncc.gov.uk/our-work/completed-seabed-surveys/#2011 [Accessed 02/06/2023].

JNCC and Natural England. (2019). Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas. Available from: https://hub.jncc.gov.uk/assets/3c9f030c-5fa0-4ee4-9868-1debedb4b47f [Accessed 26/03/2023].

Kröncke I. (1995). Long-term changes in North Sea benthos. Senckenberg Marit, 26, 73-80.

Kröncke I. (2011). Changes in Dogger Bank macrofauna communities in the 20th century caused by fishing and climate. Estuarine, Coastal and Shelf Science, 94, 234-245.

Krone, R., Gutow, L., Joschko, T.J. and Schroder, A. (2013). Epifauna dynamics at an offshore foundation – Implications of future wind power farming in the North Sea. Marine Environmental Research, 85, 1-12.

Lindeboom, H., Kouwenhoven, H., Bergman, M., Bouma, S., Brasseur, S., Daan, R., Fijn, R., de Haan, D., Dirksen, S., van Hal, R., Lambers, R., ter Hofstede, R., Krijgsveld, K., Leopold, M. and Scheidat, M. (2011). *Short-Term Ecological Effects of an Offshore Wind Farm in the Dutch Coastal Zone: A Compilation*. Environmental Research Letters, 6(3)

Linley, A., Wilding, T., Black, K., Hawkins, S. J., & Mangi, S. (2007). Review of the reef effects of offshore windfarm structures and potential for enhancement and mitigation. Report from PML Applications Ltd and the Scottish Association for Marine Science to the Department for Business, Enterprise and Regulatory Reform (BERR). Available online at: https://tethys.pnnl.gov/publications/review-reef-effects-offshore-wind-farm-structures-their-potential-enhancement [Accessed 23/05/2023].

Marine Management Organisation (2021). North East Inshore and North East Offshore Marine Plan. Available at: https://www.gov.uk/government/publications/the-north-east-marine-plans-documents Accessed on: February 2023.

Marine Management Organisation. (2014 and reviewed 2020). Cefas Chemical Action Levels. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/485576/High_level_review_of_current_UK_action_level_guidance_report__1053_.pdf.

Marine Scotland. (2020). Contaminant and biological effect data 1999-2017 for the National

Performance Framework Clean Seas Indicator 2018.

Meißner, K., Sordyl. H., Bellebaum J. & Sordyl, H. 2006. Impacts of submarine cables on the marine environment: a literature review. Germany, Institute of Applied Ecology Ltd. https://tethys.pnnl.gov/sites/default/files/publications/Meissner-et-al-2006.pdf.

Merrill, A.S., Chamberlain, J.L. & Ropes, J.W., 1969. Ocean quahog fishery. In Encyclopedia of marine

resources (ed. F.E. Firth), pp. 125-129. New York: VanNorstrand Reinhold Publ.

Mieszkowska, N., Burrows, M. and Sugden, H. (2020) Impacts of climate change on intertidal habitats relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 256–271.

Moore, P.J. and Smale, D.A. (2020) Impacts of climate change on shallow and shelf subtidal habitats relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 272–292.

Morris, E. (2015). Defining Annex I biogenic Modiolus modiolus reef habitat under the Habitats Directive: Report of an inter-agency workshop March 4th & 5th, 2014. JNCC Report No. 531. JNCC, Peterborough.

National Grid and Scottish Power (2022). Scotland England Green Link 1 / Eastern Link 1 – Marine Scheme Environmental Appraisal Report.

National Grid and SSEN (2022). Eastern Green Link 2 – Marine Scheme Environmental Appraisal

National Grid NSN Link Limited (2014). UK Environmental Statement. Available online at: https://northsealink.com/en/documents/ [Accessed 18/05/2023].

Natural England and JNCC. (2022). Nature Conservation Considerations and Environmental Best Practice for subsea cable for English Inshore and UK Offshore Waters. Available by request from neoffshorewindstrategicsolutions@naturalengland.org.uk.

Natural Power (2023). Cambois connection benthic ecology baseline – Phase 1 Survey Report.

Newell, R.C., Seiderer, L.J. and Hitchcock, D.R. (1998). The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources in the seabed. Oceanography and Marine Biology: Annual Review, 36, 127-178.

Ocean Ecology (2023). Berwick Bank Alternative Connection Intertidal Habitat Assessment 2022. REF: OEL_ XODBER0622_HA.

OneBenthic database (2020). Available from https://openscience.cefas.co.uk/OneBenthicExtraction/ [Accessed: 24/03/2023].

OSPAR. (2009). Background Document on CEMP assessment criteria for the QSR 2010. OSPAR.

Pearce, B., Taylor, J. and Seiderer, L.J. (2007). Recoverability of Sabellaria spinulosa Following Aggregate Extraction, Marine Ecological Surveys Limited.

RPS (2019). Review of Cable installation, protection, migration and habitat recoverability, The Crown Estate.

Scottish Government (2015). Scotland's National Marine Plan (NMP). Available at: https://www.gov.scot/publications/scotlands-national-marine-plan/. Accessed March 2023.

Seagreen (2012). Environmental Impact Statement. Volume 1, Chapter 11 Benthic Ecology and Intertidal Ecology. September 2012.

Smale, D.A., Wernberg, T., Yunnie, A.L. and Vance, T. (2015). The rise of Laminaria ochroleuca in the Western English Channel (UK) and comparisons with its competitor and assemblage dominant Laminaria hyperborea. Marine ecology, 36(4), pp.1033-1044.

SSE Renewables (2022). Berwick Bank Windfarm – Environmental Impact Assessment Report. Available from: https://marine.gov.scot/ml/berwick-bank-offshore-wind-farm [Accessed 26/03/2023].

Stamp, T.E. & Tyler-Walters, H. 2016. Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/337.

Taormina, B., Bald, J., Want, A., Thouzeau, G., Lejart, M., Desroy, N. & Carlier, A. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. Renewable and Sustainable Energy Reviews 96: 380-391. https://www.sciencedirect.com/science/article/abs/pii/S1364032118305355.

Theede, H., Ponat, A., Hiroki, K. & Schlieper, C., 1969. Studies on the resistance of marine bottom

invertebrates to oxygen-deficiency and hydrogen sulphide. Marine Biology, 2, 325-337.

Tillin, H.M., Hiddink, J.G., Jennings, S. and Kaiser, M.J., 2006. Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea-basin scale. Marine Ecology Progress Series, 318, pp.31-45.

Tillin, H. and Tyler-Walters, H. (2014a). Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 1 Report: Rationale and proposed ecological groupings for Level 5 biotopes against which sensitivity assessments would be best undertaken. JNCC Report No. 512A, 68 pp. Available from http://jncc.defra.gov.uk/page-6790

Tillin, H. and Tyler-Walters, H. (2014b). Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 2 Report – Literature review and sensitivity assessments

for ecological groups for circalittoral and offshore Level 5 biotopes. JNCC Report No. 512B, 260 pp. Available from: http://jncc.defra.gov.uk/PDF/Report 512-B_phase2_web.pdf

Tillin, H.M. and Tyler-Walters, H. (2015b). Finalised list of definitions of pressures and benchmarks for sensitivity assessment. May 2015.

Tillin, H.M., Marshall, C., Gibb, N. & Garrard, S. L. (2022). Sabellaria spinulosa on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/377.

Tillin, H.M. & Rayment, W., (2022). Fabulina fabula and Magelona mirabilis with venerid bivalves and amphipods in infralittoral compacted fine muddy sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/142.

Tillin, H.M. 2022. Abra prismatica, Bathyporeia elegans and polychaetes in circalittoral fine sand. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/1133.

Tyler-Walters, H. & Sabatini, M. 2017. Arctica islandica Icelandic cyprine. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/species/detail/1519.

Winklhofer, M. (2009). The physics of geomagnetic-field transduction in animals. IEEE Transactions on magnetics, 45(12), pp.5259-5265.