Bellrock Offshore Wind Farm

Wind Farm Development Area

Environmental Impact Assessment Report - Volume IV

Appendix 7.1: Benthic Ecology Baseline Report

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Glossary of Terminology

Term	Definition
Benthic/Benthos	Refers to anything associated or occurring on the bottom of a body of water (the seabed).
Biodiversity	Refers to the variety of living species, including plants, animals, bacteria and fungi.
Circalittoral	A subtidal zone that extends from 20 to 30 m water depth to the edge of the continental shelf (approximately 200 m water depth), characterised by limited light penetration and therefore fauna-dominated communities.
Epifauna	Species that live on the surface of the seabed.
Infauna	Species that live within the sediments of the seabed.
Macrofaunal assemblage	A grouped mixture of species with body sizes between 0.5 mm and 50 mm, located within a specific habitat or with a shared ecological function.
Megafauna	Any species with a body mass estimate of more than 45 kg.
Sublittoral	A subtidal zone that extends from the low tide mark (0 m water depth) to the edge of the continental shelf (approximately 200 m water depth).

Glossary of Acronyms

Term	Definition
BSH	Broad Scale Habitat
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute for Ecology and Environmental Management
DDC	Drop down camera
EUNIS	European Nature Information System
GeMS	Geodatabase of Marine features adjacent to Scotland
IEF	Important Ecological Feature
INNS	Invasive non-native species
JNCC	Joint Nature Conservation Committee
MD-LOT	Marine Directorate - Licensing Operations Team
ncMPA	Nature Conservation Marine Protected Area
OBBT	One Benthic Baseline Tool
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAHs	Polyaromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PMF	Priority marine feature
THCs	Tetrahydrocannabinols
WFDA	Wind Farm Development Area

1 Introduction

1. This Benthic Ecology Baseline Report is an Appendix to **Chapter 7: Benthic Ecology (Volume II)** of the Bellrock Wind Farm Development Area (WFDA) Environmental Impact Assessment Report. The existing baseline environment for benthic ecology considers the sediment types, infauna and epifauna within the Bellrock WFDA, and the designations and notable species within 4.7 km of the Bellrock WFDA. This Appendix is informed by **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)** and **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report (Volume IV).**

2 Study Area

2. The benthic ecology study area includes the Bellrock WFDA with a buffer of 4.7 km (as shown in **Figure 7.1.1 (Annex 1)**). It is based on the Zone of Influence of the construction, operation and maintenance and decommissioning effects from the Bellrock Wind Farm Infrastructure, which equates to one spring tidal ellipse from the Bellrock WFDA boundary. A full description of the benthic ecology study area is provided in **Chapter 7: Benthic Ecology (Volume II).**

3 Existing Baseline

3.1 Seabed Composition

3.1.1 Sediments

3. Site-specific benthic surveys were undertaken in July 2023 to characterise benthic ecology within the Bellrock WFDA, with survey methods agreed with Marine Directorate – Licensing Operations Team (MD-LOT) and NatureScot prior to commencement (for further information, see Table 7.2 in **Chapter 7: Benthic Ecology (Volume II)**). A total of 113 stations were sampled via grab sampling and drop-down camera (DDC) within the Bellrock WFDA, as shown in **Figure 7.1.2 (Annex 1)** (further details on the surveys and the results are provided in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)** and **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report (Volume IV))**. Sediments were classified using the modified Folk classification (British Geological Survey); Long, 2006) and the Wentworth sediment classification (Wentworth, 1922). The distribution of sediments within the Bellrock WFDA is shown in Figure 17 in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**.

4. The Bellrock WFDA is dominated by sandy sediment; classified as European Nature Information System (EUNIS) Broad Scale Habitat (BSH) A5.2 (sublittoral sand), with varying but generally low mud and gravel content. The mud component of the sediment increases with increasing water depth and was found to be substantial (>25%) at three stations (ST0038, ST0102 and ST0103), which were classified as BSH A5.3 (sublittoral mud). A further three stations were classified as sublittoral mud (ST0104, ST0105, and ST112) but with a smaller mud component. The gravel component of the sediment was found to be comparatively low (<1%) at most stations. Mixed sediments; BSH A5.4, were confirmed as present at four stations (ST0031, ST0032, ST0064, and ST0098).

5. The Wentworth (1922) Scale was utilised to determine the coarseness of the sediment within the Bellrock WFDA. This method employs a logarithmic scale consisting of a series of phi units that represent nine grain size ranges from fines to boulders (see Table 5.1 of **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)** for details). Folk (1954) descriptions have been used in the nomenclature of sediment types.

6. It was determined that most of the Bellrock WFDA is comprised of ‘fine sand’ (at 102 of the 113 stations) and the remaining proportion mostly ‘very fine sand’ (at nine of the 113 stations; ST0038, ST0065, ST0102, ST0104-ST0107, ST0112 and ST0113). The remaining two stations were classified as ‘coarse sand’ (ST0032), and ‘very coarse silt’ (ST0103), respectively. Approximately half of the grab samples were described as being ‘poorly sorted’ (60 of 113; ST0013, ST0021, ST0023, ST0031, ST0036, ST0038, ST0047-ST0050, ST0057-ST0060, ST0062-ST0069, ST0071-ST0073, ST0075, ST0077, ST0079, ST0080, ST0082-ST0097, ST0099-ST0113), and the remaining majority as ‘moderately sorted’ (49 of 113; ST0002-ST0012, ST0014-ST0020, ST0022, ST0024-ST0028, ST0030, ST0033-ST0035, ST0037, ST0039-ST0046, ST0051-ST0056, ST0061, ST0070, ST0074, ST0076, ST0078 and ST0081). Two samples were described as being

'moderately well sorted' (ST0001 and ST0029) and the remaining two grab samples were described as being 'very poorly sorted' (ST0032 and ST0098). Full details on the coarseness of sediments within the Bellrock WFDA can be found in Appendix XI of **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**.

7. Considering the water depth at which all grab samples were collected from (-70 m to -120 m Lowest Astronomical Tide), these sublittoral sediment types were deemed to represent the 'offshore deep sea muds' and 'offshore subtidal sands and gravels' priority marine feature (PMF) habitats. It is noteworthy that whilst these habitats are deemed to be of conservation importance in Scottish waters they are also among the most common habitats found in offshore deep waters around the coast of the UK.

8. Broadscale predictive seabed sediment mapping (EUSeaMap; EMODnet) suggests that the wider offshore region is predominantly deep circalittoral sand (A5.27) with areas of deep circalittoral coarse sediment (A5.15); characteristic of the North Sea (**Figure 7.1.3 (Annex 1)**). This is congruent with the sediments identified by the benthic survey and indicates that the sediments of the Bellrock WFDA are typical of the wider offshore region.

3.1.2 Contaminants

9. Sediment samples for chemical contaminant analysis were collected at all stations across the Bellrock WFDA resulting in 15 samples for analysis. Grab samples taken for chemical analyses were analysed for heavy and trace metals, organotins, polyaromatic hydrocarbons (PAHs), tetrahydrocannabinols (THCs), and polychlorinated biphenyls (PCBs). Full details of the sediment contamination analysis can be found in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**.

10. Sediment contamination was determined by comparing the concentration of contaminant present in each sample to the following reference levels; Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Levels, Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Background Assessment Concentrations and effect ratio low, and the Canadian Sediment Quality Guidelines threshold effect level and probable effect level.

11. The concentrations of PCBs and organotins were below the limit of detection at all stations. No heavy or trace metals, PAHs or THCs at any station exceeded Cefas AL1 or any other reference level. Sediment contamination with the Bellrock WFDA is thus considered to be negligible.

3.2 Habitats and Communities

12. Grab samples, seabed imagery and acoustic data were analysed to determine the main biotope complexes and habitat boundaries within the Bellrock WFDA, as detailed in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**. Habitats were identified and classified in accordance with the EUNIS habitat classification system (under the 2012 EUNIS classification system (European Environment Agency, 2012)), with consideration of the Joint Nature Conservation Committee (JNCC) guidance on assigning benthic biotopes (Parry

2019).Three EUNIS level 5 biotope complexes were identified, described below and summarised in **Table 3.1**.

13. Of the 113 sampling stations, 98 were assigned to a biotope. The remaining 15 stations were classified as outlier stations as statistical analysis did not show any pattern in the community composition that could be used to assign a biotope. These outlier stations were therefore assigned to their corresponding EUNIS level 4 classification based on the sediment and seabed imagery analyses.

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

14. The biotope '*Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand' (herein 'A5.272') is defined as slightly muddy sand in offshore waters characterised by high numbers of the tube building oweniid polychaete *O. fusiformis* and *Galathowenia sp.,* often with the brittlestar *A. filiformis*. Although *O. fusiformis* is found in other circalittoral or offshore biotopes, it usually occurs in lower abundances than in the A5.272 biotope. Other polychaete species, the sea cucumber *Labidoplax buski* and the cumacean *Eudorella truncatula* are commonly found in this community, and occasional bivalves (JNCC, 2023).

15. This biotope was observed across the majority of the Bellrock WFDA, at 91 of the 113 grab sampling stations. This aligns with the Particle Size Analysis results that showed that 87 of these 91 stations were assigned to BSH habitat A5.2 (sublittoral sand).

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

16. Within the Bellrock WFDA, the biotope '*Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas' (herein 'A5.371') forms a mosaic habitat with the biotope '*Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud' (herein 'A5.376') that is described below in **Section 3.2.3**. The mosaic habitat is jointly classified as A5.371/A5.376.

17. The biotope A5.371 is defined as dense stands of *Ampharete falcata* tubes which protrude from muddy sediments, appearing as a turf or meadow in localised areas. These areas seem to occur on a crucial point on a depositional gradient between areas of tide-swept mobile sands and quiescent stratifying muds. Dense populations of the small bivalve *Parvicardium ovale* occur in the superficial sediment. However, the biotope is diverse and can include a wide variety of other infauna. Both the brittlestars *A. filiformis* and *Amphiura chiajei* may be present together with *Nephrops norvegicus*, and substantial populations of mobile epifauna such as *Pandalus montagui* and smaller fish also occur, together with those that can cling to the tubes, such as *Macropodia spp*. (Connor et al. 2004).

18. The mosaic habitat A5.371/A5.376 was observed at seven of the 113 grab sampling stations (ST063, ST064, ST066, ST103, ST105, ST112, and ST113), where mud content was comparatively high. At three of these stations, the biotope mosaic occurred on sand and mixed sediment substrate, as opposed to mud substrate, indicating a biotope mismatch at these locations.

Therefore, the confidence level for the assignment of this biotope mosaic can only be considered high at four of the seven stations.

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

19. Within the Bellrock WFDA, the biotope A5.376 forms a mosaic habitat with the biotope A5.371 that is described above in **Section 3.2.2**. The mosaic habitat is jointly classified as A5.371/A5.376.

20. The biotope A5.376 is defined as deep offshore cohesive sandy mud communities characterised by the polychaete *Paramphinome jeffreysii*, bivalves such as *Parathyasira equalis* and *Thyasira gouldi* and the brittlestar *A. filiformis*. Other taxa may include *Laonice cirrata,* the sea cucumber *L. buski* and the polychaetes *Goniada maculata*, *Spiophanes kroyeri* and *Aricidea (Acmira) catherinae*. *A. chiajei* may be occasional in this biotope as may *Hermania scabra*, *Levinsenia gracilis* and *Pholoe inornate* (Connor et al., 2004).

21. This biotope mosaic was found to be present in the eastern reaches of the Bellrock WFDA, overlapping with the area of burrowed mud observed in the seabed imagery. It is noted that this area of biotope mosaic aligns with the location of a tunnel valley that forms shelf deeps (discussed further in **Section 3.7**).

3.2.4 Other Benthic Communities

22. The OneBenthic Baseline Tool (OBBT)[1] (Cefas, 2023) presents macrofaunal assemblage data derived from grab and core samples in UK waters on a digital map. The OBBT did not identify any macrofaunal assemblages within the Bellrock WFDA[2], but did identify five within the benthic ecology study area.

23. The five assemblages identified in the benthic ecology study area are located approximately 3.5 km southeast of the Bellrock WFDA, in a clustered formation. Four are classified as ‘D2b’ and one as ‘D2c’, based on the Cooper et al. (2019) system of classification. The D2b assemblage is typically associated with deep water, low bottom temperature, muddy habitats with low bottom current flows, high salinity and low chlorophyll. It is comprised of the families *Spionidae, Amphiuridae, Nephtyidae, Lumbrineridae, Oweniidae, Cirratulidae, Capitellidae, Nemertea, Semelidae*, and *Ampharetidae*.

24. The D2c assemblage dominates in sediments with high sand content and relatively low mud content and is comprised of the families *Nephtyidae, Spionidae* and *Opheliidae*. Both assemblage types are widely distributed but commonly found in the deeper waters of the central and northern North Sea. (Cooper et al., 2019). The faunal composition of the assemblage types and their typical locations and associated conditions are congruent with the findings of the benthic survey results.

[1] The OBBT has been used to inform this benthic ecology baseline as advised by NatureScot and MD-LOT (see Table 7.2 in **Chapter 7: Benthic Ecology (Volume II)**).

[2] It is noted that the OBBT only provides information on locations where sampling has taken place and is not a comprehensive map of all macrofaunal assemblages in UK offshore waters. Therefore, although no assemblages were identified within the Bellrock WFDA, that does not discount their presence.

This indicates that the biotopes identified by sampling in the Bellrock WFDA are typical of the wider offshore region.

3.2.5 Summary

25. The majority of the Bellrock WFDA is characterised by sandy sediments assigned to the biotope A5.272, with the remaining proportion characterised by a mosaic of the biotopes A5.371 and A5.376. The biotope classifications within the Bellrock WFDA are summarised in **Table 3.1** below and shown in **Figure 7.1.3 (Annex 1)**.

Table 3.1: Biotope Classifications within the Bellrock WFDA

EUNIS (2012 EUNIS classification system (European Environment Agency, 2012)) Habitat Classification		Equivalent JNCC Marine Habitat Classification for Britain and Ireland (JNCC, 2023)
Biotope Complex Level 4	**Biotope Complex Level 5**	
A5.27 Deep circalittoral sand	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	SS.SSa.OSa.OfusAfil *Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand
A5.37 Deep circalittoral mud	A5.371 *Ampharete falcata* turf with *Parvicardium ovale* on Atlantic offshore circalittoral muddy sediment near margins of deep stratified seas	SS.SMu.OMu.AfalPpin *Ampharete falcata* turf with *Parvicardium pinnulatum* on cohesive muddy sediment near margins of deep stratified seas
	A5.376 *Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in Atlantic offshore circalittoral sandy mud	SS.SMu.OMu.PjefThyAfil *Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud

3.3 Invasive Non-native Species

26. Invasive non-native species (INNS) are those that are not native to the UK and proliferate at a rate that outcompetes native species, without natural predators to manage their population. They are translocated from their native environment through various pathways or ‘vectors’, including through deliberate introduction and accidental transport e.g. in ballast water or on ship hulls. INNS pose a major threat to marine biodiversity by changing habitat and ecosystem functioning, introducing diseases and parasites, and causing genetic impacts (Cook et al. 2016).

27. No INNS or species non-native to the local habitat types were recorded in the seabed imagery analysis or grab samples within the Bellrock WFDA. No INNS or species non-native to the local habitat types were observed from the desk-based sources (i.e. OBBT) either.

3.4 Designated Sites

28. The benthic ecology study area does not overlap any offshore designated sites, as shown in **Figure 7.1.4 (Annex 1)** and detailed in **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report (Volume IV)**.

29. The nearest designated site is the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (ncMPA); 35 km northeast of the benthic ecology study area. Considering the large distance from the benthic ecology study area, any potential zones of influence, and that the qualifying features of the site are not mobile, it is very unlikely that this ncMPA would be impacted by the Bellrock Wind Farm Infrastructure. Additionally, both qualifying features of this ncMPA (ocean quahog *A. islandica* and Offshore Deep-sea Muds) are considered within the assessment due to their conservation interest PMFs and are recorded within the benthic ecology study area (see **Sections 3.5.1** and **3.5.4**).

3.5 Priority Marine Features

30. PMFs are habitats and species identified by Marine Scotland (now MD-LOT), JNCC and Scottish Natural Heritage (now NatureScot) as being a priority for conservation in Scotland's seas (Scottish Government, N.D.). The PMFs present in the benthic ecology study area are outlined in **Sections 3.5.1** to **3.5.4** and **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report** and **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report** (**Volume IV**).

31. No evidence of geogenic or biogenic reef habitats was observed across the site (**Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report** and **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report** (**Volume IV**)).

3.5.1 Ocean Quahog

32. In addition to being classified as a PMF, ocean quahog *Arctica islandica* is listed under the OSPAR List of Threatened and/or Declining Species and Habitats (2008) (herein 'the OSPAR List'). Across the benthic ecology study area, 73 individuals were identified through the site-specific DDC survey, with most of these being juveniles and only three adults being noted at stations ST0013, ST0020 and ST0088 (see **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**). There was no trend evident between the presence of this PMF species and the sediment type where located.

33. Ocean quahog are the longest-lived molluscs on record, with a possible lifespan of over 400 years. They are most commonly found burrowing 6 cm down into sandy and muddy sediments around Scotland, at water depths of 10 m to 280 m, mainly offshore in the east of Scotland and northern North Sea. Of the British records of ocean quahog, approximately 70% occur in Scotland, though their numbers are now in decline (Marine Scotland, 2018).

3.5.2 Offshore Subtidal Sands and Gravels

34. Sand and gravel sediments are the most common subtidal habitat around the British coast and are abundant in Scottish offshore waters, found at depths of 80 m to 3,000 m. Whilst the sands and gravels to the west of the UK are largely derived from shells, those in the North Sea are generally formed from rock material. Typical communities that inhabit offshore fine and muddy sands include tube-building polychaetes and other polychaetes, bivalves, and burrowing brittlestars, whilst medium sands tend to be dominated by pea urchins and fine sands by amphipods and hooded shrimps (Marine Scotland, 2016a; JNCC, 2013).

35. The majority of the benthic ecology study area is characterised by the PMF habitat 'Offshore Subtidal Sands and Gravels' (as detailed in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report** and **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report** (**Volume IV**)), based on the depth range and sediment composition (**Section 3.1.1**).

3.5.3 Burrowed Mud

36. In general, burrowed mud is found in deep water and/or sheltered conditions where there is very little water movement. On open coasts, this is only in waters below 50 m, but in the sheltered basins of sea lochs, mud-dwelling organisms can be observed in much shallower waters. Muddy seabeds are found at locations all around Britain's coast, though the majority are located in Scotland, off the west coast and in the northern North Sea (NatureScot, 2023a).

37. The benthic survey results identified burrows in muddy sediment at 59 of the 113 surveyed stations. The benthic ecology study area is largely characterised by sandy sediment with areas of a mosaic habitat comprising the PMFs 'Burrowed Mud' and 'Offshore Deep Sea Muds' (as shown in Figure 17 in **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**), based on the depth range, presence of burrows, and sediment composition (**Section 3.1.1**).

38. The phosphorescent sea pen *Pennatula phosphorea*, characteristic of Burrowed Mud habitats, was identified, via the DDC survey, at 16 of the 113 stations across the benthic survey area, as shown in Figure 5 of **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report** (**Volume IV**)). This species is listed on the Scottish Biodiversity List; a database of species and habitats in Scotland that are considered of most importance for biodiversity conservation.

39. **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report** noted how the benthic survey conducted a comprehensive burrow assessment utilising all still images collated across the benthic survey area. Stations classified as EUNIS A5.37 (deep circalittoral mud) were among those with the highest densities of burrows. However, the seabed imagery data revealed no spatial relationship between mud density and the presence of sea pens. This indicates that sea pen and burrowing megafauna were not a biotope component of the burrowed mud PMF observed.

40. The subsequent macrobenthic analysis did not reveal the presence of any species that could qualify as a biotope component of the burrowed mud PMF habitat. Most likely this area of mud at the east of the survey area reflects a combination of the offshore deep sea muds PMF habitat and the burrowed mud PMF habitat (**Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report**).

3.5.4 Offshore Deep Sea Muds

41. 'Offshore Deep Sea Muds' are one of the most widespread and common habitats in Scottish offshore waters, occurring at depths of between 200 m and 500 m. It supports a community of burrowing animals such as Norway lobster *Nephrops norvegicus*, polychaetes, bivalves, brittlestars and foraminifera (the latter being a key indicator species for ocean acidification) (Marine Scotland, 2016b).

42. The benthic ecology study area is largely characterised by sandy sediment with areas of a mosaic habitat comprising the PMFs 'Burrowed Mud' and 'Offshore Deep Sea Muds', based on the depth range and sediment composition (**Section 3.1.1**).

3.6 Important Ecological Features

43. Best practice guidelines by the Chartered Institute for Ecology and Environmental Management (CIEEM) (CIEEM, 2024) have been followed in order to identify Important Ecological Features (IEFs) within the benthic ecology study area. Any IEFs considered within the assessment are those which are deemed important and potentially impacted 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).

44. The IEFs identified within the benthic ecology study area are summarised in **Table 3.2** below.

Table 3.2: Important Ecological Features within the Benthic Ecology Study Area

Important Ecological Feature	Type	Conservation Interest	Protection Status	Representative Biotope(s)
Ocean quahog *Artica islandica*	Species	Priority Marine Feature	OSPAR Protected Species	N/A
Offshore Subtidal Sands and Gravels	Habitat	Priority Marine Feature	None	A5.272 *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand
Burrowed Mud	Habitat	Priority Marine Feature	OSPAR Protected Habitat (under 'Sea Pen and Burrowing Megfauna')	A5.371/A5.376 (mosaic habitat) *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

Important Ecological Feature	Type	Conservation Interest	Protection Status	Representative Biotope(s)
Phosphorescent sea pen *Pennatula phosphorea*	Species	Scottish Biodiversity List	OSPAR Protected Species[3]	N/A
Offshore Deep Sea Muds	Habitat	Priority Marine Feature	OSPAR Protected Habitat	A5.371/A5.376 (mosaic habitat) *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

3.7 Shelf Deeps

45. The Geodatabase for Marine Habitats and Species (GeMS) which is built upon mapping by Baxter et al. (2011) identifies areas of Shelf Deeps (Tunnel Valley) on the southeast side of the benthic ecology study area (as shown in **Figure 7.1.4 (Annex 1)**).

46. Within the Bellrock WFDA, these mapped features form part of the broader system of deep channels collectively referred to as the Devil's Hole. Not all of these channels are classified as Shelf Deeps, and only the Shelf Deeps themselves are classified as Large-scale Features.

47. Shelf deeps are channel-shaped topographic depressions in the seabed, typically created by glacial erosion during periods of lower sea level. Several types of deeps have been recognised in Scottish waters, including channels, troughs, valleys and canyons. Shelf deeps are abundant in the north Irish Sea and are present in fewer numbers in offshore waters all around Scotland (NatureScot, 2016).

48. Within shelf deeps, water current velocities are slowed, and it is therefore common for muddy sediments to accumulate. These sediments are classified as burrowed mud, and are often inhabited by diverse benthic communities, including burrowing sea anemones, sea cucumbers, starfish and sea pens. See **Section 3.5.3** for more information on burrowed mud, which is classified as a PMF and has been observed within the benthic ecology study area (NatureScot, 2023b).

49. Site-specific geophysical survey results show that the Bellrock WFDA is mostly flat, with gently to moderately sloping channel levees. The position of the shelf deeps in the southeast corner of the benthic ecology study area as depicted in the GeMS dataset matches with the geophysical survey

[3] Phosphorescent sea pens are an OSPAR Protected Species under 'Sea Pen and Burrowing Megafauna', but only when associated with certain habitats. As outlined in **Section 3.5.3**, though sea pen burrows and individuals were observed across the benthic ecology survey area, there was not a strong enough relationship with a relevant habitat to classify them as such.

results. These channels run in a northsouth direction and are of a subglacial origin, therefore can be described as ‘tunnel valleys’, a type of shelf deep (Ottesen et al., 2020).

50. In addition to the tunnel valleys in the southeast of the Bellrock WFDA, three other notable channels and levees were identified within the Bellrock WFDA that were not accounted for by the GeMS dataset. This is discussed further in **Chapter 6: Marine Geology, Oceanography and Physical Processes (Volume II)**.

51. Shelf deeps are regarded as large-scale features of functional significance due to their ability to support diverse benthic communities and act as hotspots for feeding cetaceans and foraging seabirds (NatureScot, 2023). These benthic communities are the only receptor relevant to this benthic ecology assessment and can be attributed to the burrowed mud PMF habitat, which is discussed in **Section 3.5.3**. Shelf deeps are assessed in their own right in **Chapter 6: Marine Geology, Oceanography and Physical Processes (Volume II)**.

4 Predicted Future Baseline

52. Natural processes will cause gradual change in the marine environment, causing some degree of deviation from the baseline environment described in **Section 3**. Therefore, the following section considers the predicted future baseline environment without the Bellrock Wind Farm Infrastructure ever being installed.

53. Climate change is the driver of several direct and indirect pressures on benthic communities; including ocean warming and acidification and changes in salinity, hydrodynamics, and nutrient enrichment. Notably, climate change is a key driver of shifts in benthic species distribution (Parmesan & Yohe, 2003; Poloczanska et al., 2016). Weinert et al. (2016) modelled the distribution of 75 benthic species in the North Sea to project their response to climate change from 2001 to 2099. They found that, as a result of the modelled notable increase in bottom temperature, and moderate increase in salinity associated with climate change, 64% of the species experienced a latitudinal northward shift, and 36% a southward shift. These distribution shifts may also be seen in INNS and pathogens, potentially causing further changes in the distribution and community composition of native benthic species and loss in biodiversity.

54. Birchenough et al. (2015) published a high-level matrix of climate change-related impacts on the marine benthos in the North Atlantic, based on a review of the best available literature. The only pressure predicted to have a 'very strong effect' on offshore circalittoral sediments (as those present in the benthic ecology study area), was ocean acidification. Open ocean stratification, changes in upwelling intensity and nutrient levels were predicted to have a 'strong effect', increased freshwater input and changed salinity a 'low effect', and extreme events and shelf sea stratification to have 'no known effect'. Ocean acidification is known to cause adverse impacts on benthic species at the individual level, e.g. physiological changes, and at a community level, e.g. distribution and community composition changes (Gattuso et al., 2011). The impacts of increased upwelling intensity and nutrient level changes on benthic communities are largely unclear. However, it has been predicted that increased stratification and limited nutrient transport to the seabed may counteract nutrient enrichment, leading to nutrient decreases in deep-sea benthic habitats (Sweetman et al., 2017).

55. Overall, climate change-related pressures are expected to impact the future baseline in several ways. For benthic communities of the central and northern North Sea, it is predicted that the most notable changes will likely be in species distribution and community composition. Additionally, localised changes to faunal assemblages may occur due to anthropogenic pressures such as pollution, contamination, and seabed disturbance (e.g. bottom trawling). However, it is difficult to predict whether these activities will affect the benthic ecology study area in future, or the extent to which benthic communities will be affected.

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Annex 1: Figures

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660000 670000 680000 690000 700000 710000

6320000 6310000 6300000 6290000

0 10 km

Haskoning
Enhancing Society Together

Bellrock

Legend:
- Bellrock Wind Farm Development Area
- Benthic Ecology Study Area (4.7 km Buffer)

REV	DATE	STATUS	DRW	CHK	APR
1	31/03/2026	FINAL	DL	SA	BMcG

Coordinate System: WGS 1984 UTM Zone 30N

Source: Esri, CGIAR, N Robinson, NCEAS, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, © Haskoning DHV UK Ltd, 2025.

Scale @ A3
1:150,000

Figure Title:
Benthic Ecology Study Area

Project:
Bellrock Wind Farm Development Area (WFDA)

Report:
EIA Report
Appendix 7.1:
Benthic Ecology Baseline Report

Drawing No.: RHDV_BEL_CST_REP_0003_017

Figure 7.1.1

660000 670000 680000 690000 700000 710000

6320000 6310000 6300000 6290000

0 10 km

Haskoning
Enhancing Society Together

Bellrock

Legend:
- Bellrock Wind Farm Development Area
- Benthic Ecology Study Area (4.7 km Buffer)
- Sediment Sampling Locations

REV	DATE	STATUS	DRW	CHK	APR
1	31/03/2026	FINAL	DL	SA	BMcG

Coordinate System: WGS 1984 UTM Zone 30N

Source: Esri, Intermap, NASA, NGA, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, © Haskoning UK Ltd, 2026.

Scale @ A3
1:150,000

Figure Title:
Sediment Sampling Locations

Project:
Bellrock Wind Farm Development Area (WFDA)

Report:
EIA Report
Appendix 7.1:
Benthic Ecology Baseline Report

Drawing No.: RHDV_BEL_CST_REP_0003_018

Figure 7.1.2

660000 670000 680000 690000 700000 710000

6320000 6310000 6300000 6290000

0 10 km

Haskoning
Enhancing Society Together

Bellrock

Legend:

- Bellrock Wind Farm Development Area
- Benthic Ecology Study Area (4.7 km Buffer)

European Nature Information System Broad Scale Habitat

- A5.2 Sand and Muddy Sand
- A5.3 Mud and Sandy Mud
- A5.4 Mixed Sediment

REV	DATE	STATUS	DRW	CHK	APR
1	31/03/2026	FINAL	DL	SA	BMcG

Coordinate System: WGS 1984 UTM Zone 30N

Source: Esri, CGIAR, N Robinson, NCEAS, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, © Haskoning UK Ltd, 2026.

Scale @ A3
1:150,000

Figure Title:
Seabed Sediments within the Benthic Ecology Study Area

Project:
Bellrock Wind Farm Development Area (WFDA)

Report:
EIA Report
Appendix 7.1:
Benthic Ecology Baseline Report

Drawing No.: RHDV_BEL_CST_REP_0003_019

Figure 7.1.3

500000 550000 600000 650000 700000 750000 800000 850000

6400000 6350000 6300000 6250000 6200000

Firth

Southern Trench

Buckie

A98

Fraserburgh

A96

Peterhead

Turbot Bank

A96

A96

A97

Aberdeen

East of Gannet and Montrose Fields

North Sea

155 m

939 m

Stonehaven

Brechin

Montrose

Strathmore

Arbroath

Carnoustie

Dundee

Firth of Forth Banks Complex

Fulmar

A917

Kirkcaldy

North Berwick

Forth

Edinburgh

Swallow Sand

North East of Farnes Deep Highly Protected Marine Area

Berwick to St Mary's

Farnes East

North East of Farnes Deep

A1

0 50 km

Haskoning
Enhancing Society Together

Bellrock

North Sea
Edinburgh
Belfast

Legend:
- Bellrock Wind Farm Development Area
- Benthic Ecology Study Area (4.7 km Buffer)

Designated Sites
- Marine Protected Area
- Marine Conservation Zones
- Shelf Deeps

REV	DATE	STATUS	DRW	CHK	APR
1	31/03/2026	FINAL	DL	SA	BMcG

Coordinate System: WGS 1984 UTM Zone 30N

Source:
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Scale @ A3
1:1,000,000

Figure Title:
Designated Sites Near the Benthic Ecology Study Area

Project:
Bellrock Wind Farm Development Area (WFDA)

Report:
EIA Report
Appendix 7.1:
Benthic Ecology Baseline Report

Drawing No.: RHDV_BEL_CST_REP_0003_020

Figure 7.1.4