Bellrock Offshore Wind Farm

Wind Farm Development Area

Environmental Impact Assessment Report - Volume II

Chapter 7: Benthic Ecology

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Glossary of Terminology

Term	Definition
Applicant	Bellrock Offshore Wind Farm Limited, the legal entity submitting Section 36 Consent and Marine Licence applications for the Bellrock Offshore Wind Farm Development Area.
Bellrock Offshore Wind Farm (or the Bellrock Project)	An offshore wind farm capable of exporting up to 1.8 GW of renewable energy to the National Electricity Transmission System. The Wind Farm Development Area is located 120 km east of Stonehaven, and will connect to the National Electricity Transmission System at the proposed SSEN Transmission Hurlie substation, west of Stonehaven in Aberdeenshire. The Bellrock Offshore Wind Farm comprises of the following Development Areas: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Benthic/benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides as the littoral zone.
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Biotope	The physical 'habitat' with its biological 'community'; a term which refers to the combination of physical environment (habitat) and its distinctive assemblage of conspicuous species.
Cable protection	Protective measure to minimise the effects of scour and hazards along the inter-array cables, and protecting these cables at infrastructure crossing points.
Circalittoral	The subzone of the rocky sublittoral below that dominated by algae (the infralittoral) and dominated by animals.
Commencement of construction	Commencement of construction to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 consent and Marine Licence (excluding site preparation works), being the earlier of: ▪ Intrusive pre-installation surveys; ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines; ▪ Trench excavation for inter-array cables; or ▪ Trenching for, or laying of inter-array cables on or in the seabed.

Term	Definition
Construction works	Works to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 Consent/Marine Licence, such as: ▪ Site preparation works undertaken after commencement of construction; ▪ Pre-installation surveys (intrusive and/or non-intrusive); ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines, and associated scour protection; ▪ Towing or transportation of the floating offshore unit to the Wind Farm Development Area from a port or wet storage facility; ▪ Floating offshore unit installation and commissioning, including hooking-up to the pre-installed mooring system; ▪ Trench excavation for inter-array cables; ▪ Laying of inter-array cables in or on the seabed and, associated cable protection; ▪ Installation of subsea cable hubs, including placing of associated foundation; ▪ Final commissioning following cable connections and snagging; and ▪ Post installation surveys.
Deposit feeder	Any organisms which feed on fragmented particulate organic matter in or on the substratum; detritivores.
Development Area	For consenting purposes, the area for which separate consents and/or Marine Licences will be sought by the Applicant, comprising: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Dynamic inter-array cable	The section of inter-array cable between the floating substructure and the seabed, which is designed to accommodate the dynamic movement of the floating substructure.
eDNA	Environmental DNA that is collected from the environment, such as in seawater, rather than directly from an individual organism.
Epifauna	Animals living on the surface of the seabed.
Filter feeder	Suspensivores; any organisms which feed on particulate organic matter, including plankton, suspended in the water column.
Floating offshore unit	The combined wind turbine generator and floating substructure.
Floating substructure	A floating structure which provides buoyancy and, in conjunction with the station keeping system, supports a superstructure (e.g. wind turbine generator or offshore substation), and maintaining its position within the structure's excursion limit.
Folk classification	The Folk sediment classification (1954) is a widely used system for naming unconsolidated sediments based on the relative proportions of three main grain-size fractions: gravel, sand, and mud.
Infauna	Benthic animals which live within the seabed.

Term	Definition
Integration port	A port at which wind turbine generators are integrated with floating substructures.
Inter-array cable	Armoured cable containing electrical and fibre optic cores, which link the wind turbine generators to each other and to the subsea cable hubs and/or the offshore substations and include dynamic inter-array cable and static inter-array cable sections.
Landfall	The area from Mean Low Water Springs to a transition joint bay(s), where the offshore export cables come ashore and the transition joint bays are located.
Macrofauna	Animals exceeding 1 mm in length or retained on a 1 mm or 0.5 mm sieve; often applied to organisms >0.5 mm.
Marine growth	Growth of marine organisms on introduced substrate; biofouling.
Megafaunal species	Any species with a body mass estimate of more than 45 kg.
Motile	Organisms that are capable of free movement.
Offshore export cable	Armoured cable containing electrical and fibre optic cores between the offshore substation(s) and the transition joint bay(s).
Offshore substation	An offshore platform which houses electrical equipment such as transformers, switchgear, and protection and control systems, enabling the wind farm's renewable electricity to be received via inter-array cables and exported via the offshore export cables.
Offshore Transmission Development Area	The boundary within which the Offshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned (and includes the whole of the Wind Farm Development Area).
Offshore Transmission Infrastructure	Infrastructure located within the Offshore Transmission Development Area including fixed bottom and/or floating offshore substations, offshore reactive compensation station(s) and associated scour protection; interconnector cables and associated cable protection; and offshore export cables and associated cable protection (including activities associated with the Offshore Transmission Infrastructure construction, operation and maintenance, and decommissioning).
Onshore Transmission Development Area	The boundary within which the Onshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned.
Onshore Transmission Infrastructure	Infrastructure located within the Onshore Transmission Development Area including transition joint bay(s); onshore export cables; onshore substation; temporary construction compounds; temporary working areas; environmental mitigation areas; drainage/irrigation infrastructure; access works; and any other associated infrastructure (including activities associated with the Onshore Transmission Infrastructure construction, operation and maintenance, and decommissioning).
Operational life	The expected operational life of the Wind Farm Infrastructure from the Commercial Operation Date to the first floating offshore unit being decommissioned.
Peduncle	Of Crustacea - a stalk like part of the body. Of Brachiopoda - a fleshy cuticle covered stalk by which the brachiopod attaches itself to the substratum. Of Isopoda - Proximal division of antennule or antenna. Typically consists of three segments in antennule, five segments in antenna.

Term	Definition
Polychaete	A general term for members of the class Polychaeta.
Project design envelope	Includes all relevant technical, spatial and temporal elements of the Wind Farm Infrastructure, and the proposed methodology to be employed for construction, operations and maintenance, and decommissioning.
Rachis	The vertebral column or the cord from which it develops.
Scour protection	Protective material positioned around anchors to avoid sediment being eroded as a result of the flow of water.
Sedentary	Attached to a substratum but capable of movement across (or through) it.
Sessile	Permanently attached to a substratum.
Site preparation works	Preparatory activities undertaken within the Wind Farm Development Area prior to the commencement of construction of the Wind Farm Infrastructure, which may comprise (and which may require separate consents): ▪ Geophysical surveys, geotechnical surveys, and non-archaeological/archaeological diver/ remotely operated vehicle surveys; ▪ Seabed preparation including sand wave levelling, slope levelling for gravity based anchors (if selected), boulder clearance, and pre-lay grapnel runs; ▪ Unexploded ordnance survey and/or clearance; ▪ Debris clearance; and ▪ Out of service cable/pipeline removal.
SSEN Transmission Hurlie substation	The onshore substation to be developed by SSEN Transmission, which will receive renewable electricity from the Bellrock Project onshore substation and allow supply of renewable electricity from the wind farm to the National Electricity Transmission System.
Static inter-array cable	The section of inter-array cable that is not designed to move.
Station keeping system	The system (including mooring lines and anchors) used to hold a floating offshore unit within its excursion limit and maintain the intended orientation of the floating offshore unit.
Stratified seas	Layered water masses in the ocean, primarily caused by differences in temperature, salinity, and density.
Subsea cable hub	A subsea device, with a gravel pad foundation, which allows the connection of multiple inter-array cables.
Substrate	An underlying substance or layer, such as the surface or material on or from which an organism lives, grows, or obtains its nourishment.
Subtidal	A physical term for the seabed below the mark of Lowest Astronomical Tide.
Towing	Transportation of a floating offshore unit or floating substructure between a port, and/or wet storage facility and/or the Wind Farm Development Area.
Wet storage	The temporary storage/anchorage of floating substructures and/or floating offshore units prior to their transportation to the Wind Farm Development Area.

Term	Definition
Wind Farm Development Area	The boundary within which the Wind Farm Infrastructure will be constructed, operated and maintained, and decommissioned.
Wind Farm Infrastructure	Infrastructure located within the Wind Farm Development Area including wind turbine generators; floating substructures, station keeping systems and associated scour protection; inter-array cables and associated cable protection; subsea cable hubs; and ancillary infrastructure including buoys (including activities associated with the Wind Farm Infrastructure construction, operation and maintenance, and decommissioning).
Wind turbine generator	A wind turbine generator converts wind energy into electrical energy. The main components include rotor assembly (composed of three blades and a hub); nacelle (containing the generator, shaft and gearbox, power electronic converter and transformer); and a tower (containing lifting equipment and switchgear).

Glossary of Abbreviations

Term	Definition
μT	Microteslas
AC	Alternating current
B-field	Magnetic field
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment Fisheries and Aquaculture Science
CIEEM	Chartered Institute for Ecology and Environmental Management
CMS	Construction Method Statement
DDC	Drop-down camera
DEA	Drag embedment anchor
DP	Decommissioning Programme
DSLP	Design Specification and Layout Plan
E-fields	Direct electrical field
EIA	Environmental impact assessment
EMF	Electromagnetic field
EMODnet	European Marine Observation and Data Network
EMP	Environmental Management Plan
EUNIS	European Nature Information System
FOU	Floating offshore unit
FSS	Floating substructure
GBA	Gravity based anchor
IAC	Inter-array cable
IA-CaP	Inter-array Cable Plan
IEF	Important ecological feature
iE-field	Induced electrical field
INNS	Invasive non-native species

Term	Definition
INNSMP	Invasive Non-native Management Plan
INTOG	Innovation and Targeted Oil and Gas
JNCC	Joint Nature Conservation Committee
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MD-LOT	Marine Directorate Licensing Operations Team
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
N.D.	No date
nm	Nautical mile
NMBAQC	National Marine Biological Control Scheme
NR	Not relevant
O&M	Operation and maintenance
OfSS	Offshore substation
OfTDA	Offshore Transmission Development Area
OMP	Operation and Maintenance Plan
OnTDA	Onshore Transmission Development Area
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PMF	Priority Marine Feature
PSD	Particle size distribution
SKS	Station keeping system
SSC	Suspended sediment concentration
UXO	Unexploded ordnance
VMNSP	Vessel Management and Navigational Safety Plan
v/m	volt per metre
WCS	Worst-case scenario

Term	Definition
WFDA	Wind Farm Development Area
WTG	Wind turbine generator

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7 Benthic Ecology

7.1 Introduction

1. This Chapter of the Bellrock Wind Farm Development Area (WFDA) Environmental Impact Assessment (EIA) Report presents an assessment of potential effects on benthic ecology from the construction, operation and maintenance (O&M), and decommissioning phases of the Bellrock Wind Farm Infrastructure.

2. The Bellrock Wind Farm Infrastructure comprises wind turbine generators (WTGs); floating substructures (FSSs), station keeping systems (SKSs) and associated scour protection; inter-array cables (IACs) and associated cable protection; subsea cable hubs; and ancillary infrastructure including buoys. Further detail on the Bellrock Wind Farm Infrastructure is provided in **Chapter 4: Project Description (Volume II)**.

3. This Chapter of the Bellrock WFDA EIA Report has been prepared to provide the Marine Directorate - Licensing and Operations Team (MD-LOT) (on behalf of the Scottish Ministers) and stakeholders with sufficient information to determine the potential effects of the Bellrock Wind Farm Infrastructure on benthic ecology receptors.

4. This Chapter should be read in conjunction with the following chapters of the Bellrock WFDA EIA Report:

- **Chapter 6: Marine Geology, Oceanography and Physical Processes (Volume II)**; and
- **Chapter 8: Fish and Shellfish Ecology (Volume II)**.

5. The benthic ecology assessment is likely to have key inter-relationships with the above chapters, which will be considered appropriately throughout this Bellrock WFDA EIA Report.

6. Additional information to support the benthic ecology assessment includes:

- **Appendix 7.1: Benthic Ecology Baseline (Volume IV)**;
- **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**;
- **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report (Volume IV)**; and
- **Appendix 8.1: Electromagnetic Fields Assessment Report (Volume IV)**.

7. This Chapter was prepared by Haskoning.

7.2 Legislation, Policy and Guidance

8. **Table 7.1** describes the legislation, policy and guidance which have been considered in the preparation of this Chapter. The overarching policy and legislation relevant to the Bellrock Wind Farm Infrastructure is described in **Chapter 2: Policy and Legislative Context (Volume II).**

9. Any legislation referred to in this EIA Report is as subsequently amended and as currently in force as at the date of this Bellrock WFDA EIA Report.

Table 7.1: Summary of Relevant Legislation, Policy and Guidance for Benthic Ecology

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Legislation	
The Conservation of Offshore Marine Habitats and Species Regulations 2017 (referred to as the "Offshore Marine Regulations 2017")	Applies to Marine Licence and s.36 Consent applications within Scottish waters beyond 12 nautical miles (nm).
The Wildlife and Countryside Act (1981)	Provides a list of threatened species for which killing, injuring or taking by any method is prohibited. This act is applicable to both the terrestrial and marine environment.
Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6	Makes amendments to the Wildlife and Countryside Act (1981), strengthening the legal protection for threatened species to include 'reckless' acts. This act is applicable to both the terrestrial and marine environment.
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) (the 'OSPAR Convention') 1992	Provides a legal framework to protect and conserve maritime ecosystems through the prevention and elimination of pollution from offshore sources.
Marine and Coastal Access Act 2009	Sets out the requirements for Marine Licencing in Scottish waters between 12 nm and 200 nm.
Policy	
Blue Economy Vision for Scotland 2022	Provides a strategic framework that guides marine policies to achieve sustainable use of Scotland's marine environment up to 2045.
The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention, 1979)	Promotes national policies for the conservation of wild flora, wild fauna and natural habitats.
Convention on Biological Diversity 1992	Sets overarching international commitments for the conservation and sustainable use of biodiversity, supporting the protection of marine habitats and species and informing national legislation and policy.
Scottish Biodiversity Strategy to 2045	The Scottish Biodiversity Strategy to 2045 sets out a long-term vision for Scotland to become 'Nature Positive by 2030' and to have restored and regenerated biodiversity across land, freshwater, and seas by 2045.

<table>
<tr><th>Relevant Legislation, Policy or Guidance</th><th>Relevance to the Assessment</th></tr>
<tr><td>Scotland's National Marine Plan (2015)</td><td>The following general policies apply to this benthic ecology assessment:
"General Policy (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.
Protect and, where appropriate, enhance the health of the marine area."
"GEN 13 Noise: Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects."
The SNMP is currently being updated, transitioning to the Scottish National Marine Plan 2.

Consultation on the SNMP ran from 5th November 2024 to 7th February 2025 and a consultation analysis report has been produced by the Scottish Government (2025).</td></tr>
<tr><td>Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020c)</td><td>Seeks to identify sustainable plan options for the future development of commercial-scale offshore wind energy in Scotland. This includes deep water wind technologies and covers both Scottish inshore and offshore waters. The plan recognises that offshore wind development can result in physical disturbance to the seabed, including habitat loss, sediment resuspension, and changes to benthic communities, and seeks to minimise these impacts through spatial planning and environmental assessment. The 2020 SMP is undergoing review to reflect the ScotWind and Innovation and Targeted Oil and Gas (INTOG) leasing rounds and is anticipated to be published in summer 2026.</td></tr>
<tr><td colspan="2">Guidance</td></tr>
<tr><td>Joint Nature Conservation Committee (JNCC), Marine Monitoring Handbook, (JNCC, 2001)</td><td>These guidelines have been produced to promote good practice in marine monitoring.</td></tr>
<tr><td>Ware, S.J. & Kenny, A.J. (2011) Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites, 2nd ed. Marine Aggregate Levy Sustainability Fund</td><td>This guidance promotes a comprehensive and consistent approach to the assessment of the benthic environment (i.e. sediments and associated benthic fauna).</td></tr>
<tr><td>Centre for Environment Fisheries and Aquaculture Science (Cefas), Guidelines for Data Acquisition to Support Marine Environmental Assessments for Offshore Renewable Energy Projects (Cefas, 2012)</td><td>These guidelines assist in the design, review and implementation of environmental data collection and analytical activities associated with all stages of offshore renewable energy developments.</td></tr>
</table>

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Guidance and publications from NatureScot and Marine Scotland on Priority Marine Features (PMF) and Marine Protected Area (MPA) search features (Tyler-Walters et al. 2016)	Provides guidance on the PMF and MPA features.
Chartered Institute for Ecology and Environmental Management (CIEEM), Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2024)	Provides practical advice for all professionals involved with ecological evaluation and assessment for proposed developments in terrestrial, freshwater, marine and coastal environments. The guidelines support robust assessment of benthic impacts by outlining methods for evaluating seabed disturbance, habitat sensitivity, and the significance of effects on infaunal communities.
NatureScot guidance on marine invasive non-native species (NatureScot, 2023)	Provides guidance on invasive non-native species (INNS) known to threaten Scotland.
Guidance on Non-Native Species, approved by the Scottish Parliament (Scottish Government, 2012)	Provides information on the marine invasive non-native species that could be a threat to the natural ecology of Scottish waters.

7.3 Consultation

10. Consultation undertaken to date for the Bellrock Wind Farm Infrastructure relevant to benthic ecology has been undertaken in line with the general process described in **Chapter 5: EIA Methodology (Volume II)**. Key consultation pertinent to this Chapter is provided in **Table 7.2** below.

Table 7.2: Consultation Relevant to Benthic Ecology

Consultee	Date/Document	Comment	How/Where Comment is Addressed
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	The Scottish Ministers, in line with NatureScot, are content with the proposed study area described in Section 6.4.1 and the approach that the buffer may be refined based on the distance of one tidal ellipse.	The benthic ecology study area has been refined to 4.7 km (one tidal ellipse) and is discussed further in **Section 7.5.1**.
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	The Scottish Ministers are also broadly content with the proposed data sources used to characterise the baseline in Section 6.4.2, however, highlight the additional source referenced by NatureScot in its representation and request that this is considered in the EIA Report.	Data and information sources used throughout this Chapter are outlined in **Section 7.5.2**. The additional information source (OneBenthic Tool; Cefas, 2023) has been utilised to inform the existing baseline environment (**Appendix 7.1: Benthic Ecology Baseline (Volume IV)**).
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	In line with the representation from NatureScot, the Scottish Ministers broadly agree with the impacts to be scoped in and out as summarised in Table 6.6 of the Scoping Report. The Scottish Ministers highlight the representation made by NatureScot regarding introduction of invasive non-native species from any source, not just marine traffic, and advise that this is fully considered across all phases within the EIA Report. Additionally, the Scottish Ministers highlight the representation made by Scottish Fishermen's Federation (SFF) relating to impacts to benthic invertebrates due to thermal emissions from subsea electrical cables and advise that consideration is given to this in the EIA Report.	Introduction of invasive non-native species from any source, not just marine traffic, is considered in **Sections 7.8.1.3, 7.8.2.3,** and **7.8.3.3** (for construction, O&M, and decommissioning, respectively). Impacts to benthic invertebrates due to thermal emissions from subsea electrical cables are considered in **Section 7.8.2.7**.
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	With regard to the approach to the assessment set out in Section 6.7, the Scottish Ministers are content.	Noted. The assessment methodology is set out in **Section 7.4**.
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	The Scottish Ministers note that the Mitigation Register (Appendix 3) includes relevant plans and biosecurity measures. In line with the NatureScot representation, the Scottish Ministers advise that best practice measures should be considered within the EIA Report.	In addition to the relevant policy, legislation and guidance, best practice embedded mitigation measures are proposed in **Section 7.7.3**.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	Section 6.6.3 of the Scoping Report considers potential cumulative impacts. In line with the NatureScot representation, the Scottish Ministers advise that the Cumulative Effects Assessment for benthic ecology should consider all impacts which may arise from the development and not be limited to the three impacts highlighted in paragraph 467 of the Scoping Report. Additionally, the Scottish Ministers advise that the impacts of electromagnetic field are also considered in the cumulative assessment in line with advice from NatureScot.	Impacts for which the significance of effect was assessed in the WFDA alone assessment as 'negligible', or above have been considered in the CEA, as appropriate. The CEA is provided in **Section 7.9**. This includes EMF.
MD-LOT	Bellrock WFDA Scoping Opinion (2024).	The Scottish Ministers are in agreement that transboundary impacts can be scoped out of the EIA for Benthic Ecology, as discussed in Section 6.6.4 of the Scoping Report.	Noted. Transboundary impacts are scoped out.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	The proposed study area includes a 10 km buffer around the Bellrock WFDA. However, we note that this buffer will be refined based on the distance of one tidal ellipse. We are content with this approach.	The benthic ecology study area has been refined to 4.7 km (one tidal ellipse) and is discussed further in **Section 7.5.1**.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	Within the Bellrock WFDA Scoping Report the existing environment is presented in Section 6.4 and data sources are included in Table 6.3. Site-specific benthic surveys, conducted during 2023, are outlined in Section 6.4.2.1. It is noted that data collected during these surveys will be used to inform the EIA Report. We are content that the combination of existing data sources and site-specific surveys should provide adequate information to characterise the baseline environment.	Site-specific survey data collected in 2023 from within the Bellrock WFDA have been used to inform this Chapter and **Appendix 7.1: Benthic Ecology Baseline (Volume IV)**, with full details provided in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**. The existing environment is summarised in **Section 7.6** and the relevant data and information sources in **Section 7.5.2**.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	The data sources listed in Table 6.3 are appropriate and will provide useful contextual information. In addition to the data sources identified, we also recommend that the Cefas OneBenthic Baseline Tool may also be useful, this tool can be accessed online.	Data and information sources used throughout this Chapter are outlined in **Section 7.5.2**. The additional information source (OneBenthic Tool; Cefas, 2023) has been utilised to inform the existing baseline environment (**Appendix 7.1: Benthic Ecology Baseline (Volume IV)**).

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	Section 6.5 identifies potential impacts from the Bellrock WFDA during the construction, O&M, and decommissioning phases (as summarised in Table 6.6). As outlined in Section 3.9.2 and Section 6.5.1, potential impacts from pre-construction works are to be considered alongside construction phase impacts and will be discussed further within the WFDA EIA Report technical chapters. We are generally content with the impacts identified in Section 6.5, noting one exception. Section 6.5.1 lists “Introduction of INNS from marine traffic” and Table 6.6 lists “Introduction of INNS from vessel traffic”. We advise the introduction of INNS from any source should be included, not just marine traffic. Other sources may include, for example, floating structures which may be towed into position and/or towed during maintenance activities (if required), and wet storage of floating structures (if required).	The impacts of site preparation works are considered alongside construction activities in **Section 7.8.1**. The impacts considered in this Chapter can be seen in the ‘impact’ column of **Table 7.15**. These comprise: ▪ Physical disturbance and temporary habitat loss; ▪ Increased suspended sediment concentrations (SSCs) and re-deposition; ▪ Introduction of INNS; ▪ Permanent habitat loss; ▪ Colonisation of introduced substrate (and removal of introduced substrate during decommissioning); ▪ Interactions with electromagnetic frequencies; and ▪ Thermal emissions from subsea electrical cables. Introduction of invasive non-native species from any source, not just marine traffic, is considered in **Sections 7.8.1.3, 7.8.2.3,** and **7.8.3.3** (for construction, O&M, and decommissioning, respectively). The temporary mooring of FSSs and/or FOUs at dedicated locations (known as ‘wet storage’) for the Bellrock Project will be considered through separate consenting process(es) as required. The Applicant is not seeking consent for wet storage within this application, and it has not been included within the scope of this EIA Report. Any proposed projects in the public domain for wet storage facilities on the east coast of Scotland have been considered within the cumulative assessment along with other projects and plans (**Appendix 5.3: Cumulative Effects Assessment Long List of Projects (Volume IV)**).

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	We are content with the impacts scoped in/out as per Section 6.6, with one exception. As discussed above, we advise that INNS should be scoped in from any source and not just marine traffic. This should be scoped in across pre/construction, operation and decommissioning phases. Although there are mitigation measures (i.e. management plans) which can help reduce the risks, there is still a lot of uncertainty around their effectiveness to reduce the spread of INNS. The Scoping Report states that it is assumed floating substructures/ floating offshore units will be towed from a UK-based port and not internationally. However, there are INNS present in certain ports around the UK which could pose a risk if transferred elsewhere in UK waters. Moreover, the potential for offshore wind farms to act as stepping stones for INNS should be considered. This should be considered in the EIA Report.	Introduction of invasive non-native species from any source, not just marine traffic, throughout all phases of the Bellrock Wind Farm Infrastructure, is considered in **Sections 7.8.1.3, 7.8.2.3,** and **7.8.3.3** (for construction, O&M, and decommissioning, respectively). An Invasive Non-native Species Mitigation Plan (INNSMP) will be created and adhered to as an embedded mitigation measure. The INNSMP will detail the control measures that will be implemented in order to reduce the risk of introduction and spread of INNS as far as practicable.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	The proposed approach to impact assessment is outlined in Section 6.7, we are content with the approach for benthic ecology as described in this section.	Noted. The assessment methodology is set out in **Section 7.4**.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	Potential cumulative effects are discussed in Section 6.6.3. We note that paragraph 467 states that the CEA for benthic ecology will specifically consider cumulative noise effects, habitat loss and changes to seabed habitat which may be pre-empting findings of the individual assessment. We advise that the CEA should include all impacts which may arise from the development, and not be limited to the three impacts highlighted in paragraph 467. Furthermore, it should also include any impacts which could be identified as minimal for the individual development but may have impacts when considered cumulatively (such as EMF). Regarding EMF, we have observed a tendency for wind farm projects to reach a no LSE conclusion for EMF impacts from a cumulative perspective. However, noting the proposed	Noted. The CEA methodology is summarised in **Section 7.4.2**, and the CEA is presented in **Section 7.9**, all impact pathways considered for the Bellrock WFDA alone assessment have been considered for the potential to give rise to cumulative effects.

Consultee	**Date/Document**	**Comment**	**How/Where Comment is Addressed**
		number of offshore wind developments in Scottish waters, we are concerned that the spatial and temporal scale is not being sufficiently considered cumulatively across the network of cables, including those outwith of the proposed development. Thus, we advise that EMF impacts are considered in the cumulative assessment.	
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	The embedded mitigation measures proposed in the Mitigation Register (Appendix 3) include relevant plans and biosecurity measures. We advise that further best practice measures should be considered at the EIA stage. Where possible, we encourage consideration of collaborating and contributing to strategic monitoring of EMF impacts from cables (for example, through ScotMER), to help build understanding of these poorly understood impacts.	In addition to the relevant policy, legislation and guidance, best practice embedded mitigation measures are detailed in **Section 7.7.3**, the effects of EMF on benthic receptors within the Bellrock WFDA have been considered in **Section 7.8.2.6**, informed by an EMF Assessment (**Appendix 8.1: Electromagnetic Fields Assessment of the Bellrock WFDA (Volume IV)**). The Bellrock Project would consider taking part in a strategic EMF study should one be proposed by industry bodies or Statutory Nature Conservation Bodies.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024).	Section 6.6.4 proposes to scope out transboundary benthic effects from further consideration with the EIA Report, this is due to the localised and small-scale nature of impacts on benthic ecology. We are content that transboundary effects can be scoped out for benthic ecology interests.	Noted. Transboundary impacts are scoped out.
Scottish Fishermen's Federation	Representation on the Bellrock WFDA Scoping Report (2024).	SFF would like to see the 'Impacts to benthic invertebrates due to thermal emissions from subsea electrical cables' to also be scoped in since any temperature change in the invertebrate's habitat would have adverse effects on their behaviour and increase their mortality rate.	Impacts to benthic invertebrates due to thermal emissions from subsea electrical cables are considered in **Section 7.8.2.7**.
MD-LOT	Email from MD-LOT to Applicant (sent 17th December 2025).	MD-LOT considers the deposit of marine growth to be a licensable activity under section 21 of the Marine (Scotland) Act 2010 (0-12 nm) and section 66 of the Marine and Coastal Access Act 2009 (12-200 nm). We believe that a Marine Licence application for this activity should be kept separate from Bellrock's upcoming s.36	Noted. The assessment undertaken in this Chapter considers the potential impact and effect of marine growth removal and subsequent deposition on the seabed in a qualitative manner.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
		Consent and Marine Licence applications, as it could be challenging to include deposit of marine growth as part of the s.36 Consent and Marine Licence applications due to various considerations and assessments alongside the activity, such as HRA/MPA implications; seasonal impacts; Invasive Non-Native Species, and what we understand about that now (and how we deal with it) will likely be out of date when the Bellrock Wind Farm becomes operational. As such, MD-LOT believe it would be best to keep this licensable activity separate from the s.36 Consent which ultimately avoids any unnecessary varying of the consent over marine growth activities in the future. MD-LOT advise that Bellrock should include information on marine growth as part of the upcoming EIA, outlining the removal process from the structures etc, with an understanding that there might not be in-depth detail presented at the time as the activity is very circumstantial and ad hoc; but that the information/findings within the EIA will be taken forward into the operational phase when there is a better understanding of things such as the volume of marine growth, type of marine growth, the nature of how the marine growth will practically be removed etc. This is when marine growth is more commonly referenced in an Operations and Maintenance Programme post-consent plan, and it can be looped into broader operational plans and hammered out in further detail. In the operational phase is when we would expect to see a separate Marine Licence application for the deposit of marine growth, as a result of maintenance and cleaning activities, with an accompanying Invasive Non-native Species Plan.	

7.4 Assessment Methodology

7.4.1 Impact Assessment Methodology

11. **Chapter 5: EIA Methodology (Volume II)** provides a summary of the general impact assessment methodology applied in the Bellrock WFDA EIA Report. The assessment will use the conceptual 'source-pathway-receptor' model. The model identifies potential impacts resulting from the proposed activities on the environment and sensitive receptors within it.

12. A desk-based study was undertaken to inform the benthic ecology assessment. **Table 7.12** sets out the key desk-based information and data sources that have been used to inform the benthic ecology EIA, allowing for the identification and scoping process of potential impacts associated with the development of the Bellrock Wind Farm Infrastructure. Site-specific benthic and geophysical surveys have been undertaken within the Bellrock WFDA, and the results have informed this Chapter. A summary of these site-specific surveys is provided in **Table 7.13**.

7.4.1.1 Definitions of Sensitivity and Magnitude

13. The characterisation of the existing environment helps to determine the receptor sensitivity in order to assess the potential impacts upon it. The Marine Evidence based Sensitivity Assessment (MarESA) provided by the Marine Life Information Network (MarLIN) have been used as the basis for assessing sensitivity throughout this Chapter. Additionally, project-specific context and expert judgement have been applied. This is particularly relevant to those receptors where sensitivity has been based on pressures that are different to those of the activities associated with the Bellrock Wind Farm Infrastructure. Sensitivity is defined with regard to the ability of a receptor to adapt to change, tolerate, and/or recover from potential impacts, as given in **Table 7.3**. MarESA also utilises the 'not relevant' label where the evidence base suggests that there is no direct interaction between the pressure and the biotope group.

14. In addition, for some assessments the value of a receptor may also be an element to add to the assessment of sensitivity where relevant. Receptor value considers whether, for example, the receptor is rare, has protected or threatened status, importance at local, regional, national or international scale (**Table 7.8**). The influence of value upon the overall sensitivity of a receptor is a matter of professional judgement and is applied on a case-by-case basis.

Table 7.3: Definition of Sensitivity Levels for Benthic Ecology Receptors

Sensitivity	Definition
High	Individual receptor has very limited or no capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to accommodate, adapt to or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

15. The MarESA for benthic ecology receptors includes their respective level of resistance (tolerance) and resilience (recoverability) to each pressure. Resistance refers to whether a receptor can absorb disturbance or stress without changing character, and resilience refers to the ability of a receptor to recover from disturbance or stress. The definitions of each level of resistance and resilience are defined in **Table 7.4** below. In the absence of a MarESA for a specific receptor, the same definitions of resistance and resilience are applied, supported by evidence from the best available literature.

Table 7.4: MarESA Definitions of Resistance and Resilience Levels

Level	Definition (Tyler-Walters et al. 2018)
Resistance	
None	Key functional, structural, characterising species severely decline and/or physicochemical parameters are also affected e.g. removal of habitats causing a change in habitat type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat component (where this can be sensibly applied).
Low	Significant mortality of key and characterising species with some effects on the physicochemical character of habitat. A significant decline/reduction relates to the loss of 25-75% of the extent, density, or abundance of the selected species or habitat component.
Medium	Some mortality of species (can be significant where these are not keystone structural/functional and characterising species) without change to habitats relates to the loss of less than 25% of the species or habitat component.
High	No significant effects on the physicochemical character of habitat and no effect on population viability of key/characterising species but may affect feeding, respiration and reproduction rates.
Resilience	
Very low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function.
Low	Full recovery within 10 - 25 years.
Medium	Full recovery within 2 - 10 years.
High	Full recovery within 2 years.

16. The MarESA sensitivity assessments use a matrix-based approach to determine sensitivity. This matrix is presented in **Table 7.5**.

Table 7.5: MarESA Sensitivity Assessment Matrix

Resilience	Resistance			
	None	Low	Medium	High
Very low	High	High	Medium	Low
Low	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
High	Medium	Low	Low	Not sensitive

17. Each MarESA sensitivity assessment includes a confidence score, based on the quality of the evidence or information used, the degree to which evidence is applicable to the assessment and the degree of agreement between evidence types.

Table 7.6: MarESA Confidence Assessment Categories for Evidence

Confidence Level	Quality of Evidence	Applicability of Evidence	Degree of Concordance
High	Based on peer-reviewed papers (observational or experimental) or grey literature reports by established agencies (give number) on the feature (habitat, its component species, or species of interest).	Assessment based on the same pressures acting on the same type of feature (habitat, its component species, or species of interest) in the UK.	Agree on the direction and magnitude (of impact or recovery).
Medium	Based on some peer-reviewed papers but relies heavily on grey literature or expert judgement on the feature (habitat, its component species, or species of interest) or similar features	Assessment based on similar pressures on the feature (habitat, its component species, or species of interest) in other areas.	Agree on direction but not magnitude (of impact or recovery).
Low	Based on expert judgement.	Assessment based on proxies for pressures e.g. natural disturbance events.	Do not agree on the direction or magnitude (of impact or recovery).

18. This method of confidence assessment, adapted from Tillin et al. (2010), combines resistance and resilience confidence scores into an overall rating for each feature-pressure interaction, as summarised in **Table 7.7.**

Table 7.7: MarESA Example Combined Confidence Assessments (Based on 'Quality of Evidence' Assessment Only)

	Resistance Confidence Score		
Resilience Confidence Score	**Low**	**Medium**	**High**
Low	Low	Low	Low
Medium	Low	Medium	Medium
High	Low	Medium	High

19. The value of a receptor is defined as its ecological importance or conservation significance. This does not always correlate with the sensitivity of a receptor, i.e. high sensitivity receptors are not always high value. For example, a receptor could be of high value (e.g. a species with an important ecological function) but have a low physical or ecological sensitivity to an impact. Conversely, a receptor could be of relatively low value but be of high sensitivity. Determination of receptor value is dependent on the individual receptor, supported by evidence from the best available literature. Where receptor value is considered, it may be utilised as a modifier for sensitivity level. The definitions of the value levels for benthic ecology receptors are laid out in **Table 7.8** below.

Table 7.8: Definition of the Value Levels for Benthic Ecology Receptors

Value	**Definition**
High	Habitats and species designated under national or international legislation (e.g. Annex I habitats under the Offshore Marine Regulations 2017), and habitats/species listed as qualifying features of designated sites (Special Area of Conservation and/or Nature Conservation Marine Protected Areas).
Medium	Habitats and species protected under national law (e.g. PMFs and MPAs). Species/habitats that may be rare or threatened in the UK. Habitats or species that provide prey items for other species of conservation value.
Low	Habitats and species are not designated and/or protected but are deemed to be a key part of the wider marine ecosystem.
Negligible	Habitats and species are not designated and/or protected and are deemed to be of limited importance for the wider marine ecosystem.

20. The magnitude and probability of an impact occurring is established through consideration of:

- Scale or spatial extent (small scale to large scale, or a few individuals to most of population);
- Duration (short term to long term);
- Likelihood of impact occurring;
- Frequency; and
- Nature of change relative to the baseline.

21. Definitions of the magnitude levels are given in **Table 7.9**.

Table 7.9: Definition of the Magnitude Levels for Benthic Ecology Receptors

Value	Definition
High	Fundamental, permanent/irreversible changes, over the whole receptor, and/or fundamental alteration to key characteristics or features of the particular receptor's character or distinctiveness.
Medium	Considerable, permanent/irreversible changes, over the majority of the receptor, and/or discernible alteration to key characteristics or features of the particular receptor's character or distinctiveness.
Low	Discernible, temporary (throughout project duration) change, over a minority of the receptor, and/or limited but discernible alteration to key characteristics or features of the particular receptor's character or distinctiveness.
Negligible	Discernible, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptor's character or distinctiveness.
No change	No measurable or discernible change from baseline conditions. The impact does not result in any alternation to the receptor.

7.4.1.2 Effect Significance

22. The potential significance of effect for a given impact, is a function of the overall sensitivity and the magnitude of the impact (see **Chapter 5: EIA Methodology (Volume II)** for further details). A matrix is used (**Table 7.10**) as a framework to determine the significance of an effect. Definitions of each level of significance are provided in **Table 7.11**. Impacts and effects may be either positive (beneficial) or negative (adverse). Impacts that are moderate or major adverse are considered to be significant in EIA terms.

Table 7.10: Matrix for Evaluating the Significance of an Effect

Sensitivity	Magnitude				
	High	Medium	Low	Negligible	No Change
High	Major	Major	Moderate	Minor	No effect
Medium	Major	Moderate	Minor	Negligible	No effect
Low	Moderate	Minor	Minor	Negligible	No effect
Negligible	Minor	Negligible	Negligible	Negligible	No effect

Table 7.11: Definitions of Effect Significance

Effect Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No effect	No change in receptor condition; therefore, no effect.

7.4.2 Cumulative Effects Assessment Methodology

23. The Cumulative Effects Assessment (CEA) considers the likely significant effects of impacts arising from the Bellrock Wind Farm Infrastructure cumulatively with other relevant plans, projects and activities. The general approach to the CEA for benthic ecology includes defining a CEA plans and projects screening area of search, identifying a short list of plans and projects for consideration, identifying potential cumulative impacts, and evaluating the significance of cumulative effects. The screening for this Chapter has been based on a four-month cut off period for other projects and plans, which represents a shorter cut-off than the six months that was proposed in the Scoping Report **(Appendix 1.1: Bellrock WFDA Scoping Report (Volume IV)**. MD-LOT were consulted during the screening process as part of ongoing consultation in the pre-application phase. **Chapter 5: EIA Methodology (Volume II)** provides further details on the general approach to the CEA, including the CEA with the Bellrock Offshore Transmission Development Area (OfTDA) and Onshore Transmission Development Area (OnTDA).

24. The plans and projects selected as relevant to the CEA for benthic ecology are based upon the results of a screening exercise (see **Appendix 5.3: Cumulative Effects Assessment Long List of Projects (Volume IV)** for details). Each plan or project has been considered on a case-by-case basis for screening in or out of this assessment based upon data confidence, impact-receptor pathways and the spatial/temporal scales involved.

25. Potential cumulative plans and projects were identified and screened in **Appendix 5.3: CEA Long List of Projects (Volume IV)**. Those which have been subsequently scoped into the CEA for benthic ecology are outlined in **Table 7.24**. Given that there is no potential pathway for impact to benthic ecology due to the proposed Bellrock Onshore Transmission Infrastructure, and therefore no potential for likely significant effects from those works on benthic ecology, the Bellrock Onshore Transmission Development Area has not been considered further within the CEA.

26. The proposed Offshore Transmission Infrastructure will be located within the Proposed Bellrock OfTDA and is assessed within the Bellrock WFDA CEA because of potential receptor impact pathways. As the OfTDA boundary overlaps with the Bellrock WFDA, the likely significant effects of the Bellrock Wind Farm Infrastructure together with the Bellrock Offshore Transmission

Infrastructure within the overlapping area, so far as these can be ascertained at this stage, are assessed within the Bellrock WFDA EIA Report.

27. In line with the methodology set out in **Chapter 5: EIA Methodology (Volume II)**, three tiers have been applied to the Bellrock WFDA CEA. As the site selection process for the Bellrock OfTDA and OnTDA is ongoing (see **Chapter 4: Project Description (Volume II)** for details), activities and infrastructure associated with the Bellrock OfTDA and Bellrock OnTDA will be treated as 'other projects' for the purposes of the CEA, but have been considered within Tier 1 where relevant, due to their essential requirement for the function of the Bellrock Project.

28. The three tiers for CEA are:

- Tier 1 assessment: The Bellrock WFDA plus plans/projects which are operational, under construction, those with consent or a consent application submitted but not yet determined, plus the Bellrock OfTDA and Bellrock OnTDA;
- Tier 2 assessment: The Bellrock WFDA plus all plans/projects assessed under Tier 1, plus those projects with a Scoping Report and/or Scoping Opinion; and
- Tier 3 assessment: The Bellrock WFDA plus all plans/projects assessed under Tier 1 and Tier 2, plus those projects likely to come forward where a Crown Estate Scotland Option to Lease Agreement or equivalent has been granted.

7.4.3 Transboundary Effects Assessment Methodology

29. The transboundary effects assessment considers the potential for effects to occur as a result of the Bellrock Wind Farm Infrastructure on benthic ecology within the Exclusive Economic Zone of other European Economic Area member states or other interests of European Economic Area member states.

30. For benthic ecology, there is no potential for impacts on transboundary receptors, and therefore, transboundary effects have been scoped out. This has been agreed with MD-LOT (see **Table 7.2**) as part of the Scoping Opinion (**Appendix 1.2: Bellrock WFDA Scoping Opinion (Volume IV)**).

7.5 Scope of the Assessment

7.5.1 Study Area

31. The benthic ecology study area includes the Bellrock WFDA with a buffer of 4.7 km (**Figure 7.1.1** (**Appendix 7.1: Benthic Ecology Baseline (Volume IV)**). This represents the Zone of Influence of the construction, O&M and decommissioning effects from the Bellrock Wind Farm Infrastructure, which equates to approximately one spring tidal ellipse from the boundary of the Bellrock WFDA. This is the maximum distance that sediments could be advected by tidal currents and deposited on the seabed (as detailed in the **Chapter 6: Marine Geology, Oceanography, and Physical Processes (Volume II)**).

7.5.2 Data and Information Sources

32. **Table 7.12** sets out the key desk-based information and data sources that have been used to inform the benthic ecology baseline.

Table 7.12: Key Data and Information Sources for Benthic Ecology

Dataset	Year(s)	Description
Marine Protected Areas	2017 - 2024	Marine Protected Area reports from NatureScot.
Priority Marine Features	2023 - 2025	Geodatabase for Marine Habitats and Species – Scottish PMF. (https://opendata.nature.scot/maps/0e722e3e911e424f8dacac5a587c0dfb/about).
Priority Marine Habitats	2014 - 2024	Priority marine habitats information from NatureScot and JNCC.
North Sea benthic data	2025	UK Atlas of Seabed Habitats Combined Map v2025 (https://opendata.nature.scot/maps/0e722e3e911e424f8dacac5a587c0dfb/about).
North Sea habitats	2004 - 2014	European Marine Observation and Data Network (EMODnet) Seabed Habitats, data ranging from 2004 – 2014 (https://emodnet.ec.europa.eu/en/seabed-habitats).
North Sea benthic data	1964 - 2004	MarLIN (https://www.marlin.ac.uk/).
North Sea benthic habitats	2025	MAGIC interactive map (https://magic.defra.gov.uk/).
North Sea benthic habitats	2025	National Marine Plan Interactive map (https://marinescotland.atkinsgeospatial.com/nmpi/).
Macrofaunal assemblage data	1976 - 2020	OneBenthic Baseline Tool by Cefas (https://rconnect.cefas.co.uk/content/25/).
Macrofaunal distribution data	1969 - 2016	A big data approach to macrofaunal baseline assessment, monitoring, and sustainable exploitation of the seabed (Cooper and Barry, 2017).

7.5.2.1 Site-specific Surveys

33. Site-specific surveys have been undertaken to support the desk-study by providing accurate and detailed environmental information. **Table 7.13** summarises the site-specific surveys relevant to benthic ecology undertaken to date, with full details provided in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV).**

34. The results of the site-specific surveys have been used to validate and refine the findings from broadscale datasets such as EMODnet and MarLIN, ensuring that the baseline benthic characterisation reflects recent conditions. The survey data have also been used to support the identification of sensitive benthic receptors, inform the assessment of potential impacts from the

Bellrock Wind Farm Infrastructure, increase the robustness of sensitivity and confidence evaluations, and guide the development of appropriate mitigation measures.

35. The benthic survey involved sampling a total of 113 combined drop-down camera (DDC) and grab sampling stations across the Bellrock WFDA, which has an area of 280 km^2. This equates to an estimated sampling density of approximately one station per 10 km^2, which informs the spatial resolution of the dataset. Each sampling station was screened using DDC (video and photos) to determine suitability for grab sampling.

36. If the site was deemed unsuitable, the sampling station was repositioned in a nearby area of sediment and revisited with DDC prior to grab sampling. If the site was deemed suitable; it was sampled with a 0.2 m^2 dual Van Veen grab sampler, within 20 m of the target sampling location. Each sediment sample then underwent macrobenthic and particle size distribution (PSD) analysis. Water samples for environmental deoxyribonucleic acid analysis were also collected at three different depths at 10 sampling stations.

37. All elutriation, extraction, identification and enumeration of macrobenthos in the grab samples was undertaken in line with the National Marine Biological Control Scheme (NMBAQC) Processing Requirement Protocol (Worsfold and Hall, 2010). Biomass was measured as blotted wet weight in grams to at least 4 decimal places for all countable taxa (i.e. at species level where possible).

38. As a standard, the conventional conversion factors as defined by Eleftheriou & Basford (1989) were applied to biomass data to provide equivalent dry weight biomass (ash free dry weight). Habitats were identified and classified in accordance with the European Nature Information System (EUNIS) 2008 habitat classification system, in considerations of JNCC guidance on assigning benthic biotopes (Parry, 2019).

39. EUNIS habitat and biotope classifications were assigned based on integrated analysis of seabed imagery, broad-scale habitat data derived from PSD analysis, acoustic data, and existing habitat maps (e.g. EMODnet). Seabed features were classified to the highest possible resolution, with habitat and biotope determinations informed by a combined interpretation of geophysical data, PSD analysis, and seabed imagery.

40. All DDC stations were sampled in consideration of the JNCC epibiota remote monitoring operational guidelines (Hitchin et al. 2015) and the latest NMBAQC/JNCC Epibiota Quality Assurance Framework guidance and identification protocols (NMBAQC, 2022). Where necessary, the DDC images were analysed to determine whether Annex I geogenic or biogenic reef habitats were present within the Bellrock WFDA.

41. An Annex I habitat assessment was undertaken on the DDC imagery to determine whether any habitats present met the criteria for definition as Annex I geogenic or biogenic reef.

Table 7.13: Summary of Site-specific Surveys for Benthic Ecology

Survey	Spatial Coverage	Year(s)	Description
Benthic	Bellrock WFDA	2023	The benthic survey was conducted by TerraSond Limited (TerraSond) between 5 July 2023 and 28 July 2023. The survey consisted of grab sampling and drop-down video at 113 stations. Water samples for environmental DNA analysis were collected at three different depths at 10 sampling stations.
Geophysical survey	Bellrock WFDA	2023	The geophysical and hydrographic survey was conducted by TerraSond between 24 June 2023 and 12 August 2023 and consisted of side-scan sonar, multibeam echosounder, magnetometer, parametric sub-bottom profiler, and Sparker.

7.5.2.2 Assumptions and Limitations

42. The data and information sources used to inform this Chapter are provided in **Table 7.12** above. These are the most up-to-date public data and information sources available at the time of writing and have been informed, where practicable, through consultation with stakeholders. Details of the site-specific surveys used to characterise the benthos of the Bellrock WFDA are provided in **Section 7.5.2.1** and summarised **Table 7.13** above. The site-specific surveys were conducted during periods of favourable weather over a 23-day period in July 2023. The temporal resolution of the data could therefore incur some limitations, such as the 23-day window being insufficient to observe longer-term trends or uncommon events (e.g. storm-driven mixing), or the dataset being biased toward conditions that only occur during calm or sunny periods. The spatial resolution of the data equates to one sampling station per 10 km^2, which could mean that small-scale variability (e.g. microhabitats or patchy species distributions) is not accounted for. However, the site-specific surveys and sampling design are considered high-resolution within the context of EIA and are therefore considered sufficiently detailed and accurate to inform this Chapter.

43. Some uncertainty is inherent in taxonomic identification, biotope classification, and the resolution of the datasets, which may influence the precision of habitat mapping. Variability in data quality, analyst interpretation, and natural habitat transitions can also affect classification outcomes. However, site-specific data were thoroughly validated under NMBAQC protocols, with habitats classified using EUNIS standards based on integrated analysis of seabed imagery, PSD, acoustic data, and existing habitat maps, following JNCC guidance.

44. Benthic habitat classification integrates datasets of varying spatial and temporal resolution, which may affect the precision of biotope boundaries. Minor uncertainty may also arise from natural variability in benthic communities and potential changes since the time of survey. However, these limitations are considered negligible and do not materially affect the confidence in the baseline or the outcomes of the assessment.

7.6 Existing Environment

45. The existing baseline benthic environment within the Bellrock WFDA is described in detail in **Appendix 7.1: Benthic Ecology Baseline (Volume IV)** and is summarised in the following sections.

7.6.1 Seabed Sediments

46. Seabed sediment samples (**Figure 7.1.2** and **Figure 7.1.3** (**Appendix 7.1: Benthic Ecology Baseline (Volume IV)**) from within the Bellrock WFDA underwent contaminant analysis and particle size analysis. The contaminant analysis included heavy and trace metals, organotins, polyaromatic hydrocarbons, tetrahydrocannabinols, and polychlorinated biphenyls. The results found that all contaminants were below any given reference level (e.g. Cefas Action Levels) at all sampling stations across the Bellrock WFDA. The particle size analysis showed that the Bellrock WFDA is dominated by sand. Mud content of the sediment increased with water depth, and gravel content was low throughout.

7.6.2 Habitats and Communities

47. Habitats were classified using the EUNIS habitat classification (European Environment Agency, 2022) and JNCC marine habitat classification for Britain and Ireland (JNCC, 2022). Throughout the Bellrock WFDA, three EUNIS level 5 biotope complexes were identified:

- *Owenia fusiformis* and *Amphiura filiformis* in Deep Circalittoral Sand or Muddy Sand (EUNIS classification: A5.272);
- *Ampharete falcata* turf with *Parvicardium ovale* on Cohesive Muddy Sediment Near Margins of Deep Stratified Seas (EUNIS classification: A5.371); and
- *Paramphinome jeffreysii, Thyasira spp*. and *Amphiura filiformis* in Offshore Circalittoral Sandy Mud (EUNIS classification: A5.376).

48. The latter two biotopes (A5.371 and A5.376), which are component biotopes of the Offshore Deep Sea Muds PMF form a mosaic habitat in the eastern reaches of the Bellrock WFDA which overlaps with an area of burrowed mud. However, the macrobenthos at these locations did not correspond to a component biotope of the Burrowed Mud PMF. Therefore, the Burrowed Mud PMF was only identified at a broad scale, which suggests that this area corresponds to a combination of Burrowed Mud and Offshore Deep Sea Muds PMFs. The biotope A5.272 represents the PMF habitat 'offshore subtidal sands and gravels'. PMF habitats have been identified by the Marine Directorate, JNCC and NatureScot as being a priority for conservation in Scotland's seas (Scottish Government, N.D.). No INNSs were identified within the site-specific surveys, nor were any Annex I biogenic/geogenic reefs.

49. Site-specific surveys have identified Norway lobster *Nephrops norvegicus* within the Bellrock WFDA. Whilst this species is associated with the benthic environment, particularly in burrowed mud habitats (which have been identified within the Bellrock WFDA), it is a commercially important species. As a result, it is considered within **Chapter 8: Fish and Shellfish Ecology (Volume II)** and **Chapter 11: Commercial Fisheries (Volume II).**

7.6.3 Important Ecological Features

50. Important ecological features (IEFs) are important benthic habitats, species, or biotopes, that may be affected by the Bellrock Wind Farm Infrastructure. Importance is determined based on quality or extent of habitats, species or habitat rarity, and/or the extent to which they are threatened (CIEEM, 2024). The following IEFs have been identified within the Bellrock WFDA:

- Ocean quahog *Arctica islandica*;
- Phosphorescent sea pen *Pennatula phosphorea*;
- Offshore Subtidal Sands and Gravels PMF;
- Burrowed Mud PMF; and
- Offshore Deep Sea Muds PMF.

51. Throughout this assessment, the Offshore Subtidal Sands and Gravels PMF is represented by its component biotope; A5.272. In regard to the Burrowed Mud and Offshore Deep Sea Muds PMFs, the benthic survey identified two Level 5 biotopes: A5.371 and A5.376. These are recognised components of the offshore deep sea muds PMF. While not listed as component biotopes of the Burrowed Mud PMF, the sediment type and fauna (such as cohesive mud and burrowing megafauna) match its broad definition. Based on this, and following a precautionary approach, the biotopes are used as proxies for both PMFs. Effects are assessed jointly to avoid duplication and ensure both PMFs are considered.

52. Some impact pathways relevant to ocean quahog are also considered in the Fish and Shellfish Ecology Chapter (**Chapter 8: Fish and Shellfish Ecology (Volume II)**). Specifically, underwater noise and vibration and changes in fishing activity (both assessed across construction, O&M, and decommissioning phases) are assessed in the Fish and Shellfish Chapter and are not duplicated here. All other impacts on ocean quahog are considered in this Benthic Ecology chapter, as detailed in **Section 7.8**.

7.6.4 Predicted Future Baseline

53. The predicted future baseline for benthic ecology is presented in Section 4 of **Appendix 7.1: Benthic Ecology Baseline (Volume IV)**.

7.7 Potential Impacts

7.7.1 Scope

54. **Table 7.14** sets out the impacts that have been scoped in to and out of the Bellrock WFDA EIA Report, in line with the Scoping Opinion (**Appendix 1.2: Bellrock WFDA Scoping Opinion** in **Volume IV**).

55. Remobilisation of existing contaminated sediments was considered in the **Bellrock WFDA Scoping Report (Appendix 1.1 (Volume IV)),** noting "*Potential impacts related to the remobilisation of contaminants are currently scoped in for assessment. However, should the results*

of benthic sampling demonstrate low levels of sediment contamination, the Applicant would seek to scope these out of further assessment through agreement with stakeholders in future consultation." Based on the chemical analysis of sediments within the Bellrock WFDA, contaminant levels were either below the limit of detection or Cefas Action Level 1 (or any other reference level). It is therefore concluded that there are no contaminated sediments present, and remobilisation of contaminated sediments is not considered further in this Chapter. See **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)** for the full contaminant analysis.

56. The potential risk of spreading or introducing INNS through marine traffic was considered in the **Bellrock WFDA Scoping Report (Appendix 1.1 (Volume IV)**). NatureScot raised that this impact should be considered with reference to all potential vectors for the introduction and/or spread of INNS, not just marine traffic. This has been considered in **Sections 7.8.1.3, 7.8.2.3,** and **7.8.3.3** (for construction, O&M, and decommissioning, respectively).

57. While not considered in the **Bellrock WFDA Scoping Report (Appendix 1.1 (Volume IV))**, thermal emissions were raised by the SFF in their representation on the Bellrock WFDA Scoping Report. Thermal emissions are included in the assessment in **Section 7.8.2.7**, in line with the **Bellrock WFDA Scoping Opinion (Appendix 1.2 (Volume IV))**.

Table 7.14: Potential Impacts Scoped In and Scoped Out of the EIA for Benthic Ecology as Agreed in the Bellrock Wind Farm Development Area Scoping Opinion

Potential Impact	Construction	Operation and Maintenance	Decommissioning
	Advised within the Bellrock WFDA Scoping Opinion		
Physical disturbance and temporary habitat loss of seabed habitat	✓	✓	✓
Permanent habitat loss	x	✓	✓
Increased SSC and sediment re-deposition	✓	✓	✓
Remobilisation of existing contaminated sediments	x[1]	x[1]	x[1]
Introduction of INNS	✓	✓	✓
Underwater noise and vibration	x	x	x
EMF	x	✓	x
Colonisation of introduced substrate	x	✓	✓
Potential impacts on designated sites	x	x	x

Potential Impact	Construction	Operation and Maintenance	Decommissioning
	Advised within the Bellrock WFDA Scoping Opinion		
Accidental release of pollutants	x	x	x
Thermal emissions from cables[2]	x	✓	x
Transboundary impacts	x	x	x

Notes:

[1] No contaminated sediments were identified within the Bellrock WFDA therefore there is no pathway for effect on benthic receptors, and it is scoped out. This is discussed further in **Paragraph 55**.

[2] After production of the Scoping Report, it was requested (within the Scoping Opinion) that the impact of thermal emissions from subsea electrical cables on benthic ecology receptors is considered within the assessment. See **Section 7.8.2.7** for details.

7.7.2 Realistic Worst-case Scenario

58. The final design of the Bellrock Wind Farm Infrastructure will be confirmed during detailed design, post-consent. To undertake a robust and precautionary impact assessment, the realistic worst-case design scenario has been defined. Realistic worst-case scenarios (WCS) (i.e. those that cause the greatest impact) are derived from the Project Design Envelope to ensure that all other design scenarios would have equal or less impact. Please see **Chapter 5: EIA Methodology (Volume II)** for further details on the design envelope approach.

59. The realistic WCS for the benthic ecology assessment are summarised in **Table 7.15** below. These are based on the project design as described in **Chapter 4: Project Description (Volume II)**.

Table 7.15: Realistic Worst-case Scenario for Impacts on Benthic Ecology

Impact	Realistic Worst-case Scenario	Rationale
Construction		
C1: Physical disturbance and temporary loss of seabed habitat	**Total Area of Disturbance = 3.64 km^2 (3,635,158 m^2)** **Seabed Preparation = 797,032 m^2** Maximum footprint area due to boulder clearance = 4,000 m^2. Maximum footprint area due to sand wave levelling = 420,000 m^2. Maximum footprint area due to slope levelling for gravity based anchors (GBAs) only = 373,032 m^2. **Construction = 2,838,126 m^2** Mooring Lines: Maximum footprint area due to the pre-lay of mooring lines (including clump weights) on the seabed = 532,224 m^2. Anchors: Maximum seabed footprint area for all drag embedment anchors (DEAs) (including drag distance of 60 m per DEA) = 855,360 m^2. IACs: Installation method with the largest seabed footprint area = ploughing. Maximum seabed footprint area of disturbance from ploughing = 1,447,500 m^2. Subsea Cable Hubs: Maximum seabed footprint for 18 subsea cable hubs = 3,042 m^2. Unexploded ordnance (UXO) Clearance: UXO clearance will be subject to a separate UXO Marine Licence. As the number, type and clearance method are currently unknown, the associated footprint cannot be quantified at this stage and is therefore excluded from the total footprint area for physical disturbance and temporary loss of seabed habitat. For context, indicative crater dimensions from UK UXO studies (Ordtek, 2018) suggest that a high-order detonation of a German LMB Ground Mine can create a crater of approximately	Temporary disturbance/seabed habitat loss relates to seabed preparation and installation of infrastructure on and in the seabed. The continuous footprint of infrastructure is assessed as impact of the O&M phase.

Impact	Realistic Worst-case Scenario	Rationale
	21.1 m diameter (~350 m^2) and 3.3 m depth in similar sediments. This is provided as benchmarking information only. This represents a precautionary worst-case, as low-order deflagration techniques, now commonly applied in UK waters, would result in substantially smaller craters and therefore reduced physical disturbance and temporary seabed habitat loss. A detailed assessment will be provided within the UXO Marine Licence application once UXO type, location, and clearance method are confirmed.	
C2: Increased suspended sediment concentrations and sediment re-deposition	**Total SSC released due to construction activities (including site preparation works[1]) = 0.0014 km^3 (1,394,530 m^3)** **Seabed preparation total volume of disturbance = 793,032 m^3** Maximum volume of sediment disturbed due to slope levelling prior to GBA installation = 373,032 m^3. Maximum volume of sediment disturbed due to sand wave levelling prior to IAC installation = 420,000 m^3. **Construction total volume of disturbance = 601,498 m^3** Anchor Installation: Worst case anchor type in relate to sediment mobilisation = driven pile (installed via Drive – Drill – Drive). Total volume of sediment disturbed due to pile drill arisings for up to 10% anchor locations and assuming 80% depth of drilling required. Anchor installation (with drilling (Drive – Drill – Drive)) total volume of drill arisings = 94,052 m^3. Installation of mooring buoy anchors: Maximum number of permanent mooring buoys = 2. Maximum number of anchors per mooring buoy = 3. Maximum footprint per mooring buoy = 147 m^2. Maximum footprint for all moorings buoy = 294 m^2. Maximum seabed penetration of anchor = 2 m.	In the construction phase, the WCS for this impact is associated with the activities that may result in increased suspended sediment concentrations and associated deposition.

Impact	Realistic Worst-case Scenario	Rationale
	Maximum volume of all sediment disturbance from mooring buoy installation = 588 m^3. IAC installation total volume of disturbance: Worst case IAC installation method = Jet trenching. Maximum IAC to be buried = 225 km. Maximum jet trenching disturbance width = 3 m. Maximum jet trenching disturbance depth = 2.5 m. Assuming 30% suspension of sediment. Maximum volume of sediment disturbance from IAC installation = 506,250 m^3. Installation of subsea cable hubs: Up to 18 subsea hubs, with a total footprint of 3,042 m^2. Maximum subsea cable hub disturbance depth = 0.2 m. Maximum volume of subsea cable hub disturbance = 608.4 m^3	
C3: Introduction of INNS	Vessels: A range of vessel types will be required across site preparation and construction, please see **Chapter 4: Project Description (Volume II)** for further details. Maximum number of round trips[2] for all vessels = 1,615; and Maximum number of vessels at the Bellrock WFDA at any one time = 34. Floating offshore units (FOU): Up to 132 FOUs towed to the Bellrock WFDA from temporary storage locations during the construction phase.	The site preparation and construction phase WCS for the introduction of INNS focuses on vessels and the towing of the FOUs, as these represent the primary vectors by which INNS can be introduced from external locations. Vessel hulls, ballast water, and biofouling on FSSs create a direct pathway during installation. Installed infrastructure (e.g. FOUs, SKSs, cable protection, and scour protection) may act as a substrate for INNS colonisation once in place, but this is addressed under the O&M phase impact pathway (O3). This approach ensures a conservative, phase-specific assessment of INNS risk.

Impact	Realistic Worst-case Scenario	Rationale
O&M		
O1: Physical disturbance and temporary loss of seabed habitat	**Maximum O&M Disturbance Footprint for the Bellrock WFDA (total over the lifetime of the Bellrock Project) = 47.46 km^2 (47,461,080 m^2)** Moorings: Maximum swept area seabed footprint for catenary mooring lines (all mooring lines) = 46,200,000m^2 (350,000m^2 per FOU). IACs: IAC repair due to failure: Maximum seabed disturbance footprint (per year) = 27,720m^2 (970,200m^2 over lifetime (35 years)). Remedial IAC burial due to exposure: Maximum seabed disturbance footprint (per year) = 2,880 m^2 per year (100,800 m^2 overtime lifetime (35 yrs)). Jack-up Vessels: Maximum jack-up vessel seabed footprint (per jack-up vessel) = 1,440 m^2. Maximum number of jack-up positions = 3.77 per year (132 across the operational life). Maximum jack-up vessel seabed footprint (per year) = 5,431 m^2. Maximum jack-up vessel seabed footprint across operational life = 190,080 m^2. Removal and subsequent deposit of marine growth: The removal of marine growth is not quantified within the WCS, as the volume of material that may require removal is highly uncertain and would be dependent on a range of operational and environmental factors, including the nature of the infrastructure, location within the water column, and maintenance requirements. MD-LOT considers the deposit of marine growth to be a licensable activity under Section 21 of the Marine (Scotland) Act 2010 and Section 66 of the Marine and Coastal Access Act 2009. Accordingly, the potential effects associated with the removal and deposit of marine growth are considered qualitatively within this assessment, and no quantitative estimate of volumes is provided at this stage.	The WCS for this impact pathway includes all temporary physical disturbance associated with O&M activities. This encompasses potential IAC repair works, remedial IAC burial operations, and any jack-up vessel deployments. It also includes the swept area of mooring lines. The swept area generated by mooring line movement represents periodic or intermittent disturbance of the seabed rather than permanent habitat loss footprint. Although abrasion can occur over the operational life of the Bellrock Wind Farm Infrastructure, the seabed is not permanently occupied by infrastructure and retains the potential to recover once movement ceases. For this reason, mooring line swept area is appropriately assessed under O1 rather than O4, which is limited to the fixed infrastructure footprint only.

Impact	Realistic Worst-case Scenario	Rationale
O2: Increased suspended sediment concentrations and sediment re-deposition	**Total SSC released due to O&M activities = 0.0255 km^3 (25,525,500 m^3)** IAC Repair Due to Failure: Maximum sediment disturbed per year due to IAC repair = 69,300 m^3. Maximum sediment disturbed across the operational life of the Bellrock Wind Farm Infrastructure = 2,425,500 m^3. Swept Area of the Catenary Mooring Lines: Maximum area of seabed disturbed by catenary mooring lines (all mooring lines) = 46,200,000 m^2 (350,000 m^2 *132). Maximum depth of seabed disturbed by one mooring line = 0.5 m. Maximum volume of sediment disturbed within the swept area of the catenary mooring lines = 23,100,000m^3	The WCS includes the potential repair of IACs and the swept area of mooring lines during routine operations.
O3: Introduction of INNS	**Vessels** Maximum number of O&M vessels onsite at any one time = 21. Maximum number of round trips for all O&M vessels (per year) = 211. **Hard Substrate** See WCS for impact pathway O4 (2.93 km^2) in relation to the footprint of infrastructure installed on the seabed which could be colonised by benthic species during the O&M phase. In addition, the FSSs, dynamic IACs, and mooring lines represent hard substrate introduced into the water column. Given the complexity of calculating a footprint of hard substrate associated with mooring lines, dynamic IACs and steel tubulars associated with a FSS and the uncertainty around final FSS design it is not possible to calculate an area available for colonisation of organisms. In addition, marine growth may periodically be removed from the subsea infrastructure, as it could inhibit buoyancy. **Additional considerations** Operational lifetime = 35 years.	The introduction of INNS during the O&M phase has been considered through two primary pathways, vessel activity associated with routine and non-routine maintenance, and colonisation of submerged infrastructure surfaces. For the vessel pathway, a precautionary number and range of O&M vessels have been assumed to ensure a worst-case assessment. For the infrastructure pathway, all submerged infrastructure below the waterline have been considered as colonisable, to ensure a conservative estimate. Buried infrastructure have been excluded, as these are not accessible for colonisation.

Impact	Realistic Worst-case Scenario	Rationale
O4: Permanent habitat loss	**Total Area of permanent habitat loss = 2.93 km^2 (2,926,659 m^2)** Anchors: Maximum footprint for the suction pile anchoring system (worst-case) = 377,784m^2. Mooring buoys: Maximum footprint for two mooring buoys = 294 m^2. Subsea cable hubs: Maximum seabed footprint for 18 subsea cable hubs = 3,042 m^2. IAC Protection: Maximum amount of IAC requiring external cable protection = 26.2 km. Maximum area of cable protection for IACs at 4.8 m width = 125,760 m^2. IAC Cable Crossings: Maximum seabed footprint for three cable crossings = 981 m^2. Scour Protection for Anchors: Maximum seabed footprint for anchor scour protection (all anchors) = 2,418,768 m^2. Metocean Buoys: Maximum number of metocean buoys = 2. Maximum seabed footprint per buoy = 15 m^2. Maximum footprint for all metocean buoys = 30 m^2. Additional considerations: Minimum FOU separation distance = approximately 1,150 m (centre to centre); and Operational lifetime = 35 years.	The WCS for this impact pathway covers the permanent loss of seabed habitat resulting from the physical footprint of fixed infrastructure that occupies the seabed for the lifetime of the Bellrock Wind Farm Infrastructure. It does not include mooring line swept area or other disturbance effects, as these do not result in permanent occupation of the seabed and are assessed under O1.

Impact	Realistic Worst-case Scenario	Rationale
O5: Colonisation of introduced substrate	**Hard Substrate** See WCS for impact pathway O4 (2.93 km^2) in relation to the footprint of infrastructure installed on the seabed which could be colonised by benthic species during the O&M phase. In addition, the FSSs, dynamic IACs, and mooring lines represent hard substrate introduced into the water column. Given the complexity of calculating a footprint of hard substrate associated with mooring lines, dynamic IACs and steel tubulars associated with a FSS and the uncertainty around final FSS design it is not possible to calculate an area available for colonisation of organisms. In addition, marine growth may periodically be removed from the subsea infrastructure, as it could inhibit buoyancy. **Additional considerations** Operational lifetime = 35 years	The WCS for potential colonisation mirrors the WCS reported under impact pathway O3.
O6: Interactions with EMF	**Presence of IACs** Maximum length of 300 km of 132 kV (maximum) high voltage alternating current IACs, with up to 225 km buried (with up to 26.2 km potentially requiring cable protection) and up to 92.4 km of dynamic IAC sections[3]. Target burial depth of 0.5 to 2.5 m (subject to cable burial risk assessment). **Cable Protection** Maximum amount of IAC requiring external cable protection = 26.2 km. **Cable Crossings** Maximum number of cable crossings = 3. Maximum length of cable crossings = 157.2 m. **Subsea Cable Hubs** Maximum number of subsea cable hubs = 18. **Additional considerations** The O&M phase will be up to 35 years.	The WCS for this impact is based on the greatest cable length proposed, including the extent of buried, unburied, and dynamic IAC sections, as well as the specifications of the IAC, in terms of maximum system voltage, and cable design.

Impact	Realistic Worst-case Scenario	Rationale
O7: Thermal emissions from inter-array cables	Thermal emissions from the IACs arise from the same electrical loading assumptions, burial depths, cable ratings, and protection requirements defined in the EMF WCS. As these parameters determine the potential heat flux to surrounding sediments and water, the thermal emissions WCS is identical to that presented for EMF (O6 (above)).	The WCS for thermal emissions from IACs mirrors the WCS reported under impact pathway O6.
Decommissioning		
D1: Physical disturbance and temporary loss of seabed habitat D2: Increased suspended sediment concentrations and sediment re-deposition D3: Introduction of INNS D4: Permanent habitat loss D5: Removal of introduced substrate	**Decommissioning Overview** The sequence of decommissioning is likely to be the reverse of the construction sequence, taking around seven years, with similar types and numbers of vessels and equipment expected to be involved. It is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life. The removal and dismantling of the FOUs will largely be a reversal of the installation process. Generally, the FOUs will be towed from the Bellrock WFDA to a suitable port for decommissioning. Mooring lines and anchors will be recovered and removed from the WFDA. For FOU driven pile anchors, these are expected to be either fully removed or cut off below seabed level with a proportion remaining in-situ (due to anticipated excessive cost in their complete removal) following good practice and consideration of environmental conditions and sensitivities. Subsea cable hubs are expected to be fully removed from the seabed. The dynamic sections of the IACs within the water column will be cut at the connector with the static IAC and fully removed. The approach for decommissioning the static IACs on the seabed is yet to be determined, however, this will be reviewed throughout the lifetime of the Bellrock WFDA and good practice guidance at time of decommissioning will be followed. Subject to the material used and environmental sensitivities, it may be preferable to leave scour protection in-situ to preserve the marine habitat that may have developed over the life of the Bellrock WFDA.	Decommissioning impacts are related to removal of infrastructure on or within the seabed and/or suspended within the water column. It is anticipated that decommissioning WCS would be equal to or lesser than the WCS presented for construction.

Impact	Realistic Worst-case Scenario	Rationale
	The approach for decommissioning cable protection will be similar to scour protection. Relevant stakeholders and regulators will be consulted to establish the best approach. Good practice guidance at time of decommissioning will be followed.	

Notes:

[1] Site preparation works will commence up to one year before commencement of construction (year 0), at which point they may continue albeit as construction works (rather than site preparation works) these activities have been considered in the assessments of this Chapter, for completeness.

[2] One round trip comprises two movements (i.e. one to and one from the Bellrock WFDA).

[3] The maximum IAC length is 300 km; however, the maximum values presented for buried IAC (225 km, including up to 26.2 km with cable protection) and dynamic IAC (92.4 km) represent individual worst-case parameters and would not occur simultaneously. Accordingly, these values do not sum to the total IAC length.

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7.7.3 Embedded Mitigation Measures

60. This section outlines the embedded (primary and tertiary) mitigation relevant to the benthic ecology assessment (as shown in **Table 7.16** below). Where additional mitigation measures are proposed, these are detailed in the impact assessment (**Section 7.8**). **Appendix 5.1: Mitigation and Monitoring Register (Volume IV)** sets out all mitigation measures.

61. The Applicant has made several commitments to avoid, prevent, reduce or, if possible, offset potential adverse environmental effects through mitigation measures embedded into the evolution of the project design envelope. These embedded mitigation measures include actions that will be undertaken to meet other existing legislative requirements and those considered to be standard or best practice to manage commonly occurring environmental effects.

62. Where practicable, methods and equipment utilised throughout all phases of development have been designed to minimise effects on benthic receptors. This includes minimising the amount of material placed on the seabed where possible, to reduce the potential for impacts on benthic receptors.

63. The Applicant commits to undertaking construction works in adherence with all relevant best practice guidance and legislation and will prepare all necessary plans in advance of construction activities, including Cable Plan (CaP), Environmental Management Plan (EMP), INNSMP and Marine Pollution Contingency Plan (MPCP). The INNSMP and MPCP have been submitted alongside this Bellrock WFDA EIA Report – see **Volume IV**.

64. All vessels associated with the Bellrock Wind Farm Infrastructure must comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. The EMP will ensure all works are undertaken in line with best practice for working in the marine environment. An outline EMP has been submitted alongside this Bellrock WFDA EIA Report (see **Bellrock WFDA Outline EMP (Volume V)**).

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Table 7.16: Embedded Mitigation Measures Relevant to Benthic Ecology

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-2	Minimum spacing of 1,150 m between FOUs (centre to centre) to avoid increasing the magnitude of impacts in localised areas, such as increased suspended sediment concentrations.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Development Specification and Layout Plan (DSLP) to be developed and submitted to the Scottish Ministers for approval prior to commencement of construction.
WFDA-4	Where seabed preparation is required (e.g. seabed levelling), methods and equipment that have been designed to minimise the potential for sediment suspension and dispersal will be adopted as far as is reasonably practicable.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Construction Method Statement (CMS) to be developed and submitted to the Scottish Ministers for approval prior to commencement of construction.
WFDA-5	Static sections of the IACs will be installed with a target burial depth of 0.5 to 2.5 m (if burial is required and where ground conditions allow), to avoid the need for external cable protection. External cable protection will only be used where adequate burial cannot be achieved and will be minimised so far as reasonably practicable, thereby limiting permanent benthic habitat disturbance and habitat loss. The requirement for, and extent of, any cable protection will be determined through a post-consent Cable Burial Risk Assessment (CBRA).	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an Inter-array Cable Plan (IA-CaP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-6	Scour protection (e.g. concrete mattresses, rock placement, grout bags, artificial frond mats), will prevent scour during the operational life of the Bellrock Wind Farm Infrastructure, therefore inherently reducing risk of scour-induced temporary benthic habitat loss and disturbance and increased suspended sediment concentrations.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a DSLP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-7	Where alternating current cable is used, armoured 3-phase single core (trefoil arrangement) high voltage submarine cables will be used, to minimise both electric and magnetic fields. Static sections of the IACs will be buried or protected, with a target burial depth of 0.5 to 2.5 m (if burial is required and where ground conditions allow), to reduce the impact of electromagnetic fields and thermal emissions, and to minimise disturbance. Cable trench width may also vary to accommodate greater burial depths (subject to the conclusions of a CBRA), further minimising disturbance to habitats and species.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-8	IAC burial techniques could involve ploughing, trenching or jetting reducing the magnitude of disturbance/temporary habitat loss for benthic receptors compared to other alternative techniques.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-10	Material displaced during cable burial activities will be backfilled, where necessary, to promote recovery of benthic habitats.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-11	Subsea infrastructure will be subject to routine monitoring to ensure marine growth remains within design tolerance. Localised cleaning will be undertaken when marine growth is likely to exceed or reach design tolerance. This approach limits the development and stability of extensive fouling communities and reduces the potential for INNS colonisation.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring a INNSMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. The deposit of marine growth is considered a licensable activity by MD-LOT. Therefore, the Applicant will apply for a marine growth deposit Marine Licence prior to any marine growth removal works taking place.
WFDA-14	Development of and adherence to an IA-CaP. The IA-CaP will set out detailed IAC installation methods and techniques (based on final project design). The IA-CaP will confirm planned IAC routing, burial (if any), and any additional protection if required, and will set out methods for post-installation IAC monitoring.	Tertiary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-15	A detailed CBRA will be prepared where IACs are proposed to be buried to determine the target burial depth. The burial depths may vary and will be dependent on risk and ground conditions. The CBRA will also highlight instances where adequate burial cannot be achieved, and alternative protection is needed.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-19	Development of and adherence to a MPCP outlining the approach for managing and reducing risk of pollution and procedures to protect personnel and to be followed in the event of a pollution incident.	Tertiary	Secured in the s.36 Consent and Marine Licence, via a condition requiring a MPCP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. A **MPCP (Volume V)** is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-20	During the construction and O&M of the Wind Farm Infrastructure, periodic geophysical surveys would be required to ensure the IACs remain buried and if they do become exposed, remedial works will be undertaken.	Primary	Secured in the s.36 Consent and Marine Licence, via a condition requiring an IA-CaP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-21	An EMP will be prepared and implemented to set out the procedures to avoid, reduce, and manage potential environmental effects arising across the construction and O&M of the Bellrock Wind Farm Infrastructure, in accordance with relevant international and national legislation and guidance.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an EMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An **Outline EMP (Volume V)** is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-28	Development of UXO Threat and Risk Assessment. All UXO detonations will be subject to a risk assessment undertaken in accordance with relevant guidance such as publication C754 Assessment and Management of UXO Risk in the Marine Environment (Construction Industry Research and Information Association, 2015).	Tertiary	A UXO Threat and Risk Assessment has been developed to support an indicative assessment of UXO clearance in the Bellrock WFDA EIA Report and will inform separate Marine Licence application(s) for UXO clearance.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-33	Preparation of an INNSMP to include provisions for INNS management. The INNSMP would implement biosecurity measures in line with international and national regulations and guidance, namely: ▪ International Convention for the Prevention of Pollution from Ships (MARPOL), which sets out requirements, including appropriate vessel maintenance; ▪ The International Convention for the Control and Management of Ships' Ballast Water and Sediments, which provides an international framework for the control of transfer of potentially INNS from ballast water; and ▪ Consideration of guidance from the International Maritime Organisation (IMO, 2023) on the control and management of ships' biofouling to minimise the transfer of invasive aquatic species.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an INNSMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. The **INNSMP (Volume V)** is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-34	Adherence to the following international and national regulations and guidance, namely: • International Convention for the Prevention of Pollution from Ships (MARPOL), which sets out requirements, including appropriate vessel maintenance; • The International Convention for the Control and Management of Ships' Ballast Water and Sediments, which provides an international framework for the control of transfer of potentially invasive species from ballast water; and • Consideration of guidance from the International Maritime Organisation (IMO, 2023) on the control and management of ships' biofouling to minimise the transfer of invasive aquatic species.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Vessel Management and Navigational Safety Plan (VMNSP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An **Outline VMNSP (Volume V)** is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-47	Development of, and adherence to, a Decommissioning Programme (DP). The DP will set out the framework for the safe, orderly, and environmentally acceptable decommissioning and removal of the Bellrock Wind Farm Infrastructure, in the interests of safety and environmental protection. Climate change risk measures will be included in the DP to be developed prior to the commencement of construction and will include a review of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to ensure risk assessments, H&S protocols and guidelines on safe working practices are suitable for future climate conditions at the time of	Tertiary	Secured in the s.36 Consent and Marine Licence, via a condition requiring a DP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
	decommissioning works. The DP will be refreshed prior to decommissioning activities commencing. The DP will mitigate the risk of climate change impacts on decommissioning site personnel, plant and equipment and other assets and the risk of delays to the decommissioning programme due to extreme weather events, which are becoming more frequent and intense due to climate change.		
WFDA-59	Seabed contacting infrastructure will be micro-sited, where practicable, to avoid sensitive seabed habitats, low or limited mobility benthic species, such as Annex I habitats and Priority Marine Features. Micro-siting will be informed by surveys prior to the commencement of construction which will identify the location and extent of habitats and species.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a CMS and DSLP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-60	Development of, and adherence to, a CMS. The CMS will describe the methods for construction for all consented Wind Farm Infrastructure and set out the measures to be implemented to avoid or reduce adverse effects on the environment and legitimate users of the sea during the construction phase. This will include a clear definition of roles and responsibilities and reference to relevant H&S protocols. In relation to climate change, the CMS will incorporate measures to ensure construction activities are resilient to current and projected extreme weather and metocean conditions. This will include, as appropriate: ▪ Monitoring of site-specific weather and metocean conditions, including use of recognised forecasting and severe weather alert services; ▪ Programming and phasing of construction activities with regard to seasonality and short- to medium-term forecasts; ▪ Definition of safe working limits for vessel, lifting, and installation operations and procedures for suspension of works where thresholds are exceeded; ▪ Measures to secure plant, equipment, and materials during adverse weather; and ▪ Risk assessments and safety procedures that account for site-specific extreme weather risks.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a CMS to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
	Through these measures, the CMS will mitigate risks to construction personnel, plant, and equipment, and reduce the potential for programme disruptions arising from extreme weather events.		
WFDA-61	Regular and periodic inspections and maintenance of all components of the Wind Farm Infrastructure will be undertaken over their operational lifetime to identify and remediate any damage and deterioration and maintain good working conditions. These will be included in the Operation and Maintenance Plan (OMP). Monitoring of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to provide a dynamic risk assessment of climate change impacts and inform operation and maintenance planning. The OMP will mitigate the risks of climate change impacts on the conditions and performance of the Wind Farm Infrastructure and ensures that it is adaptable to future climate conditions and remains resilient over its operational life. The O&M strategy will be adaptive, with the frequency of maintenance, repair and replacement activities being adjusted based on need (i.e. increasing planned O&M visits for components with higher deterioration rates than anticipated).	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an OMP to be developed and submitted to the Scottish Ministers for approval prior to the commissioning of the first WTG.

7.8 Assessment of Effects

65. The potential effects to benthic ecology that may occur during construction (inclusive of site preparation), O&M and decommissioning of the Bellrock Wind Farm Infrastructure are assessed in the following sections. The assessment follows the methodology set out in **Section 7.4.1** and is based on the realistic WCS defined in **Section 7.7.2**, with consideration of embedded mitigation measures identified in **Section 7.7.3.**

66. Site-specific surveys identified Norway lobster *Nephrops norvegicus* within the Bellrock WFDA associated with burrowed mud habitats. Whilst this species is associated with the benthic environment, it is a commercially important species and therefore considered and within **Chapter 8: Fish and Shellfish Ecology (Volume II)** and **Chapter 11: Commercial Fisheries (Volume II)**.

67. As noted in **Section 7.6.3**, impacts on ocean quahog are split between the Benthic Ecology and Fish and Shellfish Ecology Chapters. With the Fish and Shellfish Ecology Chapter assessing impacts on ocean quahog relating to underwater noise and vibration and change in fishing activity.

7.8.1 Potential Impacts During Construction

68. Site preparation works will take place prior to the commencement of construction for up to one year, at which point they may continue as construction works (rather than site preparation works). For the purpose of this assessment, site preparation works have been assessed as part of the construction phase.

7.8.1.1 C1: Physical Disturbance and Temporary Loss of Seabed Habitat

69. There is potential for direct physical disturbance of the seabed and temporary habitat loss during the construction of the Bellrock Wind Farm Infrastructure. The principal sources of disturbance and temporary habitat loss would include seabed preparation (including sand wave levelling, slope levelling for gravity based anchors (if selected), boulder clearance, and pre-lay grapnel runs), UXO clearance, and the installation of the Wind Farm Infrastructure on the seabed. This also includes the temporary laying of mooring lines on the seabed prior to hook-up to the FOUs. See **Table 7.15** for full details on worst-case impacts.

70. UXO clearance, if required, is also included within this impact for information. However, it is noted that a separate Marine Licence for UXO clearance would be made once more detail of any UXO clearance activities is known.

71. The assessment in this section focuses on the short-term, temporary impacts associated with seabed preparation for the Bellrock Wind Farm Infrastructure, cable laying and vessel use, from which habitats and species would be able to recover once construction is complete. Where disturbed sediments are subsequently covered with infrastructure (e.g. SKS, scour protection, and cable protection, and subsea cable hubs), habitat loss or change associated with the presence of such infrastructure would be long-term or permanent. While these long-term impacts would commence during the construction phase, they would endure throughout the lifetime of the Bellrock Wind Farm Infrastructure and are therefore considered in **Section 7.8.2.1** to avoid duplication.

72. The following MarESA pressures and benchmarks relevant to physical disturbance and temporary habitat loss throughout the construction phase have been used to inform this assessment:

- Habitat structure changes – removal of substratum (extraction):
  - The benchmark for this pressure is the extraction of substratum to 30 cm (where substratum includes sediments and soft rocks but excludes hard bedrock). This corresponds with the impact of seabed preparation activities.
- Abrasion/disturbance at the surface of the substratum:
  - The benchmark for this pressure is damage to surface features (e.g. species and physical structures within the habitat). This corresponds with the impact from the installation of SKSs and associated scour protection, subsea cable hub(s), IACs and associated cable protection.
- Penetration and/or disturbance of the substratum subsurface:
  - The benchmark for this pressure is damage to sub-surface features (e.g. species and physical structures within the habitat). This corresponds with the impact from installation of SKSs and associated scour protection, subsea cable hub(s), IACs and associated cable protection.

7.8.1.1.1 Sensitivity

73. The sensitivities of all the IEFs to physical disturbance and temporary habitat loss are presented in **Table 7.17**, informed by the MarESA pressures and benchmarks as outlined above.

74. Given the direct nature of this impact, only receptors present within the Bellrock WFDA itself would be affected. Receptors outside the WFDA (in the wider benthic study area buffer of 4.7 km) are therefore not considered in the assessment of this impact.

7.8.1.1.1.1 *Owenia fusiformis* and *Amphiura filiformis* in Deep Circalittoral Sand or Muddy Sand (A5.272)

75. The biotope A5.272 is a component biotope of the PMF habitat 'Offshore Subtidal Sands and Gravels'.

76. The characteristic species of this biotope typically reside in the upper layer of the benthos (the top 30 cm) and would be disturbed or removed as a result of substratum disturbance or removal (Eleftheriou & Robertson, 1992). Additionally, sheltered and stable habitats are more likely to suffer adverse disturbance effects than disturbed and mobile sediments (Kaiser & Spencer, 1996). The biotope is therefore considered to have no resistance to physical disturbance and temporary habitat loss. However, several characterising species, including *A. filiformis*, have traits that support recovery following disturbance. Recovery from small-scale impact may occur via adult migration from adjacent areas, while recovery following larger-scale population loss would depend on larval recruitment.

77. As the characterising species reproduce annually, recovery may occur within a few years, although this is dependent on larval supply and favourable hydrodynamic conditions for settlement. On this

basis, the biotope is considered to exhibit **medium** resilience to the impact of physical disturbance and/or temporary habitat loss.

78. The sensitivity of the receptor is therefore considered to be **medium**.

7.8.1.1.1.2 *Ampharete falcata* turf with *Parvicardium ovale* on Cohesive Muddy Sediment Near Margins of Deep Stratified Seas (A5.371)

79. The biotope A5.371 is a component biotope of the PMF mosaic habitat Burrowed Mud and Offshore Deep Sea Muds. Although biotope A5.371 is only a component biotope of the broadscale PMF Offshore Deep Sea Muds; it is used as a proxy for Burrowed Mud in lieu of the fact that no component biotopes were identified.

80. Sedimentary infauna and epifauna would be removed as a result of substratum removal, and underlying sediment that is anoxic or of a different character may be exposed, leading to topographical changes of the area. This could expose benthic fauna to unsuitable conditions (Dernie et al. 2003). A study by Cooper et al. (2007) investigated seabed recovery following substratum removal activities (aggregate dredging) and found that a characteristic species of this biotope, *Ampharete spp.* recolonised the site within one year. Therefore, the biotope A5.371 is considered to have no resistance and medium resilience to the impact of physical disturbance and/or temporary habitat loss.

81. The sensitivity of the receptor is therefore considered to be **medium**.

7.8.1.1.1.3 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in Offshore Circalittoral Sandy Mud (A5.376)

82. The biotope A5.376 is a component biotope of the PMF mosaic habitat Burrowed Mud and Offshore Deep Sea Muds. Although biotope A5.376 is only a component biotope of the broadscale PMF Offshore Deep Sea Muds; it is used as a proxy for Burrowed Mud in lieu of the fact that no component biotopes were identified.

83. The characteristic species of this biotope typically reside in the upper layer of the benthos (the top 30 cm) and would be disturbed or removed as a result of substratum disturbance or removal. For example, *Thyasira spp.* reside 2-8 cm below the sediment surface (Dando & Southward, 1986). Newell et al. (1998) found that local hydrodynamics and sediment characteristics strongly influence the recovery of soft sediment habitats. Therefore, the biotope A5.376 is considered to have no resistance. Resilience is assessed as medium as recovery of this biotope is expected to rely largely on larval recruitment where disturbance removes a substantial proportion of the population. Although some characterising species (e.g. polychaetes) have relatively short lifecycles and can recolonise quickly, key taxa such as *A. filiformis* and several bivalves are slow growing and larval recruitment can be sporadic, particularly is low-energy environments. Consequently, the recovery is anticipated to occur over a period of several years rather than rapidly.

84. The sensitivity of the receptor is therefore considered to be **medium**.

7.8.1.1.1.4 Ocean Quahog

85. Ocean quahogs occur in the upper 30 cm of the seabed and would be disturbed or removed by substratum disturbance or removal. The species is long-lived, slow-growing, and exhibits low recruitment, and therefore has no to low resistance and very low resilience to physical disturbance and temporary habitat loss.

86. MarESA classifies ocean quahog as highly sensitive to pressures associated with physical disturbance and habitat loss. This classification is primarily based on evidence from activities such as mobile bottom-contact fishing and dredging, which are more widespread, repeated, and severe than the temporary, localised disturbance from site preparation works, and the installation of the Bellrock Wind Farm Infrastructure.

87. Ocean quahog is a PMF under Scottish policy and is listed in Annex V of OSPAR, reflecting its conservation importance. While the nature of the site preparation and construction pressures is less severe than those underpinning MarESA, given the species' high sensitivity (as defined in MarESA) and high conservation importance, a **high** sensitivity is applied as a precautionary approach.

7.8.1.1.1.5 Phosphorescent Sea Pen

88. No MarESA sensitivity assessment was available for phosphorescent sea pen, so the following assessment was conducted based on the best available literature.

89. Phosphorescent sea pens are colonial and embed into the top layer of the seabed via an anchoring structure called a peduncle. Should the upper layers of the benthos be disturbed or removed, phosphorescent sea pens would also be disturbed or removed as a result. Studies have found that fishing and dredging activities cause removal of whole individuals (Kenchington et al. 2011; Hughes, 1998), though the species is able to withdraw into a tube up to 25 cm below the mud surface and can potentially escape (Tyler-Walters, 2018). Additionally, if sea pens lose anchorage within the seabed but maintain contact with the seabed via their peduncle, they are able to re-insert themselves into the seabed (Eno et al. 2001). This receptor is therefore considered to have no resistance and high resilience to physical disturbance and temporary habitat loss.

90. The sensitivity of the receptor is therefore considered to be **medium.**

7.8.1.1.1.6 Summary of Receptor Sensitivities

91. **Table 7.17** summarises the sensitivity of each IEF to the MarESA pressures corresponding to the impact of physical disturbance and temporary habitat loss.

92. Overall, the IEFs within the benthic study area largely have little to no resistance and medium to high resilience to the impact of physical disturbance and temporary habitat loss, resulting in all of the IEFs being of medium sensitivity. The IEF 'Offshore Subtidal Sands and Gravels' is characteristic of highly disturbed benthic environments and is likely to quickly recover from the impacts of construction. It is also noted that four of the five IEFs identified in the benthic study area (all except 'Offshore Subtidal Sands and Gravels) are protected under the OSPAR Commission's List of Threatened and/or Declining Species and are therefore considered to be high value habitats.

Table 7.17: Sensitivity of the Important Ecological Features (IEFs) to Physical Disturbance and Temporary Habitat Loss

Receptor (IEF)	Representative Biotopes	Resistance	Resilience	Sensitivity	Confidence Assessment
Habitat Structure Changes – Removal of Substratum (Extraction)					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	None	Medium	Medium	High
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	None	Medium	Medium	Medium
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	None	Medium	Medium	Medium
Ocean quahog	N/A	None	Very low	High	Medium
Phosphorescent sea pen	N/A	None	High	Medium [1]	High

Receptor (IEF)	Representative Biotopes	Resistance	Resilience	Sensitivity	Confidence Assessment
Abrasion/Disturbance at the Surface of the Substratum					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	Medium	Medium
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	None	Medium	Medium	High
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	Low	Medium	Medium	Medium
Ocean quahog	N/A	Low	Very Low	High	Medium
Phosphorescent sea pen	N/A	None	High	Medium	High
Penetration and/or Disturbance of the Substratum Subsurface					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	Medium	High

Receptor (IEF)	Representative Biotopes	Resistance	Resilience	Sensitivity	Confidence Assessment
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	None	Medium	Medium	Low
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud	Low	Medium	Medium	Medium
Ocean quahog	N/A	Low	Very low	High	Medium
Phosphorescent sea pen	N/A	None	High	Medium	High
Notes: [1] In the absence of a MarESA sensitivity assessment, sensitivity of phosphorescent sea pen has been determined based on the best available literature.					

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7.8.1.1.2 *Magnitude of Impact*

93. As shown in **Table 7.15**, the total worst case physical disturbance and temporary habitat loss from construction (and site preparation) activities is 3.64 km^2 within the Bellrock WFDA. It is noted that the disturbance would be intermittent throughout the site preparation and construction phase and would be located in discrete areas throughout the Bellrock WFDA (equating to 1.30% of the total footprint of the Bellrock WFDA) and is therefore considered to be highly localised.

94. Seabed preparation activities will account for up to 0.80 km^2 of the physical disturbance and temporary habitat loss footprint. Some sediment will be deposited on the seabed within the Bellrock WFDA as a result of these activities. Due to hydrodynamic movement, these sediment deposits will erode over time, and the seabed will eventually return to its usual topography. Deposited sediment will be similar in composition to its receiving environment therefore it is likely that displaced benthic organisms would soon recolonise these sediments.

95. Although detailed information is not yet available and UXO clearance will be subject to a separate Marine Licence application, it is appropriate to consider potential impacts indicatively. Clearance of a UXO typically results in a localised and short-term seabed depression. Evidence from analogous North Sea sites indicate that detonation of large ground mines can generate craters in the order of tens of metres in diameter and several metres deep (21 m wide and 3.3 m deep) (Ordtek, 2018). This represents a precautionary worst-case, as low-order deflagration techniques, now commonly applied in UK waters, would result in substantially smaller craters and therefore reduced physical disturbance and temporary seabed habitat loss.

96. Within the Bellrock WFDA, strong tidal currents and mobile sediment regimes (**Chapter 6: Marine Geology, Oceanography, and Marine Processes (Volume II)**) support rapid natural backfilling of small seabed depressions, with the infill of UXO clearance craters likely to occur over short temporal periods, depending on sediment size and prevailing hydrodynamic conditions. Recovery of benthic habitat structure and function following such temporary disturbance is therefore expected to be relatively quick, particularly in areas characterised by naturally dynamic sediments (RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited, 2025).

97. While clearance of any individual UXO would result in localised, temporary habitat loss, the footprint of disturbance is negligible in the context of the available habitat within the Bellrock WFDA and the wider central North Sea benthic environment. The activity is also expected to be episodic, with only a small number of discrete detonations (if required) during site preparation activities.

98. On this basis and recognising the high recoverability of the benthic habitats present, the magnitude of impact from UXO clearance (a component of the wider impact under assessment) is predicted to be **negligible**.

99. Installation activities (installation of the anchors, pre-lay of the mooring lines on the seabed (including clump weights), IACs, and subsea cable hubs) will account for up to 2.84 km^2 of the physical disturbance and temporary habitat loss footprint. Trenching activities for IAC laying (via ploughing) would account for up to 1.45 km^2 of this footprint, with the maximum depth of cable being laid at 2.5 m below the seabed surface, and an indicative trench width of 0.5 m. During ploughing, some of the displaced sediment will fall back into the newly created trench, whilst some will create berms on either side of the trench.

100. If FSSs are anchored to the seabed using DEAs, each anchor is expected to create a maximum disturbance footprint of 720 m^2, based on a 12 m anchor width and a drag distance of up to 60 m to achieve full embedment. As DEAs generate the largest temporary physical distance of the anchor options under consideration, they represent the WCS for assessment. Up to 1,188 DEAs may be required to anchor up to 132 FOUs to the seabed (9 DEAs per FOU), resulting in a total physical disturbance and temporary loss of seabed habitat footprint of 855,360 m^2. Mooring lines (including clump weights) may also be pre-laid on the seabed prior to connection to the FOUs; the associated total footprint for the pre-lay of mooring lines (including clump weights) is approximately 532,224 km^2. The construction phase (inclusive of site preparation works) of the Bellrock Wind Farm Infrastructure is anticipated to be up to eight years. Construction activities will occur periodically throughout this timeframe, with a small proportion of the maximum physical disturbance and temporary habitat loss footprint being affected at any one time.

101. The benthic survey recorded 73 ocean quahog individuals (70 juveniles and three adults) at only three of the 113 grab sampling stations within the Bellrock WFDA, equating to an occupancy of 2.65% of sampled stations (**Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**). This indicates a highly patchy and localised distribution within the Bellrock WFDA rather than continuous presence across the WFDA.

102. Although ocean quahog are of high conservation importance, the limited spatial occurrence within the Bellrock WFDA, combined with the small and discrete footprint of seabed disturbance associated with site preparation and construction, means that the likelihood of interaction is low. Furthermore, the species is widely distributed in suitable offshore sediments across the North Sea (Thórarinsdóttir & Einarsson, 1994; Witbaard, 1997), where substantially higher densities have been recorded, with peak densities of up to 286 individuals per m^2 in the northern North Sea (Witbaard & Bergman, 2003). Therefore, the proportion of the ocean quahog population potentially impacted is extremely small. The likelihood of direct interaction is low, and the magnitude of impact on ocean quahog is considered **negligible**.

103. Phosphorescent sea pens were recorded at 16 of the 113 sampling stations (14.2% occupancy), indicating a patchy and discontinuous distribution within the Bellrock WFDA. Most of the site did not support this species, demonstrating that suitable microhabitat occurs only in limited areas.

104. Although localised higher densities were recorded at a small number of stations, these represent small-scale clusters rather than continuous habitat. When considered across the full sampled area (including stations where sea pens were not recorded), mean site density was low (0.15 individuals/m^2), reflecting the limited spatial extent of occurrence.

105. This patchy distribution substantially reduces the likelihood of interaction between construction activities and sea pens. Given the small and discrete footprint of seabed disturbance, only a very small proportion of the local population would be affected. In the wider context, phosphorescent sea pens are broadly distributed across suitable habitats in the North Sea (Greathead et al. 2007; Greathead et al. 2011), meaning the proportion of the regional population potentially affected would be extremely small.

106. Overall, the impact of physical disturbance and temporary habitat loss during the construction phase is expected to directly impact benthic receptors, be highly localised and short duration, occur periodically throughout the construction phase, and be of high reversibility.

107. Where feasible, anchors and IACs may be micro-sited around any sensitive benthic receptors, to minimise disturbance and temporary habitat loss.

108. In consideration of these measures, the magnitude of impact is therefore considered to be **low** (except for ocean quahog for which the overall magnitude of impact is determined to be negligible).

7.8.1.1.3 Significance of Effect

109. The sensitivity of ocean quahog is assessed as high, reflecting the species' conservation importance, and ecological vulnerability (**Section 7.8.1.1.1**). The magnitude of impact during construction is **negligible** due to the localised and one-off nature of seabed disturbance and the patchy distribution and negligible density of ocean quahog within the Bellrock WFDA. In accordance with the assessment methodology and MarESA classification, this results in a **minor adverse effect**, which is **not significant** in EIA terms. No additional mitigation measures are available to reduce the impact.

110. For all other benthic receptors, sensitivity is assessed as **medium** and magnitude of impact as **low**, resulting in a **minor adverse effect** that is **not significant** in EIA terms.

7.8.1.2 C2: Increased Suspended Sediment Concentrations and Sediment Re-deposition

111. There will be increased SSCs and sediment redeposition during the construction of the Bellrock Wind Farm Infrastructure. Indirect impacts include increased turbidity (which can reduce faunal visibility and mobility) and smothering (particularly of the feeding appendages of filter feeders). This is due to seabed preparation works for installation of the SKS (anchors and mooring lines) and any required scour protection, subsea cable hubs, IACs and associated cable protection.

112. The following MarESA pressures and benchmarks relevant to increased SSCs and sediment redeposition throughout the construction phase have been used to inform this assessment:

- Smothering and siltation rate changes (light):
  - The benchmark for this pressure is up to 5 cm of fine material added to the habitat in a single, discrete event. This corresponds with the impact of site preparation and construction activities, such as sand wave levelling and trenching for the installation of IACs.

7.8.1.2.1 Sensitivity

113. The sensitivities of all the IEFs to increased SSCs and sediment redeposition during the construction phase are presented in **Table 7.18**.

7.8.1.2.1.1 *Owenia Fusiformis* and *Amphiura Filiformis* in Feep Circalittoral Sand or Muddy Sand (A5.272)

114. The biotope A5.272 is representative of the PMF habitat 'Offshore Subtidal Sands and Gravels'.

115. The characteristic species of this biotope are predominantly burrowing deposit feeders, therefore risk of mortality by smothering is very low. Unlike filter feeders, these species have morphological mechanisms that allow them to be selective with the food sources they ingest. Species of this

biotope are able to burrow upwards and are unlikely to be inhibited by an additional 5 cm layer of sediment. However, Christensen (1970) proposed 4 cm as the maximum thickness of sediment through which the infaunal sea star *Astropecten irregularis* is able to migrate. Therefore, the biotope's resistance is considered to be medium and resilience high with a low sensitivity to the pressure of smothering and siltation rate changes.

116. The sensitivity of the receptor is therefore considered to be **low.**

7.8.1.2.1.2 *Ampharete Falcata* Turf with *Parvicardium Ovale* on Cohesive Muddy Sediment Near Margins of Deep Stratified Seas (A5.371)

117. The biotope A5.371 is representative of the PMF mosaic habitat Burrowed Mud and Offshore Deep Sea Muds.

118. Increased SSCs resulting in the deposition of 5 cm of sediment (in a single, discrete event) would likely cause the smothering and death of some organisms in the biotope. There would likely be some mortalities of the characteristic polychaete of this biotope *Ampharete falcata*, as it would not be able to feed or respire through the additional layer of sediment. The small bivalve *Parvicardium ovale* would probably be unaffected by smothering due to its strong upward burrowing ability (Heath, 2005; Maurer et al. 1986). Overall, resistance to smothering is assessed as low (with low confidence), though resilience is likely to be high, therefore the biotope is considered of low sensitivity to smothering.

119. The sensitivity of the receptor is therefore considered to be **low**.

7.8.1.2.1.3 *Paramphinome Jeffreysii*, *Thyasira spp.* and *Amphiura Filiformis* in Offshore Circalittoral Sandy Mud (A5.376)

120. The biotope A5.376 is representative of the PMF mosaic habitat Burrowed Mud and Offshore Deep Sea Muds.

121. Increased SSCs resulting in the deposition of 5 cm of sediment (in a single, discrete event) is unlikely to cause adverse effects from smothering, as the characteristic species of this biotope are able to burrow upward. Both resistance and resilience to smothering are therefore assessed as high.

122. The receptor is therefore considered to be **not sensitive**.

7.8.1.2.1.4 Ocean quahog

123. Laboratory and in-field studies by Powilleit et al. (2006, 2009) have found that ocean quahog are able to burrow to the surface of sediment from sediment depths of up to 41 cm. This could take several days; but no mortalities were observed. Increased SSCs resulting in the deposition of 5 cm of sediment (in a single, discrete event) is therefore unlikely to cause adverse effects to ocean quahog and both resistance and resilience are assessed as high.

124. The sensitivity of the receptor is therefore considered to be **not sensitive**.

7.8.1.2.1.5 Phosphorescent Sea Pen

125. Phosphorescent sea pens inhabit sandy substrates that are naturally mobilised on a regular basis and are therefore acclimated to turbid environments (Hill and Tyler-Walters 2018). This species can burrow up to 25 cm beneath the seabed surface; enabling them to easily retreat during episodes of higher siltation rates, until sediments have settled (Greathead et al. 2007). As a result, phosphorescent sea pens are considered to be highly resistant and resilient to the impact of increased SSCs and sediment redeposition.

126. The sensitivity of the receptor is therefore considered to be **not sensitive**.

7.8.1.2.1.6 Summary of Receptor Sensitivities

127. **Table 7.18** summarises the sensitivity of each IEF to the MarESA pressures corresponding to the impact of increased suspended sediment concentrations and sediment re-deposition.

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Table 7.18: Sensitivity of the Important Ecological Features (IEFs) to Increased Suspended Sediment Concentrations and Sediment Redeposition During Construction of the Bellrock Wind Farm Infrastructure

Receptor (IEF)	Representative Biotopes	Resistance	Resilience	Sensitivity	Confidence Assessment
Smothering and Siltation Rate Changes (Light)					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Medium	High	Low	High
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	Low	High	Low	Low
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	High	High	Not sensitive	Medium
Ocean quahog	N/A	High	High	Not sensitive	Low
Phosphorescent sea pen	N/A	High	High	Not sensitive	Medium

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7.8.1.2.2 Magnitude of Impact

128. Site preparation and construction activities are highly localised and involve a small total volume of sediment being suspended 0.0014 km^3, as shown in **Table 7.15**. The sediments in the benthic study area are predominantly sand and mud, so most of the sediment immediately suspended as a result site preparation and construction activities will settle out of suspension rapidly, with only the finest particles becoming entrained within the water column, resulting in a sediment plume, which would be dispersed to low concentrations by tidal currents shortly after its formation.

129. Site preparation and construction activities are infrequent and not repeated, further limiting the potential impacts. Where practicable, methods and equipment designed to minimise sediment resuspension may be used.

130. Considering the small, localised, and infrequent nature of these works, the magnitude of impact is assessed as **low**.

7.8.1.2.3 Significance of Effect

131. The sensitivity of all receptors during construction of the Bellrock Wind Farm Infrastructure is considered to be **low or not sensitive**. The magnitude of the potential impact during construction is considered to be **low** for all receptors and the effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

132. No additional mitigation is required to manage potential effects during construction.

7.8.1.3 C3: Introduction of Invasive Non-native Species

133. INNS may be introduced to the Bellrock WFDA during the construction of the Bellrock Wind Farm Infrastructure. The FOUs will be towed from the integration port or wet storage[1] facility to the Bellrock WFDA, which could provide a vector for the transportation of INNS. Wet storage of the FOUs may increase the opportunity for INNS to colonise the structures before they are transported to the Bellrock WFDA. INNS may also be introduced to the Bellrock WFDA through the ballast contained within the FOUs, GBAs, vessel ballast, and vessel biofouling (Kerckhof, 2011). In addition, site preparation and construction activities within the Bellrock WFDA may facilitate localised spread of INNS between subsea infrastructure, potentially creating stepping stones for further dispersal. Indirect impacts to native benthic species may occur as a result of the introduction and/or spread of INNS.

134. The following MarESA pressure and benchmark relevant to colonisation of introduced substrate has been used to inform this assessment:

- Introduction or spread of invasive non-indigenous species:
  - The benchmark for this pressure is the introduction of one or more INNS.

[1] The temporary mooring of FSSs and/or FOUs at dedicated locations (known as ‘wet storage’) for the Bellrock Project will be considered through separate consenting process(es) as required. The Applicant is not seeking consent for wet storage within this application, and it has not been included within the scope of this EIA Report. Any proposed projects in the public domain for wet storage facilities on the east coast of Scotland have been considered within the cumulative assessment along with other projects and plans (**Appendix 5.3: Cumulative Effects Assessment Long List of Projects (Volume IV)**).

7.8.1.3.1 Sensitivity

135. The sensitivities of all the IEFs to introduction of INNS are presented in **Table 7.19**.

7.8.1.3.1.1 Priority Marine Feature Habitats

136. The component biotopes of the three PMF habitats identified within the benthic study area (A5.272, A5.371, and A5.376) were considered 'not relevant' to the spread of INNS, as no records of INNS have been identified as present within these biotopes. This determination (by MarESA) was made by comparing a review of the relevant literature against a prescribed list of INNS based on the Great Britain Non-native Species Information Portal's list of potentially invasive species (NNSS, N.D.).

137. The MarLIN and MarESA sensitivity assessment frameworks utilise the 'Not Relevant' label when the pressure is unlikely to occur or cannot realistically affect the biotope. In this circumstance, the substrata of the three biotopes are too unstable for most INNS to settle or persist (MarLIN, 2010; JNCC, 2021).

138. The sensitivity of the receptor is therefore considered to be **not relevant**.

7.8.1.3.1.2 Ocean Quahog

139. No MarESA is available for ocean quahog in relation to the spread of INNS, as MarESA determined that there is no evidence on which to base the assessment of sensitivity.

140. Ocean quahog inhabit soft and muddy sediments which are typically at low risk of invasion by most UK INNS due to regular high levels of sediment disturbance (Macleod et al. 2016; Mustow, 2021). However, slipper limpet *Crepidula fornicata* and carpet sea squirt *Didemnum vexillum* may pose a threat, as they are able to settle on smaller stones and shell fragments and form large biogenic carpets that can smother sessile organisms (Begg et al. 2020; NatureScot, 2023). However, ocean quahog have powerful burrowing abilities which suggests that they would have some ability to avoid attachment by slipper limpets. Furthermore, both slipper limpets and carpet sea squirt are typically associated with coastal environments, and there are fewer records of them in the offshore environment (Gibson-Hall and Bilewitch, 2018).

141. Based on this review of the best available evidence, ocean quahog are considered to have a high resistance and medium resilience to the introduction of INNS, resulting in an overall **low** sensitivity.

7.8.1.3.1.3 Phosphorescent Sea Pen

142. Similarly, no MarESA sensitivity assessment was available for phosphorescent sea pen in response to the spread of INNS; due to a lack of evidence. The sensitivity assessment has therefore been conducted using the best available literature.

143. As above for ocean quahog, phosphorescent sea pens inhabit soft and muddy sediments that are not typically at risk of invasion by INNS. There may be some risk of invasion by slipper limpet and carpet sea squirt though they are not widely recorded throughout offshore Scottish waters. Therefore, phosphorescent sea pens are considered to have high resistance and medium resilience to the impact of introduction of INNS.

144. The sensitivity of the receptor is therefore considered to be **low**.

7.8.1.3.1.4 Summary of Receptor Sensitivities

145. **Table 7.19** summarises the sensitivity of each IEF to the impact of introduction of INNS.

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Table 7.19: Sensitivity of the Important Ecological Features (IEFs) to Introduction of Invasive Non-native Species (INNS)

Receptor (IEF)	Representative Biotopes	Resistance	Resilience	Sensitivity	Confidence Assessment
Changes in Suspended Solids (Water Clarity)					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Not relevant (NR)	NR	NR	NR
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	NR	NR	NR	NR
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	NR	NR	NR	NR
Ocean quahog	N/A	High	Medium	Low	Low
Phosphorescent sea pen	N/A	High	Medium	Low	Low

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7.8.1.3.2 Magnitude of Impact

146. For the construction (including site preparation) phase, the worst-case number of vessel round trips is 1,615, with a maximum of 34 vessels within the Bellrock WFDA at any one time.

147. Vessels associated with the construction phase may act as vectors for the introduction of INNS to the Bellrock WFDA. This may occur via transportation of INNS in the ballast and then discharge within the Bellrock WFDA, or via biofouling of any submerged part of the vessel. However, all vessels are required to comply with the IMO's guidance on ballast water management (IMO, 2023), the Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations (2022), and the Maritime and Coastguard Agency's Marine Guidance Note 675, which will reduce the risk of introducing and spreading INNS.

148. The FOUs will be towed from the integration port or wet storage facility to the Bellrock WFDA, which could provide a vector for the transportation of INNS. Wet storage of the FOUs may increase the opportunity for INNS to colonise the structures before they are transported to the Bellrock WFDA. A maximum of 132 FOUs will be installed, with up to two transported to the Bellrock WFDA at any one time.

149. Any submerged Bellrock Wind Farm Infrastructure and tools/equipment used during construction may experience biofouling. Biofouling degradation (which may be expedited by tidal currents, drag against vessel hulls during vessel movement, or any other increase in friction against the surface that has been fouled), could act as a vector for the introduction or spread of INNS within the Bellrock WFDA.

150. An INNSMP (**Bellrock WFDA INNSMP (Volume V)**) has been prepared and will be adhered to. The INNSMP aims to reduce the risk of introduction and spread of INNS, through the identification of critical control points and the application of control measures in relation to a number of activities with the potential to introduce and/or spread INNS.

151. Several INNS species are widespread throughout the central North Sea, including modest barnacle *Autrominius* modestus, leathery sea squirt *Styela clava*, Japanese skeleton shrimp *Caprella mutica*, orange tipped sea squirt *Corella eumoyota* and orange rupple bryozoan *Schizoporella japonica* (NatureScot, 2023). However, no INNS were recorded within the Bellrock WFDA during the site-specific surveys (**Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**).

152. It is also noted that, as detailed in **Section 7.8.1.1.2**, both ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This negligible local density means that the construction activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

153. Overall, the impact of introduction of INNS is expected to be highly localised and occur periodically throughout the construction phases (in terms of invasions), with each invasion considered to be of a medium duration and be of low reversibility.

154. Prior to towing and once in its final position, the FOU will require ballasting to the correct draught. All ballasting operations will be as per the relevant regulatory and legal obligations but, as a minimum will comply with the IMO's guidance on ballast water management (IMO, 2023), Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations (2022) and the Maritime and Coastguard Agency's Marine Guidance Note 675. Additionally, it is assumed that FOUs would be towed from a UK-based port. Both these factors will further reduce the risk of introducing INNS to the Bellrock WFDA.

155. This does not include consideration of towing of FSSs from ports outside the UK.

156. The potential risk of spreading or introducing INNS will also be mitigated by employing biosecurity measures in accordance with MARPOL (which sets out appropriate vessel maintenance in terms of the prevention of pollution from ships caused by operational or accidental causes) and adherence by contractors to OSPAR and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention, 2004). These documents provide global regulations to control the transfer of INNS. As noted in **Table 7.16**, an INNSMP has been created and will be adhered to. The purpose of the INNSMP is to manage and reduce the risk of the introduction and spread of INNS during the lifetime of the Bellrock Wind Farm Infrastructure, as far as reasonably practicable.

157. In consideration of these measures, magnitude is therefore considered to be **negligible**.

7.8.1.3.3 Significance of Effect

158. The sensitivity of the three PMF habitats during construction of the Bellrock Wind Farm Infrastructure is considered to be **not relevant**, and for ocean quahog and phosphorescent sea pen, sensitivity is considered to be **low**. The magnitude of the potential impact during construction is considered to be **not relevant** for the three PMF habitats, and therefore the effect will be of **no significance** for these receptors. The magnitude of the potential impact during construction is considered to be **negligible** for ocean quahog and phosphorescent sea pen and the effect will therefore be of **negligible adverse** significance, which is **not significant** in EIA terms.

159. No additional mitigation is required to manage potential effects during construction.

7.8.2 Potential Impacts During Operation and Maintenance

7.8.2.1 O1: Physical Disturbance and Temporary Loss of Seabed Habitat

160. There is potential for direct physical disturbance of the seabed and temporary habitat loss during the O&M phase of the Bellrock Wind Farm Infrastructure. The principal sources of disturbance and temporary habitat loss would include use of jack-up vessels during repair/maintenance activities, IAC repair activities, removal of marine growth (if required), and disturbance within the swept area of the catenary mooring system (if selected). See **Table 7.15** for full details on worst-case impacts.

161. As with the construction phase (**Section 7.8.1.1**), physical disturbance and temporary loss of seabed habitat during the O&M phase is limited to short-term, episodic activities. This section also includes consideration of disturbance arising within the swept area of the catenary mooring lines. Permanent habitat loss associated with the presence of fixed infrastructure is addressed separately in **Section 7.8.2.4** to avoid duplication.

162. The following MarESA pressures and benchmarks relevant to physical disturbance and temporary habitat loss throughout the O&M phase have been used to inform this assessment:

- Abrasion/disturbance at the surface of the substratum:
  - The benchmark for this pressure is damage to surface features (e.g. species and physical structures within the habitat). This corresponds with the impact of jack-up vessel operations, IAC repair works, marine growth removal, and disturbance within the swept area of the catenary mooring system.
- Penetration and/or disturbance of the substratum subsurface:
  - The benchmark for this pressure is damage to sub-surface features (e.g. species and physical structures within the habitat). This corresponds with the impact of jack-up vessel operations, IAC repair works, marine growth removal, and disturbance within the swept area of the catenary mooring system.

7.8.2.1.1 Sensitivity

163. The sensitivity of receptors is considered to range from **medium** to **high** (ocean quahog) for the O&M phase of the Bellrock Wind Farm Infrastructure, as described for construction in **Section 7.8.1.1**.

7.8.2.1.2 Magnitude of Impact

164. O&M activities are expected to result in a physical disturbance and temporary seabed habitat loss footprint of 47.46 km^2. The impact will be small-scale, infrequent, and spatially constrained within the proximity of seabed contacting infrastructure, throughout the 35-year operational life of the Bellrock Wind Farm Infrastructure, reflecting the nature of O&M activities, such that any given time only a limited portion of the seabed will be affected.

165. The movement of the catenary mooring lines in contact with the seabed will cause abrasion of sediments within the swept area around each FSS. Some movement of the mooring lines is expected under normal conditions as the FSSs move, however, the greatest swept area will occur during elevated tidal levels. The total swept area for mooring line disturbance across the Bellrock WFDA is 46,200,00 m^2 (350,000 m^2 per FOU), within which benthic communities may experience intermittent disturbance. Due to disturbance being constrained to within the swept area of the mooring lines, this impact is considered to be localised.

166. Jack-up vessel activities during the O&M phase will involve the occasional contact of the spud cans of jack-up vessels on the seabed. During the O&M phase, a maximum of 132 jack-up locations are estimated as a realistic WCS. However, any use of jack-up vessels during the 35-year operational life is expected to be infrequent, spatially constrained and limited to non-routine maintenance or repair activities. Therefore, the magnitude of impact from jack-up activities in the O&M phase is considered to be low. Some offshore wind farm monitoring studies have found that the seabed indentations caused by jack-up vessels fully refill with sediment within 1-2 years of creation (Barrow Offshore Windfarm Limited, 2008; Bureau of Ocean Energy Management, 2020). It is anticipated that benthic species would recolonise this sediment during this time period, and that the seabed topography and faunal composition would approximately return to its original state.

167. The realistic WCS seabed footprint for IAC repairs during O&M is based on an assumed failure rate of 1.8 per year, which results in an annual disturbance footprint of 27,720 m^2, and a disturbance footprint across the operational life of the Bellrock Wind Farm Infrastructure of 970,200m^2. IAC repairs under the WCS may require de-burial, replacement, or reinstatement along the full IAC length between FOUs. Disturbance would therefore be linear and confined to the IAC cable corridor (i.e. localised along the cable length), with discrete areas of seabed turnover where excavation and reinstatement occur. Benthic communities adjacent to the IAC cable corridor would be intermittently affected over the operational life of the Bellrock Wind Farm Infrastructure.

168. As detailed in **Section 7.8.1.1.2**, ocean quahog are very patchily distributed within the Bellrock WFDA, with low occupancy levels identified through the grab sample survey (**Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**), particularly compared to other areas of the North Sea. This low local abundance means that the O&M activities associated with the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog. As such, the magnitude of the impact of ocean quahog is determined to be **negligible**.

169. The FSS will be designed to accommodate the development of marine growth which will be monitored during the O&M phase to ensure that it does not exceed design tolerances. Removal of marine growth may be necessary throughout the operational life and may involve scraping or jetting of marine growth by ROV or divers and deposit of marine growth debris on the seabed. The frequency of these unscheduled activities will be dependent on the findings of routine inspections and will be carried out during other works as and when required. The re-deposition of marine growth material on the seabed may result in temporary habitat loss for epifaunal benthic species. However, this is expected to be a highly spatially restricted effect and is unlikely to cause any impacts on a population level. Additionally, an INNSMP has been developed (**Bellrock WFDA INNSMP (Volume V)**) and will be implemented. The INNSMP includes control measures to limit biofouling and reduce the risk of INNS introduction or spread, including routine monitoring of marine growth on subsurface infrastructure and removal where growth approaches design tolerances. These controls reduce the likelihood of excessive biomass release during maintenance activities and are applied at defined critical control points. Further detail on embedded mitigation is provided in **Section 7.7.3.**

170. Overall, the impact of physical disturbance and temporary habitat loss during the O&M phase is expected to be highly localised and short duration, occur periodically throughout the O&M period, and be of high reversibility. Scour protection (which will prevent scour during the operational life of the Bellrock Wind Farm Infrastructure, therefore inherently reducing chances of scour-induced temporary habitat loss and disturbance) will only be placed if required and therefore the footprint kept to a minimum.

171. The magnitude of impact is therefore considered to be **low** (except for ocean quahog for which the overall magnitude of impact is determined to be negligible).

7.8.2.1.3 Significance of Effect

172. The sensitivity of ocean quahog is assessed as high, reflecting the species' conservation importance, and ecological vulnerability (**Section 7.8.2.1.1**). The magnitude of impact during O&M is **negligible** due to the localised and infrequent nature of seabed disturbance and the patchy distribution of ocean quahog within the Bellrock WFDA. In accordance with the assessment

methodology and MarESA classification, this results in a **minor adverse effect**, which is **not significant** in EIA terms. No additional mitigation measures are available to reduce the impact.

173. For all other benthic receptors, sensitivity is assessed as **medium** and magnitude of impact as **low**, resulting in a **minor adverse effect** that is **not significant** in EIA terms.

7.8.2.2 O2: Increased Suspended Sediment Concentrations and Sediment Re-deposition

174. There will be increased SSCs and sediment re-deposition during the O&M of the Bellrock Wind Farm Infrastructure. Indirect impacts include increased turbidity (which can reduce faunal visibility and mobility) and smothering (particularly of the feeding appendages of filter feeders). This is due to maintenance activities (e.g. use of jack-up vessels and IAC repair works), and disturbance within the swept area of the catenary mooring system.

175. The MarESA pressure irrelevant to increased suspended sediment concentrations and sediment re-deposition is the same as that applied in the construction phase assessment. Accordingly, the O&M assessment adopts the construction phase pressure benchmark presented in **Section 7.8.1.2**.

7.8.2.2.1 Sensitivity

176. The sensitivity of the identified IEFs to increased SSCs and sediment re-deposition ranges from **not sensitive** to **low,** consistent with the sensitivities presented in **Section 7.8.1.2.1**.

7.8.2.2.2 Magnitude of Impact

177. Where the catenary mooring lines make contact with sediment, rather than exposed bedrock, movement of the mooring line across the seabed will disturb the surficial sediments and generate a localised increase in SSCs. Some degree of mooring line movement is expected under normal operating conditions; however, the greatest extent of seabed disturbance (i.e. the swept area) is likely to occur during elevated tidal levels when FOU motions are highest.

178. The maximum volume of sediment that could be disturbed within the mooring line swept area has been conservatively calculated as 175,000 m^3 per FOU, resulting in a total theoretical WCS volume of 23,100,000 m^3 across all FOUs. This estimate assumed the maximum potential length of mooring line in contact with and mobilising sediment on the seabed.

179. In practice, this represents an extreme and highly precautionary scenario. Under typical metocean conditions, mooring line movement would be limited and the swept area substantially smaller than the theoretical maximum, meaning only a small proportion of this volume would be disturbed at any one time. Increased mooring line movement would occur primarily during elevated tidal levels, however, these events are intermittent and of short duration. Any associated sediment mobilisation would therefore be temporary and episodic rather than continuous.

180. As such, the calculated volume should be regarded as an upper theoretical bound, with the actual volume of sediment disturbed over time expected to be markedly lower and spatially and temporally constrained.

181. Furthermore, IAC repair works are anticipated to result in a disturbed sediment volume of 69,300 m^3 per year, which equates to 2,425,500 m^3 over the 35-year operational life of the Bellrock Wind Farm Infrastructure. Impacts associated with IAC repair works will be discrete and highly localised to specific sections of the wider IAC network.

182. Since the sediment within the Bellrock WFDA comprises sand with some areas of mud, it is likely that the majority of any sediment suspended in the water column will fall quickly back to the seabed. Only the finest fractions will stay suspended in the water column for longer periods; though this would be for short durations and restricted to the lowest water layers. Overall, though the impact will occur intermittently during the O&M phase, it is considered that it will be localised and small-scale.

183. In consideration of the above information, the magnitude of impact is considered to be **negligible**.

7.8.2.2.3 Significance of Effect

184. All receptors during O&M of the Bellrock Wind Farm Infrastructure are considered to be either **not sensitive** or of **low** sensitivity. The magnitude of the potential impact during O&M is considered to be **negligible** for all receptors and the effect will therefore be of **negligible adverse** significance, which is **not significant** in EIA terms.

185. No additional mitigation is required to manage potential effects during O&M.

7.8.2.3 O3: Introduction of Invasive Non-native Species

186. INNS may be introduced to the Bellrock WFDA during the O&M of the Bellrock Wind Farm Infrastructure. INNS may be introduced to the Bellrock WFDA via major corrective maintenance vessels; through biofouling of their submerged surfaces or associated tools and equipment, via carriage in their ballast and subsequent release within the Bellrock WFDA, or via tow-to-shore or tow-to-shallow methods for major component repair for the WTGs (see **Chapter 4: Project Description** (**Volume II**) for further information on major component repair methodologies). The subsea infrastructure (FSSs, SKSs and associated scour protection, IACs and associated cable protection, and subsea cable hubs) may be colonised by sessile INNS or may attract motile INNS to the area. Indirect impacts to native benthic species may occur as a result of the subsea infrastructure acting as a vector, or 'stepping stone' for the spread of INNS.

187. The following MarESA pressure and benchmark relevant to colonisation of introduced substrate has been used to inform this assessment:

- Introduction or spread of invasive non-indigenous species:
  - The benchmark for this pressure is the introduction of one or more INNS.

7.8.2.3.1 Sensitivity

188. The sensitivity of all receptors is considered to be **not relevant**, except for ocean quahog and phosphorescent sea pen which are considered to be of **low** sensitivity, for the O&M phase of the Bellrock Wind Farm Infrastructure, as described for construction in **Section 7.8.1.3**.

7.8.2.3.2 Magnitude of Impact

189. On an annual basis, the WCS assumes 211 round trips per year, with up to 21 vessels present within the Bellrock WFDA at any one time.

190. Vessels associated with the O&M phase may act as vectors for the introduction of INNS to the Bellrock WFDA. However, it is noted that vessel movements will likely be limited to between the Bellrock WFDA and the ports at which the vessels are held, reducing the risk of introducing INNS from outside the region. Additionally, all vessels are required to comply with the IMO's guidance on ballast water management (IMO, 2023), the Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations (2022), and the Maritime and Coastguard Agency's Marine Guidance Note 675, which will reduce the risk of introducing and spreading INNS.

191. Any submerged Bellrock Wind Farm Infrastructure and tools/equipment used during O&M may experience biofouling. Biofouling degradation (which may be expedited by tidal currents, drag against vessel hulls during vessel movement, or any other increase in friction against the surface that has been fouled), could act as a vector for the introduction or spread of INNS within the Bellrock WFDA. The FSS will be designed to accommodate the development of marine growth which will be monitored during the O&M phase to ensure that it does not exceed design tolerances. Removal of marine growth may be necessary throughout the operational lifetime and may involve scraping or jetting of marine growth by ROV or divers and deposit of marine growth debris on the seabed.

192. The frequency of these unscheduled activities will be dependent on the findings of routine inspections and will be carried out during other works as and when required. The re-deposition of marine growth material on the seabed may act as a vector for the spread of INNS. An INNSMP (**Bellrock WFDA INNSMP (Volume V)**) has been created and will be adhered to.

193. The INNSMP aims to reduce the risk of introduction and spread of INNS, through the identification of critical control points and the application of control measures in relation to a number of activities with the potential to introduce and/or spread INNS, including the O&M activity of marine growth removal.

194. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This negligible local density means that the O&M activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

195. Overall, the impact of introduction of INNS during the O&M phase is expected to be highly localised and of medium duration, occur periodically (in terms of invasions), and be of low reversibility.

196. The magnitude is therefore considered to be **negligible**.

7.8.2.3.3 Significance of Effect

197. The sensitivity of the three PMF habitats during O&M of the Bellrock Wind Farm Infrastructure is considered to be **not relevant**, and for ocean quahog and phosphorescent sea pen, sensitivity is considered to be **low**. The magnitude of the potential impact during O&M is considered to be **not relevant** for the three PMF habitats, and therefore the effect will be of **no significance** for these receptors. The magnitude of the potential impact during O&M is considered to be **negligible** for

ocean quahog and phosphorescent sea pen and the effect will therefore be of **negligible adverse** significance, which is **not significant** in EIA terms.

198. No additional mitigation is required to manage potential effects during O&M.

7.8.2.4 O4: Permanent Habitat Loss

199. There will be long-term habitat loss during the O&M of the Bellrock Wind Farm Infrastructure. Direct impacts to benthic receptors will occur as a result of infrastructure (including anchors for the FOUs, mooring buoys, and O&M phase metocean buoys) and associated scour protection, cable protection associated with the IAC network and, subsea cable hub(s)) being continuously present on the seabed throughout the operational life of the Bellrock WFDA.

200. Habitat will not be completely removed, rather a physical change will occur due to presence of infrastructure (including anchors for the FOUs, mooring buoys, and O&M phase metocean buoys) and associated scour protection, cable protection associated with the IAC network and, subsea cable hubs, from a predominantly sandy habitat to a hard and artificial substratum. Therefore, the following MarESA pressure and benchmark relevant to permanent habitat loss has been used to inform this assessment:

- Physical change (to another seabed type):
  - The benchmark for this pressure is a change in sediment type by one Folk class (Long, 2006) (based on UK SeaMap simplified classification) and/or change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.

7.8.2.4.1 Sensitivity

201. The sensitivities of all the IEFs to permanent habitat loss are presented in **Table 7.20**.

7.8.2.4.1.1 Priority Marine Feature Habitats (A5.272, A5.371, and A5.376)

202. The biotope A5.272 is a component biotope of the PMF habitat 'Offshore Subtidal Sands and Gravels'.

203. This biotope is characterised by muddy sand habitat, which would be lost if replaced with artificial hard structures. There would be a fundamental change to the physical character of the biotope, and the characteristic biological community would no longer be (or the biotope may be re-classified). As a result, this biotope is considered to have no resistance to the impact of long-term habitat loss, and very low resilience.

204. The sensitivity of the receptor is therefore considered to be **high.**

7.8.2.4.1.2 Ocean Quahog

205. Ocean quahog require sedimentary habitat to survive, which would be lost if replaced with artificial hard structures. Based on the loss of viable habitat for the species, it is considered to have no resistance to the impact of long-term habitat loss, and very low resilience.

206. The sensitivity of the receptor is therefore considered to be **high**.

7.8.2.4.1.3 Phosphorescent Sea Pen

207. No MarESA sensitivity assessment was available for phosphorescent sea pen, so the following assessment was conducted based on the best available literature.

208. Phosphorescent sea pens are largely sessile, with the ability to retreat into a tube below the mud surface (Mackie, 1998). Therefore, they lack the ability to escape or avoid habitat loss as a result of a change from sedimentary habitat to a hard, artificial substratum. These organisms serve an important ecological function by providing biogenic habitat for other marine species and are thus generally considered to be ecologically valuable (Bastari et al. 2018). Due to the slow growth rates and long life cycles of phosphorescent sea pens; their recovery from long-term habitat loss is expected to be slow (Hixon and Tissot, 2007; Neves de Moura et al. 2015).

209. Phosphorescent sea pens require sedimentary habitat to survive, which would be lost if replaced with artificial hard structures. Based on the loss of viable habitat for the species and their inability to avoid, adapt to or recover from the impact, it is considered to have no resistance and very low resilience to long-term habitat loss.

210. The sensitivity of the receptor is therefore considered to be **high**.

7.8.2.4.1.4 Summary of Receptor Sensitivities

211. **Table 7.20** summarises the sensitivity of each IEF to the MarESA pressures corresponding to the impact of permanent habitat loss.

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Table 7.20: Sensitivity of the Important Ecological Features (IEFs) to Permanent Habitat Loss

Receptor (IEF)	Representative biotopes	Resistance	Resilience	Sensitivity	Confidence assessment
Physical Change (to Another Seabed Type)					
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	None	Very low	High	High
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	None	Very low	High	High
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	None	Very low	High	High
Ocean quahog	N/A	None	Very low	High	High
Phosphorescent sea pen	N/A	None	Very low	High[1]	High

Notes:

[1] In the absence of a MarESA sensitivity assessment, sensitivity of phosphorescent sea pen has been determined based on the best available literature.

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7.8.2.4.2 Magnitude of Impact

212. The continuous footprint of the Bellrock Wind Farm Infrastructure on the seabed is considered as part of the O&M phase.

213. As shown in **Table 7.15**, the WCS total footprint of infrastructure on the seabed during the O&M phase (anchors and associated scour protection, cable protection associated with IACs, and subsea cable hubs) is 2.93 km^2 within the Bellrock WFDA. It is noted that the disturbance would be located in discrete areas throughout the Bellrock WFDA (equating to 1.05 % of the total footprint of the Bellrock WFDA) and is therefore considered to be highly localised.

214. The receptor species identified within the Bellrock WFDA are not solely dependent on the habitats within the Bellrock WFDA. The characterising species of the biotope '*Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand' are widespread around British and Irish coasts and are found buried in sand or muddy sand habitats. Both species have a large depth range; *O. fusiformis* is found from the intertidal zone to 4,500 m, and *A. filiformis* is found between 15 m and 100 m (MarLIN, 2008a, MarLIN 2008b). The characterising species that inhabit the burrowed mud and offshore deep sea muds mosaic habitat, comprising the biotopes '*Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas' and '*Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud' are widely distributed throughout the British Isles (MarLIN, 2008c; Hayward & Ryland, 1995). The formerly mentioned biotope is found at depths from 50-100 m, and the latter is likely to be found at similar depths (MarLIN, 2008d).

215. Ocean quahog is found around all British and Irish coasts and offshore, such as in the North Sea. They are predominately found buried or partially buried in sand and muddy sand that ranges from fine to coarse grains, at wide-ranging water depths of 4 to 482 m (MarLIN, 2008e). Phosphorescent sea pen is common throughout the North Sea and is recorded in other Scottish waters including sea lochs. They are found in sandy and muddy substrata at depths of 10 to 100 m (MarLIN, 2008f).

216. Due to the far-ranging and widespread distribution of receptor species; any long-term and/or permanent habitat loss caused by the presence of the Bellrock Wind Farm Infrastructure is unlikely to result in adverse effects at the population level. The species identified within the benthic study area are not highly localised or specialised to one habitat type within the benthic study area, meaning the affected habitats represent only a small proportion of their total range. This is supported by the meta-analysis conducted by Coolen et al. (2022), that reviewed data from three long-term benthic monitoring campaigns undertaken in offshore wind farms in the southern North Sea, considering a total of 2,849 sampling locations. Their results showed that changes in biodiversity near the wind farm infrastructure post-installation were principally linked to natural factors such as water depth, season and distance from the structure.

217. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed within the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the O&M activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

218. It is also noted that much of the literature regarding long-term benthic habitat loss as a result of offshore wind farm infrastructure, including the study by Coolen et al. (2022) is based on fixed-foundation wind farms. Construction methods and materials for fixed-foundation wind farms, such as dredging and pile-driving of monopiles, typically causes a far greater magnitude of long-term habitat loss than that of floating wind farms. Whilst the impact is long-term, directly impactful to receptors, and of low reversibility during the operational life of the Bellrock Wind Farm Infrastructure, it is highly localised within the benthic study area.

219. The magnitude of impact is therefore considered to be **negligible**.

7.8.2.4.3 Significance of Effect

220. The sensitivity of all receptors to permanent habitat loss is considered to be **high**. The magnitude of impact is considered to be **negligible**, and the effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

221. No additional mitigation is required to manage potential effects during O&M.

7.8.2.5 O5: Colonisation of Introduced Substrate

222. During the O&M phase of the Bellrock Wind Farm Infrastructure, colonisation of introduced hard substrate is likely to occur. Infrastructure installed on the seabed including anchors and associated scour protection, sections of mooring line, subsea cable hubs, and cable protection associated with unburied IAC sections, provides new substrate for benthic species. In addition, infrastructure suspended in the water column, such as FSSs, dynamic IACs, and mooring lines, also represents hard substrate that may be colonised. This may lead to localised increases in biodiversity but could also cause the introduction of INNS. The impact of INNS on receptors in the Bellrock WFDA is assessed above in **Section 7.8.2.3**.

223. The MarESA pressure relevant to colonisation of introduced substrate is the same as that applied for permanent habitat loss (O4). Accordingly, this assessment adopts the pressure benchmark presented in **Section 7.8.2.4**.

7.8.2.5.1 Sensitivity

224. The sensitivity of the identified IEFs to colonisation of introduced substrate is considered to be consistent with the sensitivities presented for permanent habitat loss in **Section 7.8.2.4.1** and is therefore **high** for all receptors.

7.8.2.5.2 Magnitude of Impact

225. The WCS for colonisation of introduced substrate assumes that all available hard infrastructure within the Bellrock WFDA is colonisable by epilithic benthic species and remains in situ throughout the 35-year operational life of the Bellrock Wind Farm Infrastructure. The magnitude of this impact is therefore broadly comparable to that of permanent habitat loss assessed in **Section 7.8.2.4**, with an O&M footprint of 2.93 km^2. In addition to infrastructure on the seabed, suspended structures such as FSSs, dynamic IACs, and mooring lines provide additional hard substrate that may be colonised, although a precise area cannot be calculated due to design and configuration uncertainties. Periodic removal of marine growth from subsea infrastructure to maintain buoyancy will also limit accumulation of colonising species.

226. The introduced substrate may attract local benthic epifauna associated with offshore rocky habitats; like bryozoans and anthozoans, and the infrastructure nearer the sea surface may attract species more commonly associated with rocky intertidal communities, such as blue mussel *Mytilus edulis*. Natural rocky marine habitats possess features such as ledges, crevices and cracks that provide habitat complexity. However, most of the Bellrock Wind Farm Infrastructure lacks structural complexity and is therefore unlikely to lead to the development of highly diverse communities.

227. There is currently limited research into the effects of offshore wind farms causing localised aggregations of higher trophic level species in the North Sea, often with differing results. Raoux et al. (2017) found that marine mammals, birds and piscivorous fish species responded positively to the presence of biomass on piles and turbine scour protection. This is supported by Isaksson et al. (2025) who attributed this effect to altered food web dynamics from the presence of wind farm infrastructure, through habitat and hydrodynamic changes. Conversely, Jech et al. (2023) found that the presence of wind farm infrastructure had little effect on localised fish distribution. Gill et al. (2025) conducted a systematic review of over 1,200 studies on the ecological impacts of offshore wind farms on commercially important fish species. They found that only a small subset of studies provided direct empirical evidence of increased fish aggregation near wind farm infrastructure, and even among these studies, results were inconsistent. As noted in the Bureau of Ocean Energy Management White Paper (2023), floating wind farms are far less likely to lead to a 'reef effect' than fixed-foundation wind farms, due to the lesser volume of colonised substrate within the marine environment. Overall, though evidence is limited, it is currently not anticipated that the long-term presence of the Bellrock Wind Farm Infrastructure will encourage aggregations of higher trophic levels and propagation up the food chain.

228. Whilst it is not anticipated, should fish aggregate near the Bellrock Wind Farm Infrastructure, this could increase predation. There is a lack of research into increased predation within the benthic environment as a result of fish aggregation around offshore structures (Dannheim et al. 2019). Some studies have explained that the introduction of wind farm infrastructure to the marine environment provides new benthic habitat and can compensate for other habitat losses (Langhamer, 2012). Similarly, any areas of IACs within the Bellrock WFDA that require rock berm protection, could attract benthic species similar to that of local bedrock environments. This could increase ecosystem complexity and potentially have positive effects on productivity and biodiversity.

229. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the O&M activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen. Overall, the impact is considered to be long-term, indirectly impactful to receptors, and of medium to low reversibility, and highly localised.

230. The amount of cable protection utilised (and therefore rocky surface area available for colonisation on the seabed) will be minimised through cable burial where practicable; protection will be used only where design burial depths are not achievable or where crossings require it.

The FSSs and associated SKSs introduce colonisable surfaces in the water column and on the seabed. These elements can support fouling communities, including epifauna.

231. In consideration of these measures, the magnitude of impact is therefore considered to be **negligible**.

7.8.2.5.3 Significance of Effect

232. The sensitivity of all receptors to colonisation of introduced substrate is considered to be **high**. The magnitude of impact is considered to be **negligible**, and the effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

7.8.2.6 O6: Interactions with Electromagnetic Fields

233. There will be interactions between benthic organisms and EMF during the O&M phase of the Bellrock Wind Farm Infrastructure. While the IACs are operational, they will emit EMFs that have the potential to adversely affect the behaviour of benthic species.

234. The following MarESA pressure and benchmark relevant to interactions with EMF during the O&M phase has been used to inform this assessment:

- Electromagnetic changes:
  - The benchmark for this pressure is a local electrical field of 1 volt per metre (V/m) or a local magnetic field of 10 microteslas (µT).

7.8.2.6.1 Sensitivity

7.8.2.6.1.1 All Important Ecological Features (IEFs)

235. No sensitivity assessments for any of the identified IEFs are available on MarESA, due to a lack of evidence. Whilst some studies have been conducted, more research is required to gain a full understanding of the effects of EMF on benthic species. The sensitivity assessment has therefore been undertaken using the best available literature. It is noted that most studies into the effects of EMFs on benthic organisms are focused on epifaunal crustaceans, often with inconclusive and contrasting results.

236. A study by Hutchison et al. (2020) found that American lobster *Homarus americanus* exhibit exploratory behaviours when exposed to EMF from electrical cables (65.3 µT) compared to their natural response to existing geomagnetic fields (51.3 µT). Scott et al. (2018) concluded that shelter choice, roaming activity and hormone levels in the edible crab *Cancer pagurus* are affected by exposure to EMF (2,800 µT).

237. Love et al. (2015) found that yellow rock crabs *Metacarcinus anthonyu* and red rock crabs *Cancer productus* exhibit no preferences between energized and non-energized subsea electrical cables. They also found that there were no significant differences in crab communities on and around the cables up to three years after installation, and that EMF levels reduced to background levels generally within one metre of the cable.

238. Scott et al. (2021) found that edible crab *C. pagurus* showed no signs of physiological distress when exposed to EMFs of 250 µT but could not tolerate EMFs of over 500 µT. Chapman et al. (2023) found that common sea urchin *Echinus esculentus*, common starfish *Asterias rubens*, velvet swimming crab *Necora puber*, and common periwinkle *Littorina littorea* displayed no behavioural or physiological responses when exposed to EMFs of 500 µT for 24 hours. Albert et al. (2023) found that velvet swimming crabs exhibited no behavioural changes when exposed to EMFs of 70-300 µT.

239. Donázar-Aramendía et al. (2025) conducted the first *in situ* study assessing the effects of EMF generated by subsea electrical cables on the soft-bottom macrofaunal community. Their results showed that EMFs near the cables were below known thresholds inducing laboratory effects; with a maximum deviation from background levels of 34 µT near the cable, decreasing to 1 µT at distance of 250 m. These magnitudes are considerably lower than those typically used in laboratory experiments (100-30,000 µT) that induce physiological effects.

240. To date, no studies on the effects of EMFs from subsea electrical cables have been conducted on any of the IEFs within the benthic study area, such as ocean quahog or phosphorescent sea pen. Several recent studies into the effects of EMFs on bivalves (Albert et al. 2020, Jakubowska-Lehrmann et al. 2022, Jakubowska et al. 2019, Stankevičiūtė et al. 2019) have recorded varying degrees of adverse physiological impacts (such as elevated genotoxicity in Baltic clam *Macoma balthica*). However, these studies use magnetic fields that are far greater in magnitude than is typical of the EMFs generated within the immediate vicinity of surface-laid subsea electrical cables (**Appendix 8.1: Electromagnetic Fields Assessment (Volume IV)**). For example, elevated genotoxicity in Baltic clam was recorded at exposure levels of 1,000 µT (Stankevičiūtė et al. 2019). As ocean quahog are bivalve molluscs, it can be predicted that they would experience some adverse effects when exposed to similarly high magnitude EMFs, above the typical maximum generated by OWF electrical cables.

241. Based on the evidence outlined above, it is considered unlikely that EMFs from the Bellrock IACs would produce a large enough magnetic field to induce physiological effects in receptor species. However, in the absence of research into the effect of EMFs on the specific IEF species identified within the benthic study area, on a precautionary basis, it is considered that the receptors are of medium resistance and resilience to this pressure.

242. The sensitivity of the receptor is therefore considered to be **low**.

7.8.2.6.1.2 Summary of Receptor Sensitivities

243. **Table 7.21** summarises the sensitivity of each IEF to the impact of interactions with EMFs.

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Table 7.21: Sensitivity of the Important Ecological Features (IEFs) to Interactions with Electromagnetic Fields

Receptor (IEF)	Representative biotopes	Resistance	Resilience	Sensitivity[1]	Confidence assessment
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	High	High	Low	Medium
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	High	High	Low	Medium
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	High	High	Low	Medium
Ocean quahog	N/A	High	High	Low	Medium
Phosphorescent sea pen	N/A	High	High	Low	Medium

Notes:

[1] In the absence of MarESA sensitivity assessments, sensitivities of all IEFs have been determined based on the best available literature.

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7.8.2.6.2 Magnitude of Impact

244. EMFs are only emitted from operational cables. Therefore, the impact of interactions with EMFs has been assessed for the O&M phase of the Bellrock Wind Farm Infrastructure. The total length of IACs within the Bellrock WFDA is up to 300 km, comprising buried and unburied static IAC sections and dynamic IAC sections (**Table 7.15**).

245. Dynamic IACs account for the remainder of the unburied cable length; however, these occupy the water column rather than the seabed. Only limited touchdown areas interact with the seabed. As a result, EMF exposure is restricted to a very small proportion of the benthic study area, and any impacts are expected to be highly localised.

246. EMFs are comprised of electrical fields (V/m) and magnetic fields (µT). In the North Sea, background levels of magnetic fields are around 50 µT and electric fields are around 25 µV/m (Tasker et al. 2010). Direct electrical fields (E-fields) are typically blocked or significantly attenuated by the magnetic outer sheathing materials used on subsea cables. Therefore, the only EMFs that are emitted into the marine environment are the magnetic field (B-field) and the resultant induced electrical field (iE-field; generated when organisms move through a magnetic field) (**Appendix 8.1: Electromagnetic Fields Assessment (Volume IV)**). Most studies on the effects of EMFs on benthic organisms quantify only the strength of the B-field and not the iE-field. Whilst this assessment has been undertaken based on the best available literature at the time of writing, better characterisation of EMFs in terms of the component parts (i.e. B-fields and iE-fields) and how they are influenced by the marine environment is critical to understanding how best to assess benthic species responses to them (Gill et al, 2023).

247. EMF modelling of the IACs (**Appendix 8.1: Electromagnetic Fields Assessment (Volume IV)**) reported that system voltage and magnetic field are approximately directly proportional, the maximum system voltage for the Bellrock Wind Farm Infrastructure is 132 kV, and the WCS is that all IACs are high voltage alternating current and will likely be buried between 0.5 and 2.5 m. Therefore, it is estimated that the magnetic field directly above the IACs would be between 40 and 45 µT, which is less than typical background levels in the North Sea (Tasker et al. 2010). It is noted that this is significantly lower than the magnetic fields that triggered physiological effects in the species considered in the sensitivity assessment above (e.g. ~10x smaller in the study on edible crab *C. pagurus* conducted by Scott et al. (2021)).

248. It is currently anticipated that most of the IACs will be buried anywhere up to 2.5 m below the seabed, which significantly reduces the strength of magnetic field that could affect benthic fauna, particularly benthic epifauna. This is due to field decay increasing with distance from the cable (CSA, 2019). Additionally, any surface-laid IACs will be covered by cable protection (rock berm protection as a WCS), which will further limit EMFs from reaching benthic epifauna.

249. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the O&M activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

250. Overall, the impact of interactions with EMF during the O&M phase is expected to be highly localised, long-term duration, occur continuously throughout the operational period, and be of high reversibility.

251. The magnitude of impact is therefore considered to be **negligible**.

7.8.2.6.3 Significance of Effect

252. The sensitivity of all receptors to interactions with EMF is considered to be **low**. The magnitude of impact is considered to be **negligible**, and the effect will therefore be of **negligible adverse** significance, which is **not significant** in EIA terms.

253. No additional mitigation is required to manage potential effects during O&M.

7.8.2.7 O7: Thermal Emissions from Inter-array Cables

254. Thermal emissions produced by the IACs during the operational life of the Bellrock Wind Farm Infrastructure have the potential to affect benthic faunal distribution, species composition and physical damage or mortalities of individual benthic organisms.

255. No MarESA pressure and benchmark is considered analogous to the impact of thermal emissions from subsea electrical cables, therefore an assessment has been undertaken based on the best available literature.

7.8.2.7.1 Sensitivity

7.8.2.7.1.1 Priority Marine Feature Habitats (A5.272, A5.371, and A5.376)

256. No MarESA sensitivity assessment was available for any of the component biotopes of the PMF habitats, or their characterising species. There has been very little research into the effects of thermal emissions from subsea electrical cables on benthic infauna. Increased sediment temperature can alter the physicochemical properties of the substrate, such as oxygen concentrations, and may result in development of microorganism communities (OSPAR Commission, 2008).

257. The characterising species of the component biotopes of the PMF habitats are predominantly burrowing and/or infaunal bivalves, brittlestars, tube worms, bristle worms, and other polychaetes. They are predominantly sedentary species, but some are motile, such as the burrowing polychaete *P. jeffreysii*. Therefore, the characterising species of the component biotopes have some ability to avoid the impact of increased sediment temperatures in the vicinity of the IACs. There is very little information available regarding the ability of the receptor species to accommodate or adapt to minor increases in sediment temperature. However, it is noted that these species are adapted to natural temperature fluctuations of bottom waters in the North Sea, which can vary from 6°C to 8°C in winter and up to 12 °C to 14°C in summer (Neat et al. 2007); which exceeds the maximum recorded sediment temperature increase produced by buried subsea wind farm cables (2.5°C; discussed further in **Section 7.8.2.7.2**). It is therefore anticipated that characterising species of the biotopes within the Bellrock WFDA have some ability to avoid and adapt to/accommodate minor sediment temperature increases around the IACs. To provide a conservative sensitivity assessment in the absence of specific evidence, sensitivity has been assessed as medium.

258. The sensitivity of the receptor is therefore considered to be **medium**.

7.8.2.7.1.2 Ocean Quahog

259. No MarESA sensitivity assessment was available for ocean quahog, and there has been little research into the effects of thermal emissions from subsea electrical cables on ocean quahog.

260. However, there have been some studies conducted on the deoxygenation impact on ocean quahog, which concluded that the species is highly tolerant to severe hypoxia and anoxia (Theede et al. 1969, Diaz & Rosenberg, 1995). Spawning may be reduced when ocean quahog are subject to severe water temperature increases, but juveniles can survive temperatures of 16°C-20°C; which far exceeds the maximum recorded temperature increase emitted by buried subsea OWF cables (Cargnelli et al. 1999). Whilst the mobility of ocean quahog is limited, they are able, to some degree, to avoid temperature increases in the vicinity of the IACs. Additionally, they have high tolerance to changes in oxygen levels and medium tolerance to temperature changes.

261. The sensitivity of the receptor is therefore considered to be **low**.

7.8.2.7.1.3 Phosphorescent Sea Pen

262. No MarESA sensitivity assessment was available for phosphorescent sea pen, and there has been little research into the effects of thermal emissions from subsea electrical cables on phosphorescent sea pen.

263. Phosphorescent sea pens are largely sessile, with the ability to retreat into a tube below the mud surface (Mackie, 1998). Therefore, they have a partial ability to avoid sediment temperature increases around the IACs, as their basal peduncle is permanently anchored within sediment, whilst their rachis is mobile. Whilst there are no known specific studies into the effects of sediment temperature increases on phosphorescent sea pen, Ross et al. (2021) studied the natural bottom water temperature ranges that six sea pen taxa inhabit. These taxa included *Pennatulidae spp*. which is the family of the phosphorescent sea pen. *Pennatulidae spp.* were found tolerate temperatures between 1.5°C and 13°C. It is therefore anticipated that phosphorescent sea pen would have some ability to accommodate/adapt to the minor increase in sediment temperature that may occur in the vicinity of the IACs.

264. The sensitivity of the receptor is therefore considered to be **medium.**

7.8.2.7.1.4 Summary of Receptor Sensitivities

265. **Table 7.22** summarises the sensitivity of each IEF to the impact of thermal emissions from IACs.

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Table 7.22: Sensitivity of the Important Ecological Features (IEFs) to Thermal Emissions from Inter-array Cables

Receptor (IEF)	Representative biotopes	Resistance	Resilience	Sensitivity	Confidence assessment
Offshore Subtidal Sands and Gravels	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Medium	Medium	Medium	Medium
Burrowed Mud and Offshore Deep Sea Muds mosaic habitat	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	Medium	Medium	Medium	Medium
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud	Medium	Medium	Medium	Medium
Ocean quahog	N/A	High	High	Low	Medium
Phosphorescent sea pen	N/A	Medium	Medium	Medium	Medium

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7.8.2.7.2 Magnitude of Impact

266. There is little scientific evidence of the impacts of thermal emissions from subsea electrical cables available to date. Some studies suggest that high voltage subsea cables produce thermal emissions that can be detectable within the sediments surrounding the cable (Meißner 2006; Taormina et al. 2018).

267. Meißner (2006) conducted in-field measurements of thermal emissions produced by the two Nysted Offshore wind farm cables. The cables were alternating current (AC) and 33 kV and 132 kV, respectively, and were buried under offshore sediment to a depth of 1 m. They found that the maximum increase in temperature of surrounding sediment was 2.5 ºC; 50 cm below the cable. The maximum system voltage for the Bellrock Wind Farm Infrastructure is 132 kV, therefore it is anticipated that the temperature increase would be comparable to these findings.

268. However, the IACs will be buried between 0.5 and 2.5 m where practicable, and where they are surface laid, they will be subject to cable protection measures. As heat transfer to the water column is attenuated by the cable's sheathing and sediment cover where the cable is buried, temperature increase in the surrounding sediment is generally considered negligible, particularly when considering natural seasonal temperature variations (Hughes et al. 2015, Henry et al. 2022, Taormina et al. 2020). Therefore, similar to interactions with EMF, it is not anticipated that enough individuals would be affected to result in adverse effects at a population level.

269. Some studies have been conducted on benthic infaunal composition near shallow hydrothermal vents, where sediment temperatures range from a few degrees warmer to an order of magnitude above ambient conditions (Sedwick and Stuben, 1996, Pichler et al. 1999). Melwani & Kim (2008) found that species composition in warmer sediments near the vents was influenced by a combination of temperature, hydrogen sulphide, salinity, and pH. They noted that the vent communities were predominantly a subset of the surrounding community. This suggests that minor increases in sediment temperature around the IACs are unlikely to make a meaningful impact to benthic infaunal species composition, particularly if other environmental factors such as salinity and pH are stable.

270. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the O&M activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

271. Whilst the impact is considered to be long-term, directly impactful to receptors and not reversible during the operational life of the Bellrock WFDA, it is highly localised to the immediate vicinity of the IACs and is considered to be highly localised.

272. Cable burial where practicable, cable sheathing, and cable protection will greatly attenuate thermal emissions from IACs to a point where they can be considered negligible. Additionally, the effect will be restricted to the immediate vicinity of the cable and is therefore considered to be highly localised.

273. In consideration of these measures, the magnitude of impact is therefore considered to be **negligible.**

7.8.2.7.3 *Significance of Effect*

274. Overall, it is predicted that sensitivity of the receptor is **medium**, and the magnitude of impact is **negligible.** The effect is therefore of **negligible adverse** significance, which **is not significant** in EIA terms.

275. No additional mitigation is required to manage potential effects during O&M.

7.8.3 Potential Impacts During Decommissioning

7.8.3.1 D1: Physical Disturbance and Temporary Loss of Seabed Habitat

276. The sensitivity and magnitude of impact from physical disturbance and temporary loss of seabed habitat during decommissioning would be comparable to or less than those identified for the construction phase (see **Section 7.8.1.1**).

277. Decommissioning activities include removal of the Bellrock Wind Farm Infrastructure on or within the seabed, such as anchors and associated scour protection, IACs and associated cable protection, and subsea cable hubs. The WCS would be if the magnitude of impact from decommissioning activities was equal to that of construction activities, which would be equivalent to a 3.64 km^2 physical disturbance and temporary habitat loss footprint. In general, it is expected that all structures above the seabed will be fully removed at the end of operational lifetime of the Bellrock Wind Farm Infrastructure. However, some infrastructure or parts of infrastructure may be left in-situ, as described in the decommissioning section of the realistic WCS presented in **Table 7.15**.

278. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the decommissioning activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

279. Overall, the impact of physical disturbance and temporary habitat loss during the decommissioning phase is expected to directly impact benthic receptors, be highly localised and short duration, occur periodically throughout the decommissioning period, and be of high reversibility.

280. Implementing embedded mitigation measures throughout the decommissioning phase would further limit effects. Therefore, the effect of physical disturbance and temporary loss of seabed habitat during decommissioning is assessed as **minor adverse** which is **not significant** in EIA terms.

281. No additional mitigation is required to manage potential effects during decommissioning.

7.8.3.2 D2: Increased Suspended Sediment Concentrations and Sediment Re-deposition

282. The sensitivity and magnitude of impact from increased SSCs and sediment re-deposition during decommissioning would be comparable to or less than those identified for the construction phase (see **Section 7.8.1.2**).

283. Decommissioning activities include removal of infrastructure on or within the seabed, such as anchors and associated scour protection, IACs and associated cable protection, and subsea cable hubs. The WCS would be if the magnitude of impact from decommissioning activities was equal to that of construction activities, which would be equivalent to 0.0014 km^3 of displaced sediment. In general, it is expected that all structures above the seabed will be fully removed at the end of operational lifetime of the Bellrock Wind Farm Infrastructure. However, some infrastructure or parts of infrastructure may be left in-situ, as described in the decommissioning section of the realistic WCS presented in **Table 7.15**.

284. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are present only at very low densities in the Bellrock WFDA, particularly compared to other areas of the North Sea where densities are orders of magnitude higher. This negligible local density means that the decommissioning activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

285. Overall, the impact of increased SSCs and sediment re-deposition during the decommissioning phase is expected to be highly localised and short duration, occur periodically throughout the decommissioning period, and be of high reversibility.

286. Implementing embedded mitigation measures throughout the decommissioning phase would further limit effects. Therefore, the effect of increased SSCs and re-deposition during decommissioning is considered to be of **minor adverse** significance, which is **not significant** in EIA terms.

287. No additional mitigation is required to manage potential effects during decommissioning.

7.8.3.3 D3: Introduction of Invasive Non-native Species

288. Vessels, tools, and equipment associated with decommissioning activities may cause the introduction and/or spread of INNS within the Bellrock WFDA. The factors that comprise the magnitude of impact are similar to that of the construction phase, as described in **Section 7.8.1.3**. Additionally, should there be any invasions of the Bellrock WFDA by INNS throughout the lifetime of the Bellrock WFDA, the impacts my persist into the decommissioning phase and beyond.

289. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are present only at very low densities in the Bellrock WFDA, particularly compared to other areas of the North Sea where densities are orders of magnitude higher. This negligible local density means that the decommissioning activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

290. Overall, the impact of introduction of INNS during the decommissioning phase is expected to be highly localised and medium duration, occur periodically throughout the decommissioning phase (in terms of invasions), and be of low reversibility. Implementing embedded mitigation measures throughout the decommissioning phase would further limit effects.

291. For the three PMF habitats, the effect will be of **no significance** for these receptors. The magnitude of the potential impact during decommissioning is considered to be **negligible** for ocean quahog and phosphorescent sea pen and the effect will therefore be of **negligible adverse** significance, which is **not significant** in EIA terms.

292. No additional mitigation is required to manage potential effects during decommissioning.

7.8.3.4 D4: Permanent Habitat Loss

293. The WCS of any infrastructure being left *in situ* on or in the seabed post-decommissioning is considered as part of the decommissioning phase. The sensitivity and magnitude of impact from permanent loss of seabed habitat during decommissioning would be comparable to or less than those identified for the O&M phase (see **Section 7.8.2.4**).

294. In general, it is expected that all structures above the seabed will be fully removed at the end of operational lifetime of the Bellrock Wind Farm Infrastructure. However, some infrastructure or parts of infrastructure may be left in-situ, as described in the decommissioning section of the realistic WCS presented in **Table 7.15**. Any infrastructure left in-situ would represent areas of benthic habitat that would be permanently lost. However, it is likely that, comparative to the overall amount of Bellrock Wind Farm Infrastructure installed, infrastructure left in-situ would be minimal. Implementing embedded mitigation measures throughout the decommissioning phase would further limit effects.

295. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea where densities are orders of magnitude higher. This negligible local density means that the decommissioning activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

296. The effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

297. No additional mitigation is required to manage potential effects during decommissioning.

7.8.3.5 D5: Removal of Introduced Substrate

298. The removal of introduced substrate during decommissioning of the Bellrock Wind Farm Infrastructure may affect the benthic community that has established on these structures. The seabed would change from comprising sections of hard substrate, to being sandy, as it was before the construction of the Bellrock Wind Farm Infrastructure. This may cause a change in benthic communities from that of sessile organisms that settle on hard structures, to one representative of sedimentary habitats.

299. The Bellrock Wind Farm Infrastructure is expected to have been colonised by a range of organisms over the 35-year operation life. This impact has been assessed separately in **Section 7.8.2.5** (Colonisation of Introduced Substrate).

300. The following MarESA pressure and benchmark relevant removal of introduced substrate has been used to inform this assessment:

- Physical change (to another seabed type):
  - The benchmark for this pressure is a change in sediment type by one Folk class (Long, 2006) (based on UK SeaMap simplified classification) and/or change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.

7.8.3.5.1 Sensitivity

301. The impact of removing introduced substrate that has been colonised is the reverse of the colonisation of introduced substrate (which is assessed in **Section 7.8.2.5**). This is because the physical change (to another seabed type) as described by the MarESA pressure and benchmark, is a change from a hard, artificial substratum to a sedimentary substratum; and is vice versa for the impact of Colonisation of Introduced Substrate. This reflects a positive change for the IEFs within the benthic study area, as the IEFs within the Bellrock WFDA are sedimentary and will therefore gain available habitat.

302. All receptors are therefore considered to be of **low** sensitivity to the impact.

7.8.3.5.2 Magnitude of Impact

303. As shown in **Table 7.15**, the WCS for removal of introduced substrate (equivalent to all infrastructure on the seabed and in the water column being removed) is 2.93 km^2 within the Bellrock WFDA. This equates to 1.05 % of the total footprint of the benthic study area and is therefore considered to be highly localised. Whilst some infrastructure or parts of infrastructure may be left in-situ, it is currently expected that all structures above the seabed will be fully removed at the end of operational life of the Bellrock Wind Farm Infrastructure. Therefore, the WCS presented here will likely be lower, in reality.

304. Removal of colonised substrate may lead to loss of localised biodiversity hotspots, and overall reduction in biodiversity within the Bellrock WFDA. Any species of conservation interest that have colonised the introduced substrate may be removed during decommissioning. Should the colonised substrate have created a ‘reef effect’, by attracting mobile species such as fish, this would be removed during decommissioning; potentially altering community composition, local food web dynamics, and reducing biodiversity.

305. However, as noted in **Section 7.8.2.5.2**, most of the Bellrock Wind Farm Infrastructure lacks structural complexity and is therefore unlikely to lead to the development of highly diverse communities. Furthermore, it is currently not anticipated that the long-term presence of the Bellrock Wind Farm Infrastructure will encourage aggregations of higher trophic levels and propagation up the food chain.

306. As detailed in **Section 7.8.1.1.2**, ocean quahog and phosphorescent sea pen are patchily distributed across the Bellrock WFDA, particularly compared to other areas of the North Sea. This patchy distribution means that the decommissioning activities for the Bellrock Wind Farm Infrastructure are likely to affect only a very small fraction of the regional population, reducing the overall magnitude of impact on ocean quahog and phosphorescent sea pen.

307. Overall, the impact is considered to be highly localised, long-term, and of low reversibility.

308. The magnitude of impact is therefore considered to be **low**.

7.8.3.5.3 Significance of Effect

309. The sensitivity of all receptors to removal of introduced substrate is considered to be **low.** The magnitude of impact is considered to be **low**, and the effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

310. No additional mitigation is required to manage potential effects during decommissioning.

7.9 Cumulative Effects Assessment

311. The CEA follows the methodology set out in **Chapter 5: EIA Methodology (Volume II)** and summarised in **Section 7.4.2**.

7.9.1 Screening of Potential Cumulative Impacts

312. Potential impacts from the Bellrock WFDA alone assessment are brought forward into the CEA. Some potential impacts considered for the Bellrock WFDA alone assessment may be specific to a particular phase of development (e.g. construction, O&M, or decommissioning). The potential for cumulative effects with other plans or projects requires spatial and/or temporal overlap with the Bellrock Wind Farm Infrastructure during the relevant phases of development. Therefore, impacts associated with a certain phase may be screened out from further consideration where no projects or plans have been identified that have the potential for cumulative effects during the same temporal period and/or across the same spatial extent. All impacts considered in the Bellrock WFDA alone assessment (**Section 7.8**) were initially brought forward for CEA impact pathway screening (**Table 7.23**). Impact screening considered the Zone of Influence of the impacts and the plans and projects identified in **Table 7.24**. Impacts with no rationale for cumulative effects i.e. those assessed as no change or where impacts were highly spatially and/or temporally constrained, and therefore would not contribute to a cumulative effect, were screened out.

Table 7.23: Potential Cumulative Impacts for Benthic Ecology

Impact	Potential for Cumulative Impact	Rationale
C1, O1 and D1: Physical disturbance and temporary loss of seabed habitat	No	The Ossian array is located 8.68 km from the Bellrock WFDA, and the areas subject to physical disturbance and temporary loss of seabed habitat during construction, O&M, and decommissioning at the Bellrock WFDA do not overlap with any seabed-disturbing activities associated with the Ossian offshore wind farm array. The Bellrock WFDA's physical disturbance and temporary loss of seabed habitat footprint is spatially constrained and does not extend across the intervening distance. Although the indicative construction and O&M periods may have overlap, there is no spatial or mechanistic interaction between the physical disturbance and temporary loss of seabed habitat footprints of the two projects. Ossian is therefore screened out of the CEA for this impact pathway across all project phases. The Bellrock OfTDA lies immediately adjacent to, and overlaps with, the Bellrock WFDA, and introduces comparable seabed contact activities within the same spatial area across all project phases. As spatial and temporal interaction of physical disturbance and temporary loss of seabed habitat footprints is plausible, the Bellrock OfTDA is screened in for CEA.
C2, O2, and D2: Increased suspended sediment concentrations and sediment re-deposition	No	Sediment disturbance from construction, O&M, and decommissioning is highly localised for both projects. For the Bellrock WFDA, sediments are predominantly sand and mud, and site-specific activities generate sediment plumes that rapidly settle, with most deposition occurring within the vicinity of the source. Concentrations of fine particulates beyond the immediate area are negligible. The Ossian array is located approximately 8.68 km from the Bellrock WFDA, and its SSC and sediment re-deposition footprints are similarly spatially constrained (Ossian Offshore Wind Farm Limited, 2024). Given the rapid attenuation of SSC and the negligible concentrations at distance, there is no plausible mechanism for a material cumulative effect between the Ossian array and the Bellrock WFDA. Potential temporal overlap in construction or O&M phases does not alter this conclusion. Accordingly, Ossian is screened out, while the Bellrock OfTDA is screened in due to its immediate spatial overlap (and temporal overlap) with the Bellrock WFDA.
C3, O3 and D3: Introduction of INNS	No	Introduction of INNS is primarily associated with vessel movements, fouling of infrastructure, and installation of hard substrate. Within the Bellrock WFDA, no INNS were recorded during the site-specific surveys, and the area is offshore, reducing the likelihood of invasion compared to nearshore environments. Best practice measures will be implemented, including adherence to the INNSMP, biofouling management, and compliance with IMO ballast water guidance (**Section 7.7.3**), further reducing the risk. The Ossian array is located approximately 8.68 km from the Bellrock WFDA, and its construction, O&M, and decommissioning activities are confined to its own array boundary. There is no spatial overlap or

Impact	Potential for Cumulative Impact	Rationale
		plausible mechanism for INNS introduced via Ossian to reach the Bellrock WFDA, and any temporal overlap does not alter this conclusion. As such Ossian is screened out for this impact pathway. The Bellrock OfTDA and WFDA are both part of the Bellrock Project, and the OfTDA will also implement mitigation measures, including a specific INNSMP. As a result, there is no potential for cumulative effects between them, and the Bellrock OfTDA is screened out. As such, this impact pathway is screened out of CEA entirely.
O4 and D4: Permanent habitat loss	No	Permanent habitat loss arises from long-term seabed infrastructure and is highly spatially constrained. For the Bellrock WFDA, permanent habitat loss is reported under the O&M phase to avoid double counting with construction. The Ossian array's permanent habitat loss footprint (19.27 km^2; 2.25% of its study area) is confined within the Ossian array boundary (Ossian Offshore Wind Farm Limited, 2024). Ossian is located approximately 8.68 km from the Bellrock WFDA, and the Bellrock permanent habitat loss footprint does not extend across this intervening distance. As the two projects' permanent habitat loss footprints are discrete, with no spatial overlap or realistic interaction mechanism, Ossian is screened out for this impact pathway. In Contrast, the Bellrock OfTDA lies immediately adjacent to, and overlaps with, the Bellrock WFDA, and introduces comparable permanent habitat loss pathways within the same spatial area. As spatial and temporal interaction of permanent habitat loss footprints is plausible, the Bellrock OfTDA is screened in for CEA.
O5: Colonisation of introduced substrate	No	Colonisation of introduced substrate is restricted to the physical surfaces of long-term infrastructure, including foundations, mooring systems, and exposed or protected cables, and is therefore highly localised to each project footprint. At Bellrock, colonisation effects are limited to in-situ structures within the Bellrock WFDA. The Ossian array is located approximately 8.68 km from the Bellrock WFDA and its artificial substrate footprint is contained entirely within its own array boundary. Although natural larval dispersal occurs across the wider North Sea, colonisation at each site is driven by the availability of local hard surfaces, there is no shared or contiguous infrastructure, nor any mechanisms by which the presence of artificial substrate at Ossian would influence colonisation processes at Bellrock. Consequently, even if O&M periods overlap, no spatial or mechanistic interaction exists between the two projects for this pathway, and Ossian is screened out. In contrast, the Bellrock OfTDA lies directly adjacent to and overlaps with the Bellrock WFDA. As the Bellrock OfTDA introduces additional hard substrate within the same spatial area and temporal period, cumulative colonisation effects are plausible, and the Bellrock OfTDA is screened in.

<table>
<tr><th>Impact</th><th>Potential for Cumulative Impact</th><th>Rationale</th></tr>
<tr><td>O6: Interactions with EMF</td><td>No</td><td rowspan="2">EMF and thermal emissions from subsea cables attenuate rapidly with distance and are restricted to the immediate vicinity of each cable. Within the Bellrock WFDA, IACs will be buried where feasible, with any unavoidable unburied sections protected. Both burial and protection measures further limit the spatial extent of material EMF and thermal change.

The Ossian array lies approximately 8.68km from the Bellrock WFDA, and its IAC network is entirely contained within its own array boundary. Given the short-range nature of EMF and thermal diffusion, this separation distance precludes any spatial interaction between emissions from Ossian's IACs and those of the Bellrock WFDA. Potential temporal overlap in O&M phases does not introduce any mechanism for interaction in the absence of spatial overlap. Ossian is therefore screened out of this impact pathway.

In contrast, the Bellrock OfTDA overlaps with the Bellrock WFDA, and interconnector and export cable circuits are co-located with the Bellrock WFDA IACs. As identified in Appendix 8.1: Electromagnetic Fields Assessment (Volume IV), IACs in the WFDA and interconnectors within the OfTDA are all AC systems operating at 50 hertz. Where alternating circuits at the same frequency occur in proximity, cumulative magnetic field effects are possible (e.g. local field amplification), governed by engineering parameters such as cable separation, burial depth, and shielding. Accordingly, a plausible cumulative interaction exists.</td></tr>
<tr><td>O7: Thermal emissions from IACs</td><td>No</td></tr>
<tr><td>D5: Removal of introduced substrate</td><td>No</td><td>Removal of introduced substrate during decommissioning is confined to the immediate footprint of infrastructure within each project boundary. Within the Bellrock WFDA, this impact is highly localised and does not extend beyond the Bellrock WFDA itself.

The Ossian array involves removal of up to 19.27 km^2 of introduced hard substrate (2.25% of the study area). This represents a small, spatially constrained footprint that is wholly contained within the Ossian array boundary, and there is not spatial overlap or proximity-based interaction mechanism with the Bellrock WFDA. As the decommissioning footprint does not extend across the intervening distance and no processes act beyond the immediate footprint of each project, there is no plausible pathway for cumulative effects. Ossian is therefore screened out for this impact pathway.

In contrast, the Bellrock OfTDA lies immediately adjacent to, and overlaps with, the Bellrock WFDA. As both areas may involve removed of co-located infrastructure during decommissioning, accumulative effect cannot be ruled out. The Bellrock OfTDA is therefore screened in.</td></tr>
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7.9.2 Screening of Other Plans, Projects and Activities

313. Potential cumulative plans and projects were identified and screened in **Appendix 5.3: Cumulative Effects Assessment Long List of Projects (Volume IV).** For this CEA, a 10 km distance is used to identify possible projects or plans as this distance encompasses the Zone of Influence for all relevant impacts from the Bellrock Wind Farm Infrastructure as well as incremental changes over the wider relevant area. The plans and projects which have been subsequently scoped into the CEA for benthic ecology are outlined in **Table 7.24.** Given that there is no potential pathway for impact to benthic ecology due to the proposed Bellrock Onshore Transmission Infrastructure, the Bellrock OnTDA has not been considered further within the CEA. The Proposed Bellrock OfTDA however, remains as part of the Tier 1 assessment, due to a potential receptor impact pathway.

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Table 7.24: Other Projects and Plans Considered within the Benthic Ecology Cumulative Effects Assessment

Project	Status	Approx. closest distance from the Bellrock WFDA	Project Summary	Planned Dates of Construction	Planned Dates of Operation	Tier	Screened into the CEA	Rationale
Bellrock OfTDA	In Planning	0 km	The Bellrock OfTDA represents the boundary within which the Offshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned (and includes the whole of the Bellrock WFDA). Infrastructure located within the OfTDA includes fixed bottom and/or floating offshore substations[1] (OfSS), offshore reactive compensation station(s) and associated scour protection; interconnector cables and associated cable protection; and offshore export cables and associated cable protection.	2031 to 2036	Unknown	1	Yes	Please see **Table 7.23**. There is potential for cumulative effects in relation to shared impact pathways.
Ossian offshore wind farm array	In Planning (Application Submitted)	9.00 km	Floating offshore wind farm project. Up to 265 floating wind turbines are proposed, with a total export capacity of 3.6 GW.	2031 to 2038	2038 to 2072	1	No	Due to the nature of the shared impact pathways and the distance between the Bellrock WFDA and the Ossian array, it has been determined there is no potential for cumulative effects. Please see **Table 7.23**.

Notes:

[1] Offshore substations will be consented as part of the OfTDA and will be assessed as part of the Bellrock OfTDA EIA Report. The OfTDA is also considered within the Bellrock WFDA EIA's cumulative effects assessments.

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7.9.3 Cumulative Assessment of Effects

314. The only project or plan screened into the CEA for all impacts is the Bellrock OfTDA, which, for the purposes of this Bellrock WFDA EIA Report is considered a Tier 1 project. However, it is noted that there is not currently a Scoping Report available for the Bellrock OfTDA, therefore the information available to inform this CEA is limited.

7.9.3.1 Potential Cumulative Impacts During Construction

7.9.3.1.1 Physical Disturbance and Temporary Loss of Seabed Habitat

7.9.3.1.1.1 Sensitivity of Receptors

315. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.1.1.1**, where all receptors were assessed as **medium** sensitivity.

7.9.3.1.1.2 Magnitude of Cumulative Impact

316. Temporary physical disturbance and habitat loss within the Bellrock WFDA is primarily associated with site preparation works and installation of SKSs, IACs and subsea cable hubs (please see **Section 7.8.1.1**). The Bellrock OfTDA will include the Bellrock Offshore Transmission Infrastructure which is expected to comprise of fixed bottom and/or floating OfSSs, offshore reactive compensation station(s) and associated scour protection, interconnector cables and associated cable protection, and offshore export cables and associated cable protection, along with any site preparation works limited to the immediate footprint of these installations. Consequently, cumulative physical disturbance and temporary loss of seabed habitat are confined to the areas directly affected by the installation of the Bellrock Wind Farm Infrastructure and Bellrock Offshore Transmission Infrastructure. Activities across both Development Areas will be intermittent during the construction phase and reversible in nature. Based on this, the cumulative magnitude of impact ranges from **negligible** to **low** (negligible for ocean quahog due to the low occupancy and patchy distribution).

7.9.3.1.1.3 Significance of Cumulative Effects

317. Given that receptors are of **medium** sensitivity and the cumulative magnitude of impact is **low**, the cumulative effect of physical disturbance and temporary loss of seabed habitats during construction is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.1.2 Increased Suspended Sediment Concentrations and Sediment Re-deposition

7.9.3.1.2.1 Sensitivity of Receptors

318. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.1.2**, where receptor sensitivity ranged from **not sensitive** to **low.**

7.9.3.1.2.2 Magnitude of Cumulative Impact

319. For the Bellrock WFDA alone, site preparation works and construction activities (installation of SKS, IACs and subsea cable hubs) are predicted to result in temporary increases in SSCs and localised sediment re-deposition. These impacts are largely confined to the immediate area of

disturbance, short-term in duration, and highly reversible, and the magnitude of impact has assessed as low.

320. For the Bellrock OfTDA, sediment disturbance and re-deposition associated with the construction phase is expected to be locally constrained to the vicinity of the site preparation works and construction works, intermittent, temporary, and reversible, with SSCs and re-deposition diminishing rapidly with distance from the works.

321. Considering the Bellrock WFDA and OfTDA together, cumulative impacts are predicted to remain temporary, reversible, and primarily confined to the vicinity of the site preparation and construction works. Sediment plumes from one area are not expected to materially influence the other. Consequently, the magnitude of the cumulative impact is assessed as **low**.

7.9.3.1.2.3 Significance of Cumulative Effect

322. Given that receptor sensitivity ranges from **not sensitive** to **low** and the cumulative magnitude of impact is **low**, the cumulative effect of increased suspended sediment concentrations and sediment re-deposition during construction is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.2 Potential Cumulative Impacts During Operation and Maintenance

7.9.3.2.1 Physical Disturbance and Temporary Loss of Seabed Habitat

7.9.3.2.1.1 Sensitivity of Receptor

323. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.2.1.1**, where all receptors were assessed as **medium** sensitivity.

7.9.3.2.1.2 Magnitude of Cumulative Impact

324. The Bellrock WFDA-alone assessment concludes that O&M activities will generate localised, intermittent, and reversible seabed disturbance from the mooring line abrasion, occasional jack-up vessel deployment, and infrequent IAC repair works. These pressures affect small areas at any one time, do not persist and result in a low magnitude of impact for the Bellrock WFDA alone.

325. Within the Bellrock OfTDA, activities with the potential to give rise to this impact are limited to maintenance, repair and/or replacement of interconnector cables and export cables, localised reburial/de-burial works, and occasional maintenance at the OfSSs and reactive compensation station(s) (if required). These activities are likely to give rise to impacts that are infrequent, restricted to discrete locations, and smaller in nature than those associated with the Bellrock Wind Farm Infrastructure, with no routine activities expected to disturb the seabed.

326. Although the Bellrock OfTDA overlaps with, and extends outwards to landfall from the Bellrock WFDA, the scale, frequency, and spatial extent of disturbance within the OfTDA are small relative to the WFDA footprint. Disturbance footprints remain confined to the immediate vicinity of installed infrastructure, and associated maintenance activities, and there is no realistic mechanism for the spatially discrete O&M activities in each area to combine to create a materially greater cumulative impact than that assessed for the Bellrock WFDA alone.

327. Accordingly, the cumulative impact during the O&M phase is expected to be highly localised, long-term but intermittent duration, and highly reversible, directly affecting benthic receptors only in the immediate vicinity of the relevant activities. Based on this, the cumulative magnitude of impact ranges from **negligible** to **low** (negligible for ocean quahog due to the low occupancy and patchy distribution).

7.9.3.2.1.3 Significance of Cumulative Effect

328. Given that receptors are of **high** (ocean quahog) and **medium** sensitivity and the cumulative magnitude of impact is **negligible** (ocean quahog) **low**, the cumulative effect during O&M is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.2.2 Increased Suspended Sediment Concentrations and Sediment Re-deposition

7.9.3.2.2.1 Sensitivity of Receptor

329. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.2.2.1** where receptor sensitivity ranged from **not sensitive** to **low**.

7.9.3.2.2.2 Magnitude of Cumulative Impact

330. For the Bellrock WFDA alone, increases in SSCs arise only from the intermittent sweeping action of the mooring lines on the seabed primarily during storm events and occasional jack-up vessel deployment. These events disturb small areas of seabed, generate limited volumes of sediment, and result in short-lived, highly localised increases in SSCs that rapidly settle. The magnitude of impact is negligible.

331. Within the Bellrock OfTDA, only infrequent interconnector cable and export cable repair, replacement, and/or localised re-burial/de-burial works, and occasional OfSSs and reactive compensation station(s) maintenance (if required) have the potential to resuspend sediment. These activities are restricted to narrow, discrete locations and generate small sediment volumes that are likely to re-deposit quickly in the immediate vicinity of the activity.

332. Although the Bellrock OfTDA overlaps with, and extends outwards to the landfall from, the Bellrock WFDA, O&M footprints are spatially discrete and infrequent in nature. There is no realistic mechanism for sediment plumes from either area to combine to create a materially greater cumulative impact than that assessed for the Bellrock WFDA alone.

333. The cumulative impact is therefore local in extent, intermittent and highly reversible, with impacts limited to the vicinity of individual O&M activities. The cumulative magnitude is **negligible**.

7.9.3.2.2.3 Significance of Cumulative Effect

334. Given that receptor sensitivity ranges from, **not sensitive** to **low** and the cumulative magnitude of impact is **negligible**, the cumulative effect during O&M is assessed as **negligible** adverse, which is **not significant** in EIA terms.

7.9.3.2.3 Permanent Habitat Loss

7.9.3.2.3.1 Sensitivity of Receptor

335. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.2.4.1**, where all receptors were assessed as **high** sensitivity.

7.9.3.2.3.2 Magnitude of Cumulative Impact

336. For the Bellrock WFDA alone, permanent habitat loss arises from the long-term presence of SKSs, sections of IACs where burial is not possible, and subsea cable hub(s) on the seabed. These features create a small, discrete, and highly localised footprint relative to the wider benthic study area, and the magnitude of impact is negligible.

337. Within the Bellrock OfTDA, permanent seabed footprint would be limited to sections of external cable protection where burial is not possible and the foundations of any OfSSs. These features are spatially discrete, small in area, spatially constrained, and are likely to be substantially less extensive than the permanent footprint of the Bellrock Wind Farm Infrastructure. No routine activities within the Bellrock OfTDA are expected to cause additional long-term habitat loss.

338. Although the Bellrock OfTDA overlaps with, and extends outwards to the landfall from the Bellrock WFDA, the permanent habitat loss footprints remain confined to distinct locations. Given the nature of the impact for both the Bellrock WFDA and OfTDA there is no mechanism for the two footprints to combine to create a materially greater impact than that assessed for the Bellrock WFDA alone. Accordingly, the cumulative impact during O&M is highly localised, long-term duration, and low reversibility, affecting only a very small proportion of available habitat. The cumulative magnitude of impact is therefore **negligible**.

7.9.3.2.3.3 Significance of Cumulative Effect

339. Given that receptors are of **high** sensitivity and the cumulative magnitude of impact is **negligible**, the cumulative effect during O&M is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.2.4 Colonisation of Introduced Substrate

7.9.3.2.4.1 Sensitivity of Receptor

340. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.2.5.1**, where all receptors were assessed as **high** sensitivity.

7.9.3.2.4.2 Magnitude of Cumulative Impact

341. The Bellrock Wind Farm Infrastructure introduces discrete areas of hard substrate on the seabed and in the water column, including FSSs, SKSs, IACs, subsea cable hubs, cable protection, and scour protection. These structures provide limited colonisable surface area, and the majority of substrate lacks structural complexity, with the colonisable seabed area considered to be small relative to the wider benthic study area. Colonisation is expected to be limited to local epilithic species (e.g. bryozoans), with very low densities of the scoped in receptors likely. Overall, colonisation is expected to be localised and long-term, and the magnitude of the impact was determined to be negligible for the Bellrock WFDA alone.

342. Within the Bellrock OfTDA, introduced hard substrate is limited to external cable protection where burial is not possible and the foundations of the OfSSs. These features are spatially discrete, localised, and substantially smaller than the footprint of the Bellrock Wind Farm Infrastructure, and colonisation is expected to be similarly localised.

343. Although the Bellrock OfTDA overlaps with, and extends outwards to the landfall from the Bellrock WFDA, introduced substrate, that is suitable for colonisation, in the two areas is confined to separate, localised locations. The cumulative spatial extent of potential colonisation remains small in absolute terms. Given the nature of the impact for both the Bellrock WFDA and OfTDA there is no mechanism for the two footprints to combine to create a materially greater impact than that assessed for the Bellrock WFDA alone. Consequentially, the cumulative impact during O&M is expected to be highly localised and long-term duration. The magnitude of the cumulative impact is therefore **negligible**.

7.9.3.2.4.3 Significance of Cumulative Effect

344. Given that receptors are of **high** sensitivity and the cumulative magnitude of impact is **negligible**, the cumulative effect during O&M is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.2.5 Interactions with Electromagnetic Fields and Thermal Emissions from IACs

7.9.3.2.5.1 Sensitivity of Receptor

345. The sensitivity of receptors to these two impact pathways are detailed in **Section 7.8.2.6.1** and **Section 7.8.2.7.1**, where receptor sensitivity was **low** in relation to interactions with EMFs and ranged from **low** to **medium** in relation to thermal emissions from IACs.

7.9.3.2.5.2 Magnitude of Cumulative Impact

346. For the Bellrock Wind Farm Infrastructure EMF and thermal emissions during O&M arise from energised IACs. The majority of the IACs will be buried, with any unburied sections protected, which limits EMF and thermal propagation into surround sediments and the water column. EMF and thermal emissions attenuate rapidly with distance from the source and any impacts are therefore very highly localised. For the Bellrock Wind Farm Infrastructure alone, Impacts are long-term but spatially constrained, with a **negligible** magnitude of impact on benthic receptors.

347. Within the Bellrock OfTDA, EMF and thermal emissions originate from the interconnector and export cables. As with the Bellrock WFDA, these emissions diminish rapidly with distance, and any impacts are restricted to the immediate vicinity of each cable circuit.

348. Part of the Bellrock OfTDA overlaps with the entire Bellrock WFDA, and AC IACs in the WFDA may occur in proximity to AC interconnectors in the OfTDA (**Appendix 8.1: Electromagnetic Fields Assessment (Volume IV)**). Where AC circuits operate under the same frequency and are not spatially separated, local field amplification is possible. However, any such interaction remains confined to the immediate surrounds of the cables and does not alter the highly localised spatial extent of EMF and thermal change. Potential direct current export circuits in the OfTDA do not interact with AC circuits and can be considered separately.

349. Given the discrete linear nature of the cable infrastructure, the rapid attenuation of EMF and thermal emissions, and the limited area of seabed or water column where AC to AC proximity could rise, there is not credible mechanism by which impacts on benthic receptors would combine to produce a materially greater impact. Cumulative impacts remain very highly localised, long-term and negligible. The cumulative magnitude of impact is therefore assessed as negligible.

7.9.3.2.5.3 Significance of Cumulative Effect

350. Given that receptor sensitivity ranges from, **low** in relation to EMF and **low** to **medium** in relation to thermal emissions and the cumulative magnitude of impact is **negligible**, the cumulative effect for interactions with EMF is assessed as **negligible** adverse and the cumulative effect for thermal emissions is assessed as **negligible** adverse (medium sensitivity) during O&M, which are **not significant** in EIA terms.

7.9.3.3 Potential Cumulative Impacts During Decommissioning

7.9.3.3.1 Physical Disturbance and Temporary Loss of Seabed Habitat

7.9.3.3.1.1 Sensitivity of Receptor

351. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.3.1**, where receptor sensitivity was defined as **medium**.

7.9.3.3.1.2 Magnitude of Cumulative Impact

352. In relation to the decommissioning activities for the Bellrock Wind Farm Infrastructure which are localised, short-term, intermittent, and high reversible, affecting only a small proportion of benthic receptors. The magnitude of impact is determined to be low.

353. For the Bellrock OfTDA, decommissioning activities are expected to involve the removal of export cables, interconnectors cables and associated cable protection, the reactive compensation station, OfSS foundations, and associated scour protection. Some of these works, specifically the removal of OfSSs and any associated cable sections located within the Bellrock WFDA, will contribute to localised disturbance footprints within the Bellrock WFDA. Disturbance along the remaining export cable route will occur outside of the Bellrock WFDA, along narrow, linear corridors and will be highly localised relative to the wider benthic environment and will therefore not contribute to disturbance within the Bellrock WFDA. Across the OfTDA as a whole, decommissioning impacts will be spatially discrete and short-term in duration.

354. Given the discrete footprints, localised extent, and short-term duration, there is no credible mechanism for impacts to combine and create a materially different impact. Based on this, the cumulative magnitude of impact ranges from **negligible** to **low** (negligible for ocean quahog due to the low occupancy and patchy distribution).

7.9.3.3.1.3 Significance of Cumulative Effect

355. Given that receptors are of **high** (ocean quahog) and **medium** sensitivity and the cumulative magnitude of impact is **negligible** (ocean quahog) **low**, the cumulative effect during O&M is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.3.2 Increased Suspended Sediment Concentrations and Sediment Re-deposition

7.9.3.3.2.1 Sensitivity of Receptor

356. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.3.2**, where receptor sensitivity ranged from **not sensitive** to **low**.

7.9.3.3.2.2 Magnitude of Cumulative Impact

357. Decommissioning within the Bellrock WFDA, including the removal of SKSs and associated scour protection, IACs and associated cable protection, and subsea cable hubs, may temporarily suspend and redeposit sediments. Impacts are localised, short-term, intermittent, and highly reversible, affecting only small areas and a very small proportion of benthic receptors.

358. Within the Bellrock OfTDA decommissioning is likely to involve the removal of the interconnector cables, export cables, and the reactive compensation station(s) and OfSS(s)' foundations. Similarly to the Bellrock Wind Farm Infrastructure, these decommissioning activities may temporarily suspend and redeposit sediments. However, as with the Bellrock WFDA, sediment suspension is likely to be highly localised, short-term, intermittent and highly reversible in nature.

359. Given the discrete footprints, localised extent, and short-term duration, there is no credible mechanism for impacts to combine and create a materially different impact. As such, the magnitude of the cumulative impact is determined to be **low.**

7.9.3.3.2.3 Significance of Cumulative Effect

360. Given that receptors are either **not sensitive** or of **low** sensitivity and the cumulative magnitude of impact is **low**, the cumulative effect during decommissioning is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.3.3 Permanent Habitat Loss

7.9.3.3.3.1 Sensitivity of Receptor

361. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.3.4**, where receptor sensitivity was determined to be **high.**

7.9.3.3.3.2 Magnitude of Cumulative Impact

362. Permanent habitat loss in relation to the Bellrock Wind Farm Infrastructure would occur only where seabed infrastructure is left in-situ. Most structures are expected to be removed, and any remaining components would represent a very small proportion of the original footprint.

363. In relation to the Bellrock OfTDA, permanent habitat loss would likely be limited to any external cable protection (associated with the interconnector cables and export cables) and scour protection (associated with the OfSSs and reactive compensation station(s)), and potentially parts of the OfSS and reactive compensation station foundations left in-situ. These features are spatially discrete and localised in relation to the wider regional benthic habitat.

364. Residual in-situ infrastructure across both areas would be minimal, spatially constrained, and affect only a small proportion of the regional habitat. As such, there is no credible mechanism for impacts

to combine and create a materially different impact. Given this, the magnitude of the cumulative impact is determined to be **negligible**.

7.9.3.3.3.3 Significance of Cumulative Effect

365. Given that receptors are of **high** sensitivity and the cumulative magnitude of impact is **negligible**, the cumulative effect during decommissioning is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.9.3.3.4 Removal of Introduced Substrate

7.9.3.3.4.1 Sensitivity of Receptor

366. The sensitivity of receptors to this impact pathway is detailed in **Section 7.8.3.5.1**, where receptor sensitivity was determined to be **low**.

7.9.3.3.4.2 Magnitude of Cumulative Impact

367. In relation to the Bellrock Wind Farm Infrastructure, removal of introduced substrate (i.e. the Wind Farm Infrastructure) would release areas of seabed back to their original sediment type, allowing for natural recolonisation. The footprint of removed infrastructure would be localised and represent only a small proportion of the benthic study area. Overall, the magnitude of impact for the Bellrock Wind Farm Infrastructure was determined to be low.

368. In regard to the Bellrock OfTDA, removal of introduced infrastructure is likely to be limited to interconnector and export cable protection, reactive compensation station(s) foundations and OfSS foundations. The footprint of removed infrastructure is likely to be small and spatially discrete. Recovery of natural sediment conditions would enable recolonisation.

369. Cumulatively, removal activities are confined to discrete locations with limited spatial overlap. Loss of introduced substrate may temporarily reduce localised biodiversity associated with colonised infrastructure; however, footprints are small, impacts are direct but highly localised, and recovery potential is high once original habitats are reinstated. Therefore, the magnitude of the cumulative impact is **low**.

7.9.3.3.4.3 Significance of Cumulative Effect

370. Given that receptors are of **low** sensitivity and the cumulative magnitude of impact is **low**, the cumulative effect during decommissioning is assessed as **minor** adverse, which is **not significant** in EIA terms.

7.10 Inter-related and Interacting Impacts

7.10.1 Inter-relationships

371. **Table 7.25** below provides a summary of the key inter-relationships between benthic ecology and other technical chapters and indicates where those issues have been addressed in the relevant chapters.

Table 7.25: Benthic Ecology Inter-relationships

Topic and Description	Related Chapter(s) (Volume II)	Where Addressed in this Chapter	Rationale
Construction			
Physical disturbance and temporary habitat loss	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; ▪ **Chapter 8: Fish and Shellfish Ecology**; and ▪ **Chapter 9: Marine Mammals**.	**Section 7.8.1.1**	Hydrodynamic changes could cause greater abrasion/scour of benthic sediments which could cause an indirect impact on benthic receptors. Fish nursery grounds and spawning locations that utilise the benthic habitats within the Bellrock WFDA may be indirectly impacted as a result of changes to benthic habitats. Changes to prey availability that may occur as a result of benthic habitat changes from the Bellrock Wind Farm Infrastructure could have indirect impacts to marine mammals.
Increased SSCs	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**.	**Section 7.8.1.2**	Changes in marine physical processes could lead to increased suspended sediment concentrations and re-deposition on the seabed, potentially causing smothering of benthic receptors.
Introduction of INNS	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; and ▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.1.3**	Construction activities may alter sediment dynamics, creating conditions that favour colonisation by INNS. INNS introduced to the Bellrock WFDA during the construction phase may lead to competition or predator-prey interactions between fish and shellfish species with benthic species.
O&M			
Physical disturbance and temporary habitat loss	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; ▪ **Chapter 8: Fish and Shellfish Ecology**; and ▪ **Chapter 9: Marine Mammals**.	**Section 7.8.2.1**	Hydrodynamic changes could cause greater abrasion/scour of benthic sediments which could cause an indirect impact on benthic receptors. Fish nursery grounds and spawning locations that utilise the benthic habitats within the Bellrock WFDA may be indirectly impacted as a result of changes to benthic habitats.

Topic and Description	Related Chapter(s) (Volume II)	Where Addressed in this Chapter	Rationale
			Changes to prey availability that may occur as a result of benthic habitat changes from the Bellrock Wind Farm Infrastructure could have indirect impacts to marine mammals.
Increased suspended SSCs and re-deposition	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**;	**Section 7.8.2.2**	Changes in marine physical processes could lead to increased suspended sediment concentrations and re-deposition on the seabed, potentially causing smothering of benthic receptors.
Introduction of INNS	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; and ▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.2.3**	Catenary drag of mooring lines and jack-up vessel operations may alter sediment dynamics, creating conditions that favour colonisation by INNS. INNS introduced to the Bellrock WFDA during the O&M phase may lead to competition or predator-prey interactions between fish and shellfish species with benthic species.
Permanent habitat loss	▪ **Chapter 9: Marine Mammals**; and ▪ **Chapter 10: Offshore Ornithology**.	**Section 7.8.2.4**	Changes to prey availability that may occur as a result of benthic habitat changes from the Bellrock Wind Farm Infrastructure could have indirect impacts to marine mammals and offshore birds.
Colonisation of introduced substrate	▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.2.5**	Colonisation of the Bellrock Wind Farm Infrastructure could lead to changes in prey availability and/or distribution, causing indirect impacts to fish and shellfish.
Interactions with EMF	▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.2.6**	EMF may alter behaviour in fish and shellfish species (e.g. by attracting them to the cables) leading to competition or predator-prey interactions between fish and shellfish species with benthic species.
Thermal emissions from cables	▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.2.7**	EMF may alter behaviour in fish and shellfish species leading to competition or predator-prey interactions between fish and shellfish species with benthic species.

Topic and Description	Related Chapter(s) (Volume II)	Where Addressed in this Chapter	Rationale
Decommissioning			
Physical disturbance and temporary habitat loss	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; ▪ **Chapter 8: Fish and Shellfish Ecology**; and ▪ **Chapter 9: Marine Mammals**.	**Section 7.8.3.1**	Hydrodynamic changes could cause greater abrasion/scour of benthic sediments which could cause an indirect impact on benthic receptors. Fish nursery grounds and spawning locations that utilise the benthic habitats within the Bellrock WFDA may be indirectly impacted as a result of changes to benthic habitats. Changes to prey availability that may occur as a result of benthic habitat changes from the Bellrock Wind Farm Infrastructure could have indirect impacts to marine mammals.
Increased SSCs and re-deposition	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**.	**Section 7.8.3.2**	Changes in marine physical processes could lead to increased suspended sediment concentrations and re-deposition on the seabed, potentially causing smothering of benthic receptors.
Introduction of INNS	▪ **Chapter 6: Marine Geology, Oceanography, and Physical Processes**; and ▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.3.3**	Decommissioning activities may alter sediment dynamics, creating conditions that favour colonisation by INNS. INNS introduced to the Bellrock WFDA during the decommissioning phase may lead to competition or predator-prey interactions between fish and shellfish species with benthic species.
Permanent habitat loss	▪ **Chapter 9: Marine Mammals**; and ▪ **Chapter 10: Offshore Ornithology**.	**Section 7.8.3.4**	Changes to prey availability that may occur as a result of benthic habitat changes from the Bellrock Wind Farm Infrastructure could have indirect impacts to marine mammals and offshore birds.
Colonisation of introduced substrate	▪ **Chapter 8: Fish and Shellfish Ecology**.	**Section 7.8.3.5**	Colonisation of the Bellrock Wind Farm Infrastructure could lead to changes in prey availability and/or distribution, causing indirect impacts to fish and shellfish.

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7.10.2 Interactions

372. The impacts identified and assessed in this Chapter have the potential to interact with each other. Areas of potential interaction between impacts are presented in **Table 7.26**, **Table 7.27**, and **Table 7.28** below. The impacts are assessed relative to each development phase (i.e. construction, O&M or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the magnitude of impact upon that receptor.

373. A subsequent Bellrock WFDA lifetime assessment has been undertaken which considers the impact interactions identified and the potential for impacts to effect receptors relevant to this Chapter across all development phases (**Table 7.29**).

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Table 7.26: Potential Interaction Between Impacts - Construction

Potential Interaction Between Construction Impacts			
Impact	**C1: Physical disturbance and temporary loss of seabed habitat**	**C2: Increased SSCs and re-deposition**	**C3: Introduction of INNS**
C1: Physical disturbance and temporary loss of seabed habitat		Yes	Yes
C2: Increased SSCs and re-deposition	Yes		No
C3: Introduction of INNS	Yes	No	

Table 7.27: Potential Interaction Between Impacts – Operation and Maintenance

Potential Interaction Between O&M Impacts							
Impact	**O1: Physical disturbance and temporary loss of seabed habitat**	**O2: Increased SSCs and re-deposition**	**O3: Introduction of INNS**	**O4: Permanent habitat loss**	**O5: Colonisation of introduced substrate**	**O6: Interactions with EMF**	**O7: Thermal emissions from IACs**
O1: Physical Disturbance and Temporary Loss of Seabed Habitat		Yes	Yes	Yes	No	Yes	Yes
O2: Increased SSCs and re-deposition	Yes		No	No	No	No	No
O3: Introduction of INNS	Yes	No		Yes	Yes	No	No
O4: Permanent habitat loss	Yes	No	Yes		No	No	No
O5: Colonisation of introduced substrate	No	No	Yes	No		Yes	Yes
O6: Interactions with EMF	Yes	No	No	No	Yes		No
O7: Thermal emissions from IACs	Yes	No	No	No	Yes	No	

Table 7.28: Potential Interaction Between Impacts - Decommissioning

Potential Interaction Between Decommissioning Impacts					
Impact	**D1: Physical disturbance and temporary loss of seabed habitat**	**D2: Increased SSCs and re-deposition**	**D3: Introduction of INNS**	**D4: Permanent habitat loss**	**D5: Removal of introduced substrate**
D1: Physical Disturbance and Temporary Loss of Seabed Habitat		Yes	Yes	Yes	No
D2: Increased SSCs and re-deposition	Yes		No	Yes	No
D3: Introduction of INNS	Yes	No		Yes	Yes
D4: Permanent habitat loss	Yes	Yes	Yes		No
D5: Removal of introduced substrate	No	No	Yes	No	

Table 7.29: Potential Interactions Between Impacts - Phase and Lifetime Assessment

Highest Significance of Effect Level					
Receptor	**Construction**	**O&M**	**Decommissioning**	**Phase Assessment**	**Lifetime Assessment**
Owenia fusiformis and *Amphiura filiformis* in deep circalittoral sand or muddy sand (A5.272)	Minor adverse	Minor adverse	Minor adverse	**No greater than individually assessed impact for each phase.** The impacts are considered to have a minor adverse effect on the receptor. Given that each impact is localised, it is considered that effects would not, when considered together, result in appreciably greater impact than assessed individual.	**No greater than individually assessed impact.** As with the phase assessment, all potential impacts are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases.
Ampharete falcata turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas (A5.371)	Minor adverse	Minor adverse	Minor adverse		
Paramphinome jeffreysii, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud (A5.376)	Minor adverse	Minor adverse	Minor adverse		
Ocean quahog	Minor adverse	Minor adverse	Minor adverse		
Phosphorescent sea pen	Minor adverse	Minor adverse	Minor adverse		

7.11 Summary

374. **Table 7.30** presents a summary of the assessment of potential effects on benthic ecology during the construction, O&M and decommissioning phases of the Bellrock Wind Farm Infrastructure.

375. No significant effects on benthic receptors are predicted within the benthic study area, either from the Bellrock Wind Farm Infrastructure alone, or cumulatively with other relevant plans and projects.

376. With the application of embedded mitigation (**Section 7.7.3**), effects on benthic receptors during construction, O&M, and decommissioning are assessed as being of minor adverse significance (at most) and therefore not significant in EIA terms. The overall lifetime assessment concluded that combined effects across all phases are no greater than those identified for each phase in isolation.

377. No additional mitigation is required. The project design and embedded mitigation measures are considered sufficient to ensure that benthic receptors are not significantly affected throughout the operational life of the Bellrock Wind Farm Infrastructure, either alone or cumulatively.

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Table 7.30: Summary of Potential Effects for Benthic Ecology

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect
Construction							
C1: Physical disturbance and temporary habitat loss	Ocean quahog	High	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
	All other receptors	Medium	Low	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
C2: Increased Suspended Sediment Concentrations and Sediment Re-deposition	A5.272	Low	Low	No significance of effect	None	No significance of effect	No significance of effect
	A5.371	Low	Low	Minor adverse	None	Minor adverse	Minor adverse (not significant)
	A5.376	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
	Phosphorescent sea pen	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
	Ocean quahog	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
C3: Introduction of INNS	All PMF habitats	Not relevant	Negligible	No significance of effect	None	No significance of effect	N/A
	Phosphorescent sea pen and ocean quahog	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect
Operation and Maintenance							
O1: Physical Disturbance and Temporary Loss of Seabed Habitat	Ocean quahog	High	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
	All other receptors	Medium	Low	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
O2: Increased Suspended Sediment Concentrations and Sediment Re-deposition	A5.272	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	Minor adverse (not significant)
	A5.371	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	Minor adverse (not significant)
	A5.376	Not sensitive	Negligible	No significance of effect	None	No significance of effect	No significance of effect
	Phosphorescent sea pen	Not sensitive	Negligible	No significance of effect	None	No significance of effect	No significance of effect
	Ocean quahog	Not sensitive	Negligible	No significance of effect	None	No significance of effect	No significance of effect
O3: Introduction of INNS	All PMF habitats	Not relevant	Negligible	No significance of effect	None	No significance of effect	N/A
	Phosphorescent sea pen and ocean quahog	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect
O4: Permanent Habitat Loss	All receptors	Hig	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
O5: Colonisation of Introduced Substrate	All receptors	High	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
O6: Interactions with EMF	All receptors	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	Negligible adverse (not significant)
O7: Thermal Emissions from Inter-array Cables	All PMF habitats	Medium	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A
	Phosphorescent sea pen	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A
	Ocean quahog	Medium	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A
Decommissioning							
D1: Physical Disturbance and Temporary Loss of Seabed Habitat	Ocean quahog	High	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
	All other receptors	Medium	Low	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect
D2: Increased Suspended Sediment Concentrations and Sediment Re-deposition	A5.272	Low	Low	Negligible adverse	None	Negligible adverse (not significant)	Minor adverse (not significant)
	A5.371	Low	Low	Negligible adverse	None	Negligible adverse (not significant)	Minor adverse (not significant)
	A5.376	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
	Phosphorescent sea pen	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
	Ocean quahog	Not sensitive	Low	No significance of effect	None	No significance of effect	No significance of effect
D3: Introduction of INNS	All PMF habitats	Not relevant	Negligible	No significance of effect	None	No significance of effect	N/A
	Phosphorescent sea pen and ocean quahog	Low	Negligible	Negligible adverse	None	Negligible adverse (not significant)	N/A
D4: Permanent Habitat Loss	All receptors	High	Negligible	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)
D5: Removal of Introduced Substrate	All receptors	Low	Low	Minor adverse	None	Minor adverse (not significant)	Minor adverse (not significant)

7.12 References

Albert, L. Deschamps, F. Jolivet, A. Olivier, F. Chauvaud, L. and Chauvaud, S. (2020). A current synthesis on the effects of electric and magnetic fields emitted by submarine power cables on invertebrates. Marine Environmental Research, 159, p.104958.

Barrow Offshore Windfarm Limited. (2008). Post Construction Monitoring Report. Available at: https://docslib.org/doc/9606405/barrow-offshore-wind-farm-post-construction-monitoring-report.

Bureau of Ocean Energy Management (BOEM) (2020). Scientific and Technical Publications for 2020. Available at: https://www.boem.gov/newsroom/library/scientific-and-technical-publications-2020.

Bastari, A. Pica, D. Ferretti, F. Micheli, F. and Cerrano, C. (2018). Sea pens in the Mediterranean Sea: habitat suitability and opportunities for ecosystem recovery. ICES Journal of Marine Science, 75(5), pp. 1722-1732.

Begg, T. Graham, J. and Matejusova, I. (2020). The Marine Invasive Non-Native Species Didemnum vexillum: Loch Creran Surveys – September 2019. Scottish Marine and Freshwater Science Vol 11 No 5. The Scottish Government pp. 20.

BOEM (2023). BOEM White Paper 2024-055. US Department of the Interior. Bureau of Ocean Energy Management Gulf of Mexico Regional Office New Orleans, LA Electromagnetic Fields: Background and Potential Impacts of Offshore Wind Farms on Marine Organisms.

Cargnelli, L.M. Griesbach, S.J. and Zetlin, C.A. (1999). Essential fish habitat source document. Northern shortfin squid, Illex illecebrosus, life history and habitat characteristics.

Cefas (2012). Guidelines for Data Acquisition to Support Marine Environmental Assessments for Offshore Renewable Energy Projects. Available at: https://tethys.pnnl.gov/sites/default/files/publications/CEFAS_2012_Eenvironmental_Assessment_Guidance.pdf.

Cefas (2023). OneBenthic Baseline Tool. Available at: https://rconnect.cefas.co.uk/content/25/.

Chapman, E.C. Rochas, C.M. Piper, A.J. Vad, J. and Kazanidis, G. (2023). Effect of electromagnetic fields from renewable energy subsea power cables on righting reflex and physiological response of coastal invertebrates. Marine Pollution Bulletin, 193, p.115250.

Christensen, N.I. (1970). Composition and evolution of the oceanic crust. Marine Geology, 8(2), pp. 139-154.

CIEEM (2024). Guidelines for Ecological Impact Assessment (EcIA). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal, and Marine, 1(3), pp. 29-35. Available at: https://cieem.net/wp-content/uploads/2018/08/EcIA-Guidelines-v1.3-Sept-2024.pdf.

Construction Industry Research and Information Association (2015). Assessment and management of unexploded ordnance (UXO) risk in the marine environment (C754). Available at: https://www.thenbs.com/PublicationIndex/documents/details?Pub=CIRIA&DocID=313715.

Coolen, J.W. Vanaverbeke, J. Dannheim, J. Garcia, C. Birchenough, S.N. Krone, R. and Beermann, J. (2022). Generalized changes of benthic communities after construction of wind farms in the southern North Sea. Journal of Environmental Management, 315, p.115173.

Cooper, K. Boyd, S. Eggleton, J. Limpenny, D. Rees, H. and Vanstaen, K. (2007). Recovery of the seabed following marine aggregate dredging on the Hastings Shingle Bank off the southeast coast of England. Estuarine, Coastal and Shelf Science, 75(4), pp. 547-558.

Cooper and Barry (2017). A big data approach to macrofaunal baseline assessment, monitoring and sustainable exploitation of the seabed. Available online at: https://www.nature.com/articles/s41598-017-11377-9.

CSA Ocean Sciences Inc. and Exponent. (2019). Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, pp. 49-59.

Dando, P.R. and Southward, A.J. (1986). Chemoautotrophy in bivalve molluscs of the genus Thyasira. Journal of the Marine Biological Association of the United Kingdom, 66(4), pp.915-929.

Dernie, K.M. Kaiser, M.J. Richardson, E.A. and Warwick, R.M. (2003). Recovery of soft sediment communities and habitats following physical disturbance. Journal of Experimental Marine Biology and Ecology, 285, pp. 415-434.

Diaz, R.J. and 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), p.03.

Donázar-Aramendía, I. Reyes-Martínez, M.J. Megina, C. Florido, M. and García-Gómez, J.C. (2025). Assessing the effects of electromagnetic fields generated by submarine power cables on the soft-bottom community: An ecological in-situ study. Environmental Research, 266, p.120573.

European Environment Agency (2022). EUNIS habitat classification. Available at: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1.

Eleftheriou, A. and Basford, D.J. (1989) 'The Macrobenthic Infauna of the Offshore Northern North Sea', *Journal of the Marine Biological Association of the United Kingdom*, 69(1), pp. 123–143. doi:10.1017/S0025315400049158.

Eleftheriou, A. and Robertson, M.R. (1992). The effects of experimental scallop dredging on the fauna and physical environment of a shallow sandy community. Netherlands Journal of Sea Research, 30, pp. 289-299.

EMODnet (2023). EMODnet broad-scale seabed habitat map for Europe (EUSeaMap). Available at: https://emodnet.ec.europa.eu/geoviewer/.

Eno, N.C. MacDonald, D.S. Kinnear, J.A. Amos, S.C. Chapman, C.J. Clark, R.A. Bunker, F.S.P. and Munro, C. (2001). Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science, 58(1), pp. 11-20.

Gill, A.B. Bremner, J. Vanstaen, K. Blake, S. Mynott, F. and Lincoln, S. (2025). Limited evidence base for determining impacts (or not) of offshore wind energy developments on commercial fisheries species. Fish and Fisheries, 26(1), pp.155-170.

Gill, A.B. Hutchison, Z.L. and Desender, M. (2023). Electromagnetic Fields (EMFs) from subsea power cables in the natural marine environment. Cefas Project Report for Crown Estate Offshore Wind Evidence and Change Programme, pp.66-66.

Greathead, C.F. Donnan, D.W. Mair, J.M. and Saunders, G.R. (2007). The sea pens Virgularia mirabilis, Pennatula phosphorea and Funiculina quadrangularis: distribution and conservation issues in Scottish waters. *Journal of the Marine Biological Association of the United Kingdom*, *87*(5), pp.1095-1103, page 4.

Greathead, C. Demain, D. Dobby, H. Allan, L. and Weetman, A. (2011). Quantitative assessment of the distribution and abundance of the burrowing megafauna and large epifauna community in the Fladen fishing ground, northern North Sea. Scottish Government: Edinburgh (UK).

Hayward, P.J. & Ryland, J.S. (ed.) (1995). Handbook of the marine fauna of North-West Europe. Oxford: Oxford University Press.

Heath, T.A. (2005). *Ampharete falcata* A bristleworm. 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 at: http://www.marlin.ac.uk/species/detail/1915.

Hill, J. M. and Tyler-Walters, H. (2018). Seapens and burrowing megafauna in circalittoral fine mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom. Plymouth, UK. Available at: https://plymsea.ac.uk/id/eprint/8373/1/marlin_habitat_131_2019-03-21.pdf.

Hixon, M. A. and Tissot, B. N. (2007). Comparison of trawled vs untrawled mud seafloor assemblages of fishes and macroinvertebrates at Coquille Bank, Oregon. Journal of Experimental Marine Biology and Ecology, 344: pp. 23–34.

Hughes, B.B. Levey, M.D. Fountain, M.C. Carlisle, A.B. Chavez, F.P. and Gleason, M.G. (2015). Climate mediates hypoxic stress on fish diversity and nursery function at the land–sea interface. *Proceedings of the National Academy of Sciences*, *112*(26), pp.8025-8030.

Hughes, D.J. (1998). Sea pens and burrowing megafauna. An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science.

Hutchison, Z.L. Gill, A.B. Sigray, P. He, H. and King, J.W. (2020). Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. Scientific reports, 10(1), p.4219.

IMO (2023). Guidelines on Ballast Water Management. Available at: https://www.imo.org/en/ourwork/environment/pages/bwmconventionandguidelines.aspx.

Isaksson, N. Scott, B.E. Hunt, G.L. Benninghaus, E. Declerck, M. Gormley, K. Harris, C. Sjöstrand, S. Trifonova, N.I. Waggitt, J.J. and Wihsgott, J.U. (2025). A paradigm for understanding whole ecosystem effects of offshore wind farms in shelf seas. ICES Journal of Marine Science, 82(3), p.fsad194.

Jakubowska, M. Urban-Malinga, B. Otremba, Z. and Andrulewicz, E. (2019). Effect of low frequency electromagnetic field on the behavior and bioenergetics of the polychaete Hediste diversicolor. Marine environmental research, 150, p.104766.

Jakubowska-Lehrmann, M. Białowąs, M. Otremba, Z. Hallmann, A. Śliwińska-Wilczewska, S. and Urban-Malinga, B. (2022). Do magnetic fields related to submarine power cables affect the functioning of a common bivalve?. Marine Environmental Research, 179, p.105700.

Jech, J.M. Lipsky, A. Moran, P. Matte, G. and Diaz, G. (2023). Fish distribution in three dimensions around the Block Island Wind Farm as observed with conventional and volumetric echosounders. Marine and Coastal Fisheries, 15(5), p.e210265.

JNCC (2021). Developing a method for broadscale and feature-level sensitivity assessments: the MarESA aggregation. https://data.jncc.gov.uk/data/faa8722e-865d-4d9f-ab0b-15a2eaa77db0/JNCC-Report-662-REVISED-2021-WEB.pdf.

JNCC (2022). JNCC Marine Habitat Classification for Britain and Ireland. Available at: https://mhc.jncc.gov.uk/.

Kaiser, M.J. and Spencer, B.E. (1996). The effects of beam-trawl disturbance on infaunal communities in different habitats. Journal of Animal Ecology, pp. 348-358.

Kenchington, E. Murillo, F.J. Cogswell, A. and Lirette, C. (2011). Development of encounter protocols and assessment of significant adverse impact by bottom trawling for sponge grounds and sea pen fields in the NAFO regulatory area. Centro Oceanográfico de Vigo.

Kerckhof, F. Degraer, S. Norro, A. and Rumes, B. (2011). Offshore intertidal hard substrata: a new habitat promoting non-indigenous species in the Southern North Sea: an exploratory study. Offshore wind farms in the Belgian Part of the North Sea: Selected findings from the baseline and targeted monitoring. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit, Brussels, pp. 27-37.

Langhamer, O. (2012). Artificial reef effect in relation to offshore renewable energy conversion: state of the art. The Scientific World Journal, 2012(1), p.386713.

Long (2006). BGS detailed explanation of seabed sediment modified folk classification. Available at:

https://www.researchgate.net/publication/284511408_BGS_detailed_explanation_of_seabed_sediment_modified_folk_classification.

Love, M.S. Nishimoto, M.M. Clark, S. and Bull, A.S. (2015). Identical response of caged rock crabs (genera Metacarcinus and Cancer) to energized and unenergized undersea power cables in Southern California, USA. Bulletin, Southern California Academy of Sciences, 114(1), pp.33-41.

Macleod, A. Cottier-Cook, E. Hughes, D. and Allen, C. (2016). Investigating the impacts of marine invasive non-native species. Natural England Commissioned Report NECR223, Natural England, p. 58.

MarLIN (2008a). A tubeworm *(Owenia fusiformis).* Available at: https://www.marlin.ac.uk/species/detail/1703.

MarLIN (2008b). A brittlestar *(Amphiura filiformis).* Available at: https://www.marlin.ac.uk/species/detail/1400.

MarLIN (2008c). *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas. Available at: https://www.marlin.ac.uk/habitats/detail/75.

MarLIN (2008d). *Paramphinome jeffreysii, Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud. Available at: https://www.marlin.ac.uk/habitats/detail/1109/paramphinome_jeffreysii_thyasira_spp_and_amphiura_filiformis_in_offshore_circalittoral_sandy_mud.

MarLIN (2008e). Icelandic cyprine *(Arctica islandica).* Available at: https://www.marlin.ac.uk/species/detail/1519.

MarLIN (2008f). Phosphorescent sea pen *(Pennatula phosphorea).* Available at: https://www.marlin.ac.uk/species/detail/1817.

MarLIN (2010). MarLIN (1999-2010) sensitivity assessment methodology. https://www.marlin.ac.uk/sensitivity/MarLIN-sensitivity-methods.

Maurer, D. Keck, R.T. Tinsman, J.C. Leatham, W.A. Wethe, C. Lord, C. & Church, T.M. (1986). Vertical migration and mortality of marine benthos in dredged material: a synthesis. Internationale Revue der Gesamten Hydrobiologie, 71, pp. 49-63.

Meißner, K. and Sordyl, H. (2006). Literature review of offshore wind farms with regard to benthic communities and habitats. *Ecological Research on Offshore Wind Farms: International Exchange of Experiences*, *1.*

Melwani, A.R. and Kim, S.L. (2008). Benthic infaunal distributions in shallow hydrothermal vent sediments. *acta oecologica*, *33*(2), pp.162-175.

Mustow, S. (2021). Marine invasive non-native species in the UK: scale of the problem and progress of the response. In practice. Bulletin of the Chartered Institute of Ecology and Environmental Management, 12(112), pp. 21-25.

NatureScot (2023). Marine non-native species. Available at: https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/marine-non-native-species.

Neat, F. and Righton, D. (2007). Warm water occupancy by North Sea cod. Proceedings of the Royal Society B: Biological Sciences, 274(1611), pp.789-798.

Neves de Moura, B. Edinger, E. Layne, G. D. and Wareham, V. E. (2015). Decadal longevity and slow growth rates in the deep-water sea pen Halipteris finmarchica (Sars, 1851) (Octocorallia: Pennatulacea): implications for vulnerability and recovery from anthropogenic disturbance. Hydrobiologia, 759: pp. 147–170.

NNSS (N.D.) Information Portal. Available at: https://www.nonnativespecies.org/non-native-species/information-portal#.

Ordtek (2018). Estimated ranges of impact for various UXO detonations, Norfolk Vanguard. Available at: https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN010079-001535-Appendix%2005.04%20Underwater%20noise%20from%20UXO.pdf.

OSPAR Commission. (2008). CEMP Assessment Manual: Co-ordinated Environmental Monitoring Programme Assessment Manual for contaminants in sediment and biota. OSPAR Commission.

Ossian Offshore Wind Farm Limited (2024). Chapter 8: Benthic Subtidal Ecology. In Array Environmental Impact Assessment Report, Volume 2 – Technical Assessments. Available at: https://marine.gov.scot/sites/default/files/volume_2_-_technical_assessments_-_chapter_8_-_benthic_subtidal_ecology.pdf.

Payne, R. Cook, E.J. and Macleod, A. (2014). Marine biosecurity planning-Identification of best practice: A review. Scottish Natural Heritage. Pichler, T. Veizer, J. and Hall, G.E. (1999). The chemical composition of shallow-water hydrothermal fluids in Tutum Bay, Ambitle Island, Papua New Guinea and their effect on ambient seawater. Marine Chemistry, 64(3), pp.229-252.

Powilleit, M. Graf, G. Kleine, J. Riethmüller, R. Stockmann, K. Wetzel, M.A. and Koop, J.H.E. (2009). Experiments on the survival of six brackish macro-invertebrates from the Baltic Sea after dredged spoil coverage and its implications for the field. Journal of Marine Systems, 75(3-4), pp. 441-451.

Powilleit, M. Kleine, J. and Leuchs, H. (2006). Impacts of experimental dredged material disposal on a shallow, sublittoral macrofauna community in Mecklenburg Bay (western Baltic Sea). Marine Pollution Bulletin, 52(4), pp. 386-396.

Raoux, A. Tecchio, S. Pezy, J.P. Lassalle, G. Degraer, S. Wilhelmsson, D. Cachera, M. Ernande, B. Le Guen, C. Haraldsson, M. and Grangeré, K. (2017). Benthic and fish aggregation inside an offshore wind farm: which effects on the trophic web functioning?. Ecological Indicators, 72, pp.33-46.

Ross, R.E. Gonzalez-Mirelis, G. Lozano, P. and Buhl-Mortensen, P. (2021). Discerning the management-relevant ecology and distribution of sea pens (Cnidaria: Pennatulacea) in Norway and beyond. *Frontiers in Marine Science*, *8*, p.652540.

RWE Renewables UK Dogger Bank South (West) Limited and
RWE Renewables UK Dogger Bank South (East) Limited (2025) *Review of evidence on recovery of sandbank habitat following habitat damage: Appendix B – Dogger Bank B UXO crater survey results*. Available at: https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN010125-000814-10.36%20Review%20of%20evidence%20on%20recovery%20of%20sandbank%20habitat%20following%20habitat%20damage.PDF.

Scott, K. Harsanyi, P. Easton, B.A. Piper, A.J. Rochas, C.M. and Lyndon, A.R. (2021). Exposure to electromagnetic fields (EMF) from submarine power cables can trigger strength-dependent behavioural and physiological responses in edible crab, Cancer pagurus (L.). Journal of Marine Science and Engineering, 9(7), p.776. Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. The journal of geology, 30 (5), pp.377–392.

Sedwick, P. and Stuben, D. (1996). Chemistry of shallow submarine warm springs in an arc-volcanic setting: Vulcano Island, Aeolian Archipelago, Italy. *Marine Chemistry*, *53*(1-2), pp.147-161.

Stankevičiūtė, M. Jakubowska, M. Pažusienė, J. Makaras, T. Otremba, Z. Urban-Malinga, B. Fey, D.P. Greszkiewicz, M. Sauliutė, G. Baršienė, J. and Andrulewicz, E. (2019). Genotoxic and cytotoxic effects of 50 Hz 1 mT electromagnetic field on larval rainbow trout (Oncorhynchus mykiss), Baltic clam (Limecola balthica) and common ragworm (Hediste diversicolor). Aquatic toxicology, 208, pp.109-117.

Taormina, B. Bald, J. Want, A. Thouzeau, G. Lejart, M. Desroy, N. and 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, pp.380-391.

Taormina, B. Marzloff, M.P. Desroy, N. Caisey, X. Dugornay, O. Metral Thiesse, E. Tancray, A. and Carlier, A. (2020). Optimizing image-based protocol to monitor macroepibenthic communities colonizing artificial structures. *ICES Journal of Marine Science*, *77*(2), pp.835-845.

Tasker M. L. Mats A. Michel A. Hawkins T. Lang W. Merck T. Scholik-Schlomer A. Teilmann, J. Thomsen F.Werner S. and Manell Z. (2010). Marine Strategy Framework Directive - Task Group 11 Report - Underwater noise and other forms of energy.

Theede, H. Ponat, A. Hiroki, K. and Schlieper, C. (1969). Studies on the resistance of marine bottom invertebrates to oxygen-deficiency and hydrogen sulphide. Marine Biology, 2(4), pp.325-337.

Thórarinsdóttir, G.G. and Einarsson, S.T. (1994). Distribution, abundance, population structure, meat yield, size of sexual maturity and sex ratio of ocean quahog, Arctica islandica. *ICES CM*, *39*(7).

Tillin, H.M. Hull, S.C. and Tyler-Walters, H. (2010). Development of a sensitivity matrix (pressures-MCZ/MPA features).

Tyler-Walters, H. James, B. Carruthers, M. (eds.), Wilding, C. Durkin, O. Lacey, C. Philpott, E. Adams, L. Chaniotis, P.D. Wilkes, P.T.V. Seeley, R. Neilly, M. Dargie, J. and Crawford-Avis, O.T. (2016). Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.

Tyler-Walters, H. Tillin, H.M. d'Avack, E.A.S. Perry, F. Stamp, T. (2018). Marine Evidence-based Sensitivity Assessment (MarESA) – A Guide. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, pp. 91. Available from https://www.marlin.ac.uk/publications.

Witbaard, R. (1997). Tree of the sea: The use of the internal growth lines in the shell of Arctica islandica (Bivalvia, Mollusca) for the retrospective assessment of marine environmental change. Thesis. University of Groningen. 149pp.

Witbaard, R. and Bergman, M.J.N. (2003). The distribution and population structure of the bivalve Arctica islandica L. in the North Sea: what possible factors are involved?. *Journal of Sea Research*, *50*(1), pp.11-25.

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