MachairWind Offshore Windfarm

Appendix 8.1 Habitat Assessment Report

ScottishPower Renewables

MachairWind Offshore Windfarm: Habitat Assessment Report

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BSL2522_Machair OWF_HAS	02	11/12/2025	[redacted]	[redacted]	[redacted]

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Table of Abbreviations

BAP	Biodiversity Action Plan
BDC	Biodiversity Committee
BSL	Benthic Solutions Limited
CES	Crown Estate Scotland
DDV	Drop Down Video
EC	European Commission
EMODNet	European Marine Observation and Data Network
EUNIS	European Nature Information System
FOCI	Feature of Conservation Interest
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MAG	Magnetometry
MBES	Multibeam Echosounder
MCZ	Marine Conservation Zone
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Area
NCMPA	Nature Conservation Marine Protected Area
OSPAR	Oslo and Paris Accords
OWF	Offshore Wind Farm
PMF	Priority Marine Feature
PSD	Particle Size Distribution
SAC	Special Areas of Conservation
SBL	Scottish Biodiversity List
SBP	Sub-Bottom Profiler
SCI	Sites of Community Importance
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SPR	ScottishPower Renewables
Sulmara	Sulmara Subsea Limited
SSS	Side Scan Sonar
UK	United Kingdom
UKBF	United Kingdom Biodiversity Framework
UKCS	United Kingdom Continental Shelf
2DHR	2d High Resolution Seismic

1 Introduction

1.1 Project Information

Client:	ScottishPower Renewables
Project:	MachairWind OWF HAS
Main Contractor:	Sulmara Subsea Ltd
Sub-contractor	Benthic Solutions Ltd
Sub-contractor Reference:	2522
Survey Area:	Sea of the Hebrides
Survey Type:	Habitat Survey
Geophysical Survey Period:	05/05/25 – 16/07/2025
Survey Vessel:	*Mainport Edge*
Main Contractor Project Manager:	[redacted]@sulmara.com)
Sub-Contractor Project Manager:	[redacted]@benthicsolutions.com)

1.2 Project Description

ScottishPower Renewables (SPR) was awarded the development rights to the MachairWind Offshore Windfarm (OWF) within the ScotWind W1 Option Area by Crown Estate Scotland (CES). The option agreement area is located approximately 15km northwest of Islay, and 12km west of Colonsay, covering an area of approximately 754km^2, with the 2025 geophysical survey area approximately 449km^2 (Figure 1.1).

Geophysical and environmental surveys for the MachairWind OWF were commissioned by SPR and undertaken by Sulmara Subsea Ltd (Sulmara), supported by Benthic Solutions Ltd (BSL). The geophysical survey was conducted aboard the *Mainport Edge* between the 12th of April and the 15th of July 2025. Survey operations comprised the deployment of a vessel-mounted multibeam echosounder (MBES) for bathymetric data acquisition, towed side scan sonar (SSS), shallow sub-bottom profiler (SBP), magnetometry (MAG) and high-resolution seismic acquisition (2DHR).

In addition, a maximum of 20 drop-down Video (DDV) stations were to be proposed after review of the geophysical data by the environmental scientist onboard. However, this environmental camera scope was subsequently cancelled on the 4th of July 2025 due to extended and recurring periods of unworkable weather conditions.

The geophysical and environmental survey conducted by Fugro in 2023, which encompassed a larger area of the MachairWind OWF site, was considered alongside the current geophysical dataset acquired by Sulmara (2025). Together, these datasets were used to characterise marine habitats, including the identification of potential Annex I habitats within the survey area, in order to inform the environmental consent process for the OWF (MCW-SCH-GEO-SOW-IBR-000004 Rev 2: Scope of Work).

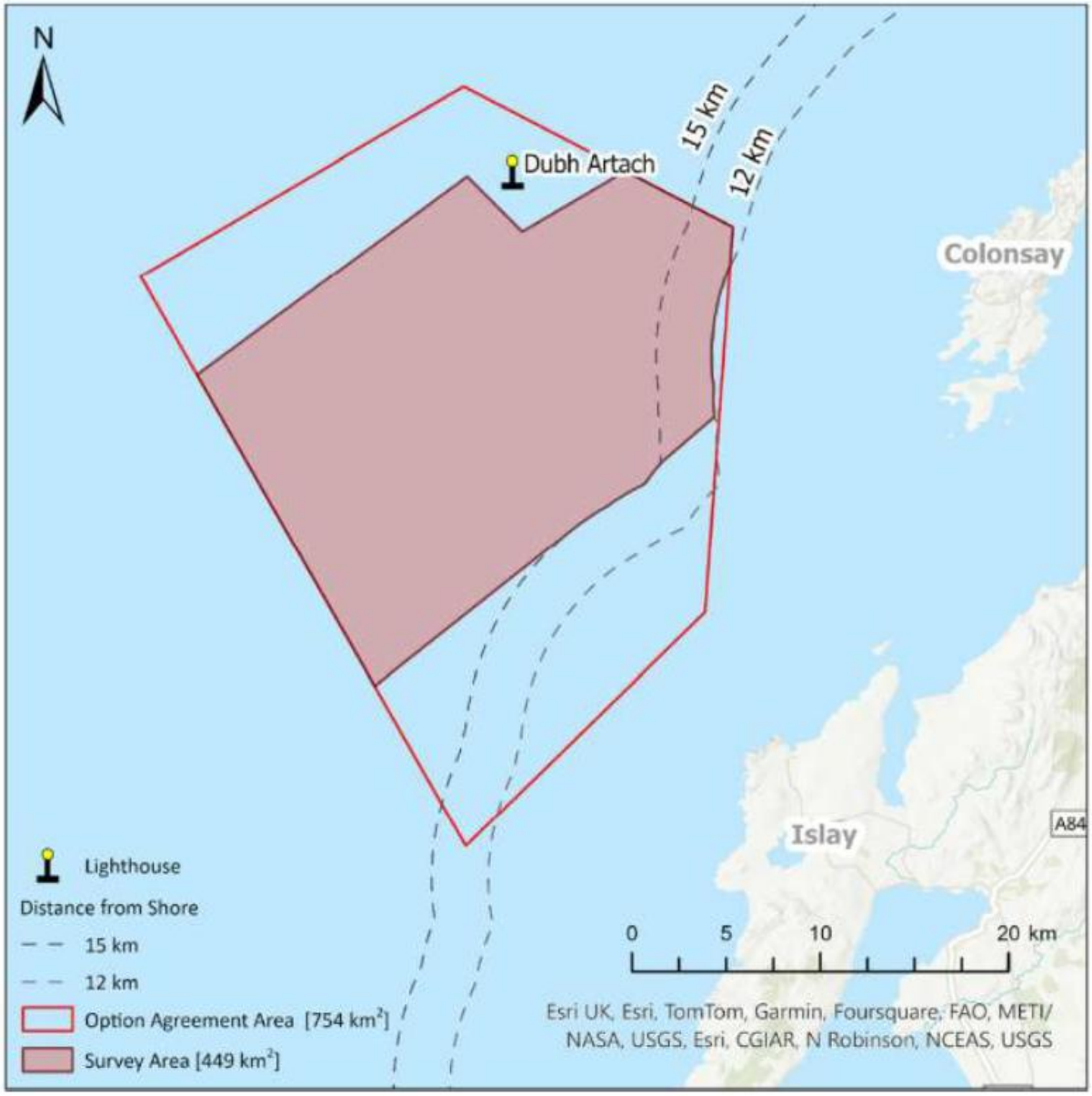


Figure 1.1: MachairWind Offshore Windfarm Area

1.3 Scope of Work

The initial scope of work included habitat assessment for characterisation of the benthos and investigation of potential sensitive habitats or species to provide an understanding of the baseline conditions prior to proposed construction activities at the MachairWind OWF site.

Following cancellation of the camera element of the survey scope, this was adapted to use a combination of historical and current geophysical and environmental datasets to characterise the marine habitats, according to the following objectives:

- Undertake a review of the acquired geophysical data within the survey area to preliminarily identify all habitats for further investigation and characterisation.

- Identify habitats of potential conservation interest defined as those listed in Annex I of the EC Habitats Directive, the OSPAR List of Threatened and/or Declining Species and Habitats, and the UK Biodiversity Framework (UKBF; formerly the UK Biodiversity Action Plan Priority Habitat descriptions).

1.4 Geodetic Parameters

The horizontal datum was referenced to the ERTS89 Datum, UTM 29N projection. The geodetic parameters used are provided below in Table 1.1

Table 1.1: Geodetic Parameters

GPS Satellite System – ERTS89	
Datum	ERTS89
Spheroid	GRS 1980
Semi-Major Axis	a = 6,378,137.000m
Semi-Minor Axis	b = ,356,752.3141 m
First Eccentricity Squared	e^2 = 0.00669438002290
Inverse Flattening	1/f = 298.257222101
Project projection parameters for site surveys	
EPSG Map Projection Code	25829
Projection	UTM Zone 29N
Central Meridian	9° West
Longitude of Origin	9° West
Latitude of Origin	0° North
False Easting	500,000.00 m
Scale Factor at Central Meridian	0.9996
Units	Metres

1.5 Background Information

1.5.1 EMODnet Predicted Habitats Distributions

To further aid interpretation, comparison has been made with the predicted seabed habitat distribution data produced by the European Marine Observation and Data Network (EMODnet). EMODnet is a long-term marine data initiative developed through a stepwise approach to collect data and build on existing databases to provide access to European marine data across seven discipline-based themes: bathymetry, geology, seabed habitats, chemistry, biology, physics, and human activities (EMODnet, 2023).

The broad-scale seabed habitat map is a predictive delineation of habitats within all European seas to the EUNIS classification system (EUNIS, 2022). Formulated through international (OSPAR) and national monitoring programmes in collaboration with European projects such as Mapping European Seabed Habitats (MESH) or MESH Atlantic, the predicted seabed habitat map can be a useful resource to aid assignment of habitats within a given survey area.

1.5.2 Legislative Background

1.5.2.1 UK Biodiversity Framework

The UK Biodiversity Framework (UKBF), published in May 2024, supersedes both the previous UK Post-2010 Biodiversity Framework and the UK Biodiversity Action Plan (UKBAP). Developed in response to the Kunming-Montreal Global Biodiversity Framework agreed upon at the 15th Conference of the Parties of the Convention on Biological Diversity in December 2022, the UKBF outlines the UK's strategic approach to biodiversity conservation (JNCC, 2024).

The UKBF emphasises collaborative efforts among the UK's four nations to meet international biodiversity commitments. It identifies key activities that can be more effectively achieved through joint action, enhancing the efficiency and impact of conservation initiatives across the UK.

In Scotland, the Nature Conservation (Scotland) Act 2004 and the Wildlife and Natural Environment (Scotland) Act 2011 provide the legal framework for biodiversity conservation (NatureScot, 2024). This is supported by the Scottish Biodiversity List (SBL), which identifies species and habitats of principal importance, as well as priority marine features, which highlight critical marine species and habitats requiring protection. A total of 81 PMFs have been identified in the seas around Scotland and include: intertidal mudflat, maerl beds, burrowed mud, blue and horse mussel beds and lesser sandeels.

1.5.2.2 OSPAR Commission

At its Biodiversity Committee (BDC) meeting in 2003, OSPAR agreed to proceed with a programme to collate existing data on the distribution of 14 key habitats, as part of a wider programme to develop measures for their protection and conservation. The UK agreed to compile the relevant data for its marine waters and submit these for collation into composite maps on the distribution of each habitat type across the whole OSPAR area. This work is being coordinated by the JNCC. Key OSPAR habitats that may occur in an open water marine environment are essentially the same as listed under the UKBF, with the 'Mud Habitats in Deep Water' listed as "Seapens and Burrowing Megafauna Communities".

1.5.2.3 European Habitats Directive

The United Kingdom (including Scotland), a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979), adopted the European Community Habitats Directive in 1992 to fulfil its obligations under the convention. This Directive mandates member states to undertake various measures including, protecting species listed in Annexes, monitoring habitats and species, and submitting reports every six years on Directive Implementation.

Annex I of the Directive lists 189 habitat types, while Annex II includes 788 species that must be protected through a network of designated sites. Member States are responsible for proposing national site lists, which are evaluated to form a European network of Sites of Community Importance (SCIs). These SCIs are later designated as Special Areas of Conservation (SACs). Together with Special Protection Areas (SPAs) under the Birds Directive (2009), they make up the Natura 2000 network. The Habitats Directive was amended in 1997 and 2003.

In Scotland, environmental responsibilities now lie with the Scottish Government and its agencies. The Nature Conservation (Scotland) Act 2004, the Marine (Scotland) Act 2010, and the Marine and Coastal Access Act 2009—which provides the legal framework for marine planning and the designation of Marine Conservation Zones (MCZs) in UK offshore waters—continue to underpin habitat and species protection in Scottish inshore and offshore waters. These frameworks have been updated to reflect post-Brexit requirements, with NatureScot and the Marine Directorate overseeing enforcement and compliance.

1.5.2.4 Priority Marine Features

In July 2014, 81 Priority Marine Features (PMFs) were identified for the seas around Scotland. The list, which covers a variety of habitats and species that are a priority for conservation in Scotland's seas, was developed by Marine Scotland, the JNCC and Scottish Natural Heritage (SNH). Key PMF habitats in Scottish circalittoral environment consist of Horse-mussel (*Modiolus modiolus*) beds, soft coral and sponge communities as well as burrowing fauna.

1.5.3 Habitat Investigation

1.5.3.1 Habitat Classification

A marine biotope classification system for British waters was developed by Connor *et al*. (2004) from data acquired during the JNCC Marine Nature Conservation Review (MNCR) and subsequently revised by Parry (2019) to provide an improved classification of deep-sea habitats. The resultant combined JNCC (2022) classification system is analogous to the European Nature Information Service Habitat Classification (EUNIS, 2022), which compiled information from across Europe into a single database. The two classification systems are based on the same hierarchical analysis. Initially, abiotic habitats are defined at four levels. Biological communities are then linked to these (at two lower levels) to produce a biotope classification (Connor *et al.,* 2004; EUNIS, 2022).

The predicted seabed habitat map produced by EMODnet was utilised in the habitat investigation across the MachairWind OWF survey area. As illustrated in Figure 1.2, the predicted EUNIS habitats across the OWF survey area were predominantly classified as 'Atlantic Circalittoral Sand' (MC52/ SS.SSa.CFiSa), with patches of 'Atlantic Offshore Circalittoral Sand' (MD52/ SS.SSa.OSa) and a small area of 'Atlantic Offshore Circalittoral Rock' (MD12/ CR.HCR), coinciding with the location of the Dubh Artach Lighthouse.

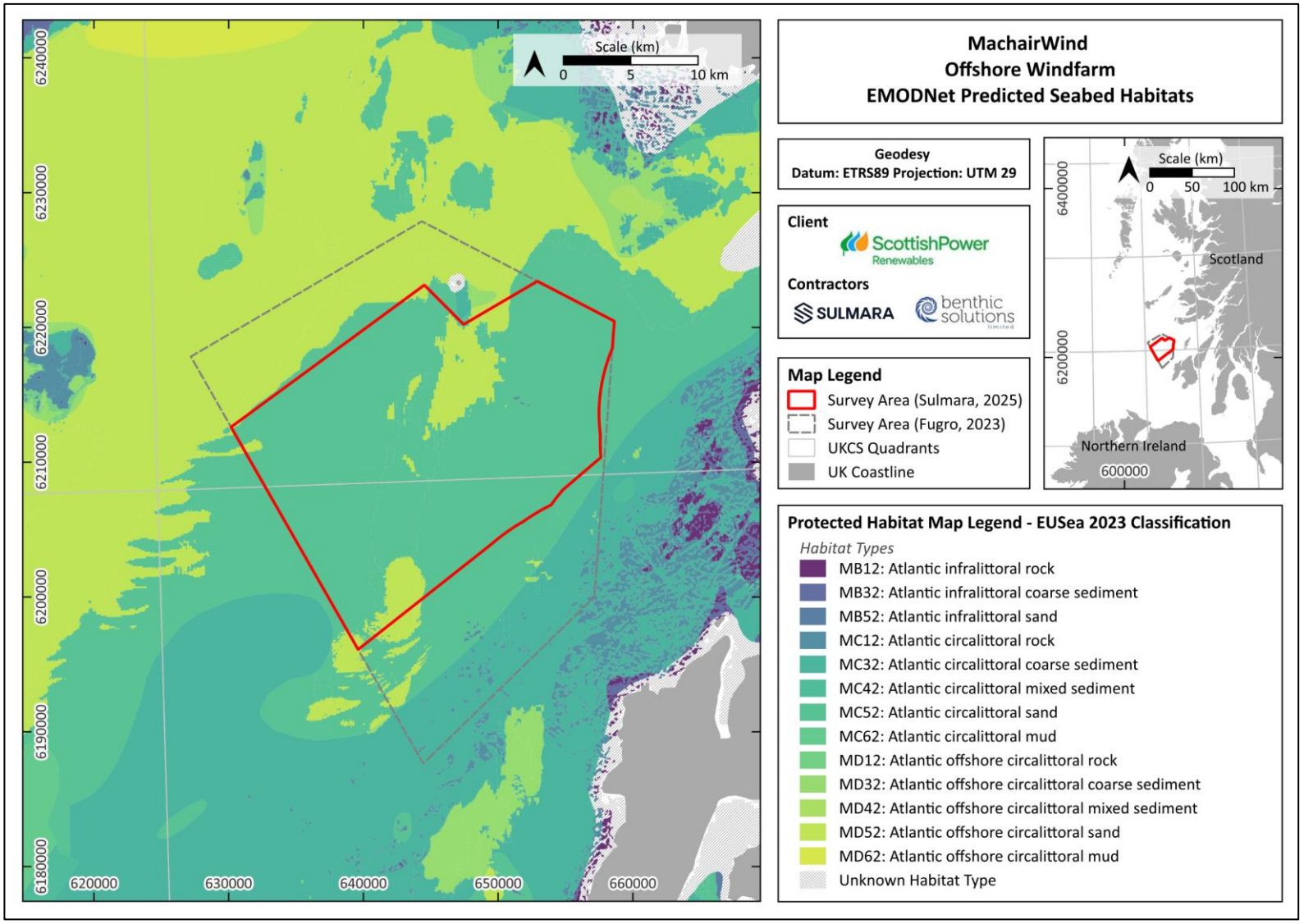


Figure 1.2: Predicted Seabed Habitats for the OWF Survey Area

1.5.3.2 Expected Habitat Sensitivities

The MachairWind OWF overlaps the Inner Hebrides and the Minches SAC by approximately 80m. This SAC covers both inshore and offshore waters between the Inner Hebrides and the Scottish mainland and was designated for the protection of the harbour porpoise (*Phocoena phocoena*) under Annex II of the UK Habitats Regulations. The Sea of the Hebrides Nature Conservation Marine Protected Area (NCMPA), designated for the presence of basking sharks, minke whales and unique geological features, is located 1.5km north of the OWF (Table 1.2).

Table 1.2: Key Aspects of Nearby Protected Areas

Designation	Designated Site	Designation Year	Site Area	Distance to Survey Site	Key Aspects
SAC	Inner Hebrides and The Minches	2017	13,814 km^2	MachairWind OWF overlaps by approximately 80m	Extends from the Scottish mainland to the Inner Hebrides and designated for the protection of the harbour porpoise; the area hosts a consistently high density of the species year-round. The area also has a high biodiversity and provides habitats for various PMFs including horse mussel beds.
NCMPA	Sea of the Hebrides	-	10,039 km^2	1.5km	Protects key mobile species, notably basking sharks and minke whales, by safeguarding important foraging and migratory habitats. The Inner Hebrides Carbonate Production Area represents the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature and is responsible for generating carbonate-rich sediments.

1.5.3.3 Protected Habitat Assessment

Based on the features that were granted in the above areas, as well as those found in previous surveys (Fugro, 2023) the habitats, and species of relevance to this region of UK waters are:

- Subtidal Sands and Gravels (UKBF Habitat of Principle Importance, Scottish PMF).
- Geogenic Reefs (EC Habitats Directive Annex I, UKBF Habitat of Principle Importance).
- Sensitive and Priority Species, including:
  - Ocean Quahog (*Arctica islandica*) (Species FOCI, OSPAR Threatened and/or Declining Species).
  - Sandeels (*Ammodytes marinus* & *A. tobianus*) (Species FOCI, Scottish PMF, UKBF Species of Conservation Interest).
  - Atlantic Cod (*Gadus morhua*) (OSPAR Threatened and/or Declining Species).

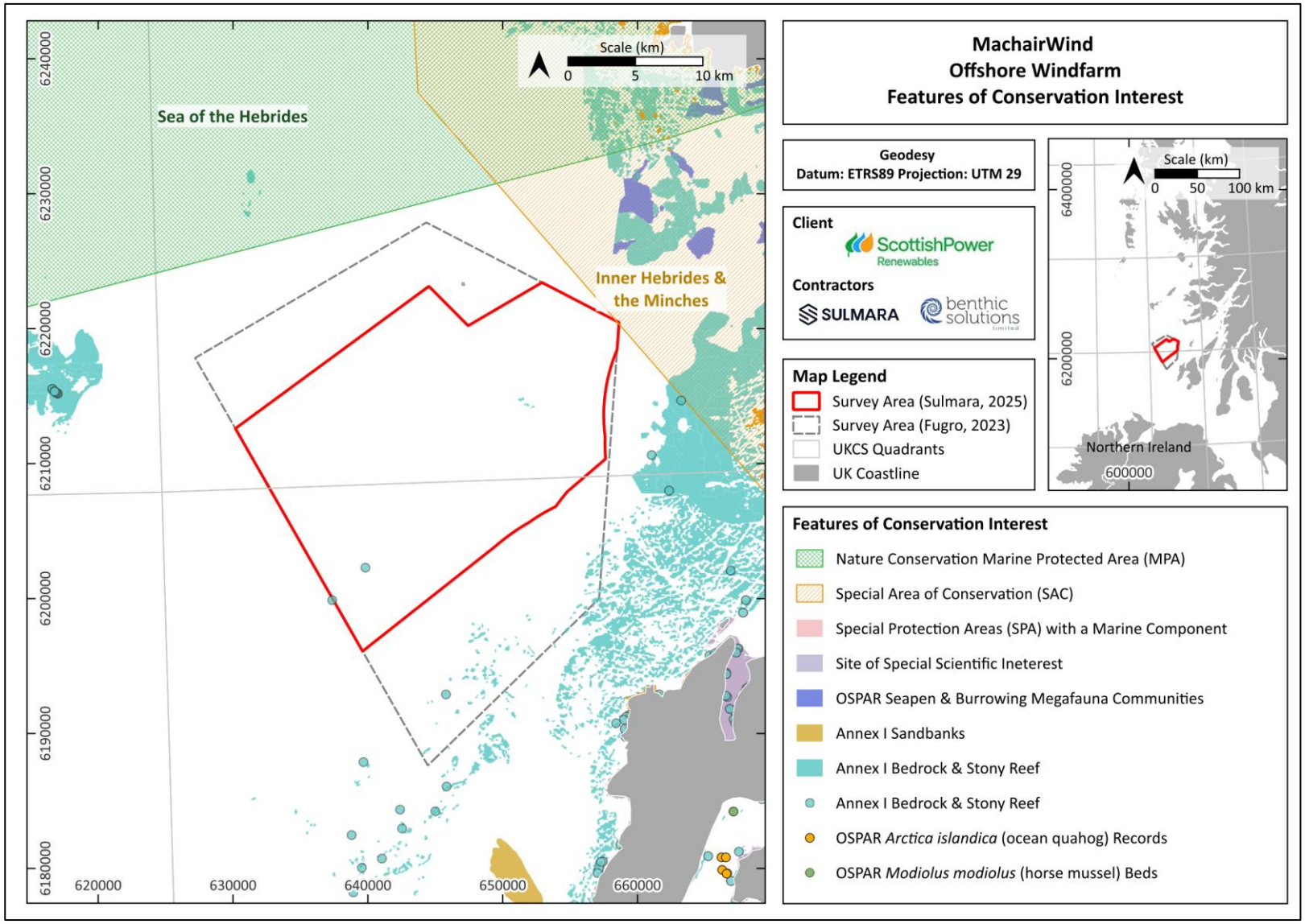


Figure 1.3: Locations of Features of Conservation Interest in Relation to the MachairWind OWF Survey Area

2 Available Survey Reports and Datasets

2.1 Geophysical Reports and Datasets

Three reports pertaining to the MachairWind OWF survey area were made available by the client for review and comparison to the current survey data:

- MCW-SCH-GEO-REP-FUG-000003: Geophysical Field Operations Report
- MCW-SCH-GEO-REP-FUG-000005: OWF Geophysical Results Report
- MCW-SCH-GEO-REP-FUG-000006: Geophysical and Habitat Interpretative Report
- MCW-SCH-GEO-REP-SMS-R002: Geophysical Characterisation SI Phase 2

From these reports, geophysical data (SSS and MBES), identified seabed features, and habitat assessment polygons were used in conjunction with the newly acquired geophysical dataset (SSS and MBES) collected by Sulmara for the current habitat assessment. Available reports and datasets, including both geophysical and environmental data, are summarised in Table 2.1 and illustrated in Figure 2.1.

Table 2.1: Summary of Available Geophysical Survey Datasets & Reports

Contractor & Year	Description	Bathymetry Resolution	SSS Mosaic	Interpreted Seabed Features	Environmental Grab Stations	Camera Data (Logs and Interpretation)
Fugro, 2023	Preliminary geophysical and environmental characterisation site survey	1m	High & Low Frequency	Yes	62	59
Sulmara, 2025	Geophysical characterisation site survey	1m	High & Low Frequency	Yes	N/A	N/A

2.2 Seabed Photography and Sampling

The previous environmental survey carried out at the MachairWind OWF site (Fugro, 2023) used a combination of seabed photography and sampling to provide an outlook on the sediment and habitats on the seafloor. The survey area was surveyed on a wide line spacing (500 m x 2 km grid spacing). A summary of the camera operations undertaken by Fugro (2023) is provided in Table 2.2.

Table 2.2: Summary of previous MachairWind OWF environmental camera transect acquisition

Geodetic Parameters: ETRS89, UTM Zone 29N						
Transect		Easting (m)	Northing (m)	Depth (m LAT)	Video Footage (mm:ss)	Number of Stills
MCW-A-ST01	SOL	641 119	6 225 433	62	09:03	12
	EOL	641 155	6 225 390			
MCW-A-ST02	SOL	643 864	6 225 562	68	11:50	13
	EOL	643 891	6 225 512			
MCW-A-ST03	SOL	646 751	6 225 374	74	09:44	12
	EOL	646 762	6 225 315			
MCW-A-ST05	SOL	638 499	6 223 012	63	09:17	12
	EOL	638 495	6 222 954			
MCW-A-ST07A	SOL	643 945	6 223 041	65	09:31	12
	EOL	643 891	6 223 017			
MCW-A-ST08A	SOL	645 660	6 221 868	59	10:27	17
	EOL	645 647	6 221 804			

Geodetic Parameters: ETRS89, UTM Zone 29N						
Transect		Easting (m)	Northing (m)	Depth (m LAT)	Video Footage (mm:ss)	Number of Stills
MCW-A-ST12	SOL	636 003	6 220 270	66	10:41	12
	EOL	636 005	6 220 207			
MCW-A-ST14	SOL	640 983	6 220 521	52	08:29	12
	EOL	640 976	6 220 468			
MCW-A-ST22	SOL	630 634	6 217 718	75	09:54	13
	EOL	630 623	6 217 657			
MCW-A-ST34	SOL	633 131	6 215 215	65	09:25	13
	EOL	633 088	6 215 176			
MCW-A-ST36	SOL	638 877	6 214 834	50	08:48	12
	EOL	638 863	6 214 781			
MCW-A-ST44A	SOL	630 639	6 212 686	58	09:24	14
	EOL	630 584	6 212 705			
MCW-A-ST55	SOL	633 383	6 209 770	50	08:41	12
	EOL	633 406	6 209 723			
MCW-B-ST09A	SOL	650 117	6 222 911	104	19:26	16
	EOL	650 013	6 222 872			
MCW-B-ST10	SOL	652 152	6 222 704	51	18:06	12
	EOL	652 088	6 222 620			
MCW-B-ST17A	SOL	649 188	6 220 217	58	17:59	10
	EOL	649 123	6 220 137			
MCW-B-ST18A	SOL	651 413	6 220 772	52	20:12	16
	EOL	651 335	6 220 687			
MCW-B-ST19A	SOL	654 911	6 219 720	51	18:36	24
	EOL	654 911	6 219 835			
MCW-B-ST28	SOL	646 381	6 217 842	62	16:34	20
	EOL	646 298	6 217 784			
MCW-B-ST29A	SOL	649 613	6 217 241	60	19:13	22
	EOL	649 493	6 217 237			
MCW-B-ST30A	SOL	652 173	6 217 412	51	17:32	18
	EOL	652 112	6 217 501			
MCW-B-ST38A	SOL	644 193	6 214 647	60	17:32	25
	EOL	644 087	6 214 668			
MCW-B-ST57	SOL	638 414	6 209 784	56	18:36	19
	EOL	638 364	6 209 882			
MCW-B-ST59A	SOL	643 528	6 210 197	63	19:04	15
	EOL	643 421	6 210 171			
MCW-C-ST20	SOL	657 511	6 219 953	45	10:54	10
	EOL	657 468	6 220 004			
MCW-C-ST31	SOL	654 524	6 217 460	47	10:25	10
	EOL	654 515	6 217 522			
MCW-C-ST32	SOL	657 077	6 217 652	45	09:52	10
	EOL	657 083	6 217 713			
MCW-C-ST41	SOL	651 608	6 215 065	55	23:30	30
	EOL	651 726	6 215 149			
MCW-C-ST42	SOL	654 566	6 214 920	46	09:41	13
	EOL	654 608	6 214 963			
MCW-C-ST43	SOL	657 099	6 215 065	46	09:40	10
	EOL	657 113	6 215 123			
MCW-C-ST51	SOL	649 242	6 212 427	55	09:48	13
	EOL	649 206	6 212 376			
MCW-C-ST52	SOL	651 656	6 212 474	50	09:44	13
	EOL	651 603	6 212 444			
MCW-C-ST53	SOL	654 496	6 212 296	50	10:22	13
	EOL	654 508	6 212 233			

Geodetic Parameters: ETRS89, UTM Zone 29N						
Transect		Easting (m)	Northing (m)	Depth (m LAT)	Video Footage (mm:ss)	Number of Stills
MCW-C-ST54	SOL	657 295	6 212 408	52	09:26	13
	EOL	657 296	6 212 350			
MCW-C-ST62	SOL	651 793	6 209 617	50	12:53	15
	EOL	651 816	6 209 561			
MCW-C-ST63	SOL	654 466	6 209 648	50	10:08	12
	EOL	654 523	6 209 641			
MCW-C-ST70	SOL	649 491	6 206 785	52	10:32	12
	EOL	649 542	6 206 757			
MCW-C-ST71	SOL	651 618	6 207 255	52	11:24	13
	EOL	651 599	6 207 193			
MCW-C-ST75	SOL	638 731	6 204 211	55	09:05	13
	EOL	638 707	6 204 263			
MCW-C-ST77	SOL	644 161	6 204 242	65	08:58	14
	EOL	644 126	6 204 199			
MCW-C-ST79	SOL	649 122	6 204 506	53	09:21	13
	EOL	649 108	6 204 449			
MCW-C-ST83	SOL	638 746	6 201 692	48	09:27	19
	EOL	638 781	6 201 642			
CW-C-ST91	SOL	638 657	6 199 013	49	12:06	17
	EOL	638 700	6 198 962			
MCW-C-ST92	SOL	641 227	6 199 154	55	08:49	11
	EOL	641 259	6 199 198			
MCW-D-ST64	SOL	656 999	6 209 829	55	17:49	22
	EOL	656 971	6 209 724			
MCW-D-ST72A	SOL	654 859	6 206 718	56	18:56	12
	EOL	654 837	6 206 665			
MCW-D-ST73	SOL	657 310	6 206 853	59	21:23	39
	EOL	657 437	6 206 822			
MCW-D-ST80	SOL	651 952	6 204 318	55	19:06	14
	EOL	651 997	6 204 285			
MCW-D-ST81	SOL	654 425	6 204 405	59	18:53	10
	EOL	654 401	6 204 296			
MCW-D-ST82	SOL	656 830	6 204 546	57	09:42	34
	EOL	657 024	6 204 537			
MCW-D-ST86A	SOL	647 291	6 201 713	53	19:28	10
	EOL	647 381	6 201 646			
MCW-D-ST88A	SOL	651 487	6 201 953	58	18:50	12
	EOL	651 595	6 201 935			
MCW-D-ST89A	SOL	654 049	6 202 156	58	18:17	8
	EOL	654 137	6 202 095			
MCW-D-ST95A	SOL	649 710	6 198 504	52	18:03	17
	EOL	649 710	6 198 396			
MCW-D-ST100A	SOL	645 937	6 197 290	59	20:28	10
	EOL	645 908	6 197 174			
MCW-D-ST101	SOL	649 523	6 196 387	58	17:18	18
	EOL	649 629	6 196 368			
MCW-D-ST103A	SOL	641 624	6 193 697	62	20:20	8
	EOL	641 706	6 193 617			
MCW-D-ST104	SOL	643 705	6 193 487	60	19:06	13
	EOL	643 770	6 193 393			
MCW-D-ST108A	SOL	646 196	6 191 655	49	17:18	21
	EOL	646 252	6 191 564			

Notes
LAT = Lowest Astronomical Tide
SOL = Start of Line; EOL = End of Line
Station names with the suffix 'A' were moved from original client defined positions

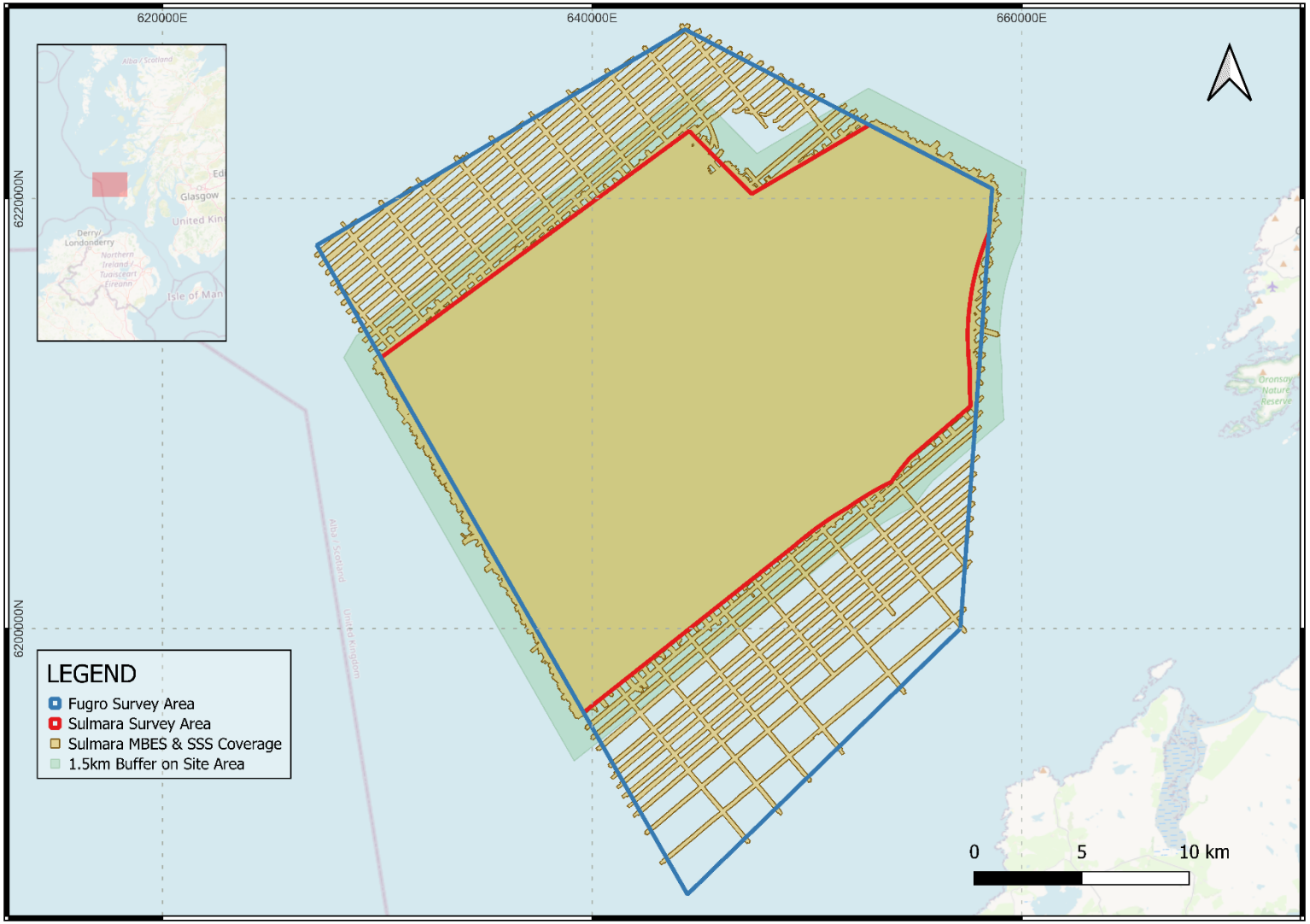


Figure 2.1: MachairWind OWF Coverage Area (Source: Sulmara, 2025)

3 Results & Interpretation

3.1 Geophysical Characterisation

The following text utilises the geophysical report from Sulmara (2025) (Doc Ref: MCW-SCH-GEO-REP-SMS-R002). Sulmara have acquired Innomar SBP, MBES and 2D-UHR data at the site, which has been integrated with Fugro's 2023 datasets to deliver a comprehensive understanding of seafloor geology and its spatial variability across the Machair OWF area (Figure 3.1 and Figure 3.2).

3.1.1 Shallow Geology

The Machair OWF site is located in the Inner Hebrides, off the west coast of mainland Scotland. The shallow geology of the survey area comprises Holocene and Pleistocene sediments overlying pre-Quaternary bedrock, which locally outcrops at the seafloor. Quaternary deposits were laid down under alternating glacial and interglacial conditions, influenced by associated sea-level changes. Pre-Quaternary (Caledonian) faults, trending southwest to northeast, are thought to have controlled the development of Quaternary depocentres and acted as primary flow pathways for ice streams from the mainland (Davies *et al.,* 1987; Callard *et al.,* 2018).

3.1.2 Bathymetry

Across the site, the average seabed gradient is very gentle (<1°), although localised steep slopes are present. Water depths range from a minimum of 21m LAT, recorded at the bedrock outcrops supporting the Dubh Artach lighthouse in the north of the survey area, to a maximum of 119m LAT within a large scour feature immediately east of these outcrops. The steepest measured slope, 86°, is also associated with bedrock exposures in the northeast (Figure 3.1).

The northern part of the site is dominated by the prominent bathymetric high formed by the Dubh Artach outcrops. Extensive scour depressions occur to the north and east of these features, where the deepest water depths are observed. Scattered smaller outcrops are also present across the north and east. To the west of the lighthouse, the central and western sectors of the survey area are marked by widespread sand dune fields, the eastern edge of which is bounded by an elongated depression aligned north-northeast to south-southwest. South of this dune field lies a bathymetric high, thought to represent an exposure of glacial till and reworked sediments.

Smaller sand waves and dune features are observed along the flanks of this high and at the margins of the central depression, extending into the southern and southeastern portions of the site. Additional bathymetric highs, composed of glacial till, reworked sediment, and further isolated bedrock exposures, occur in these southern areas. In contrast, the seabed east of the central depression is more subdued, with a gradual slope shallowing towards the east and northeast, transitioning into generally flat terrain interspersed with occasional bedrock outcrops.

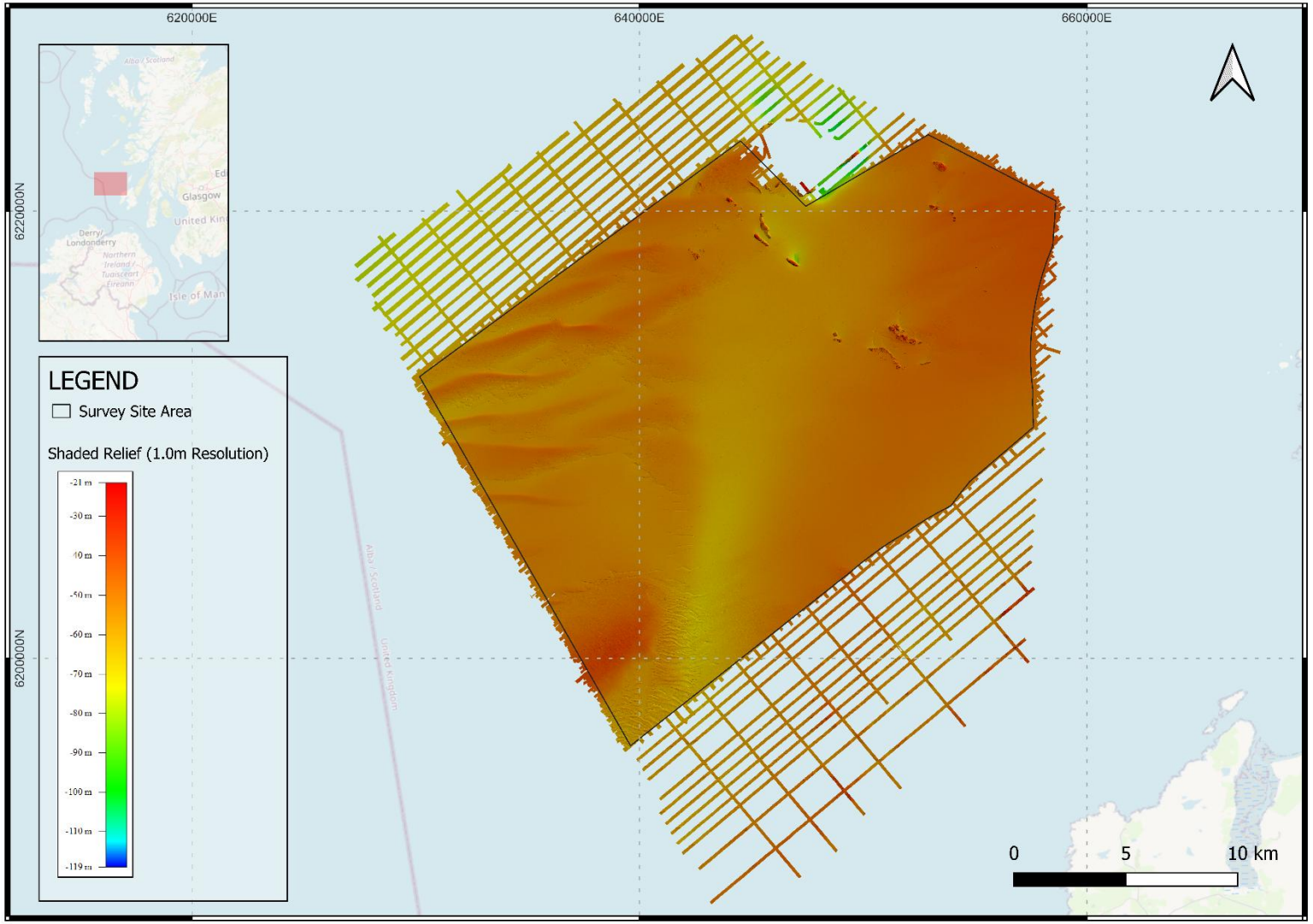


Figure 3.1: MachairWind OWF Bathymetry Overview (Source: Sulmara, 2025)

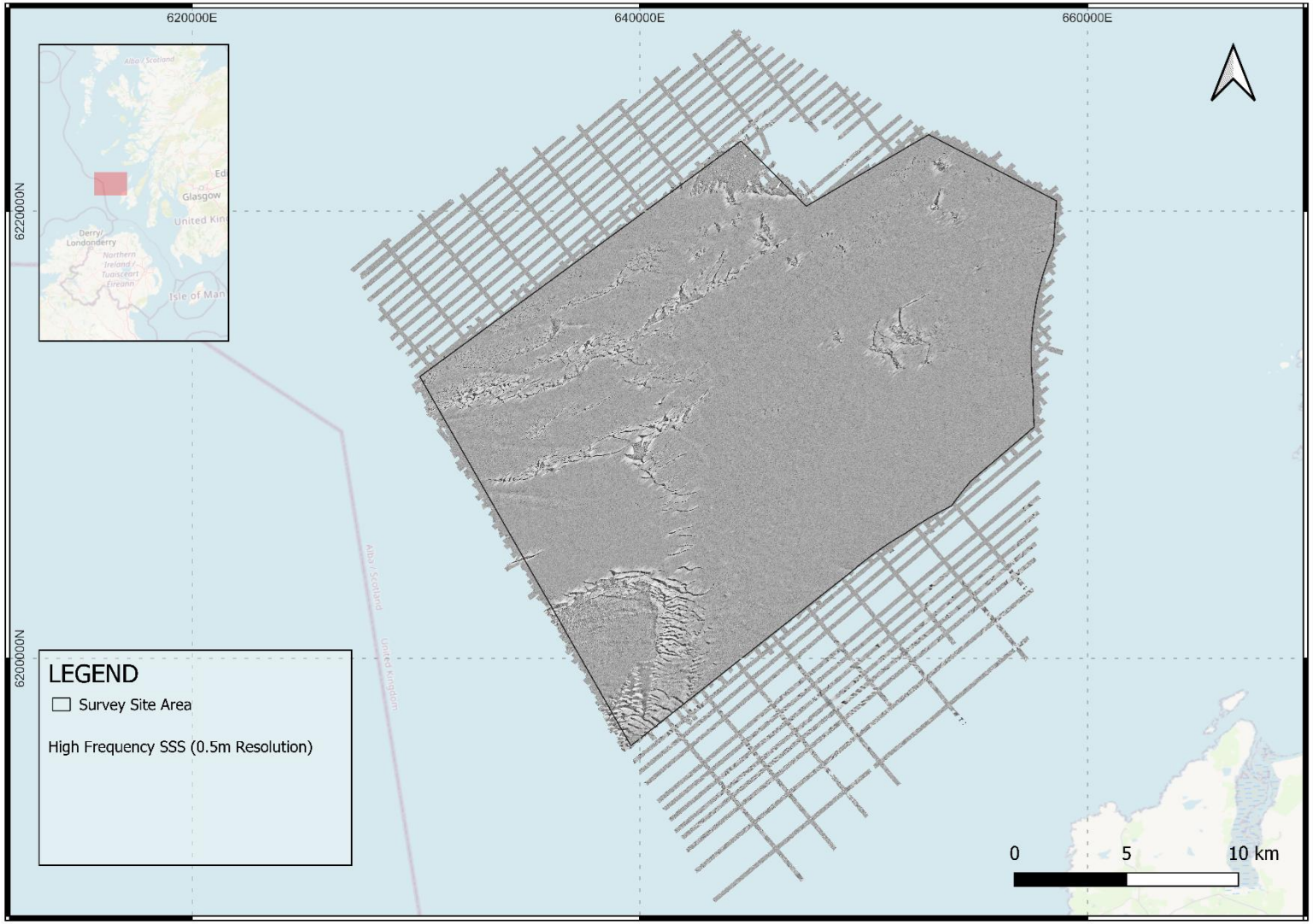


Figure 3.2: MachairWind OWF SSS Mosaic Overview (Source: Sulmara, 2025)

3.1.3 Sediments

Large areas of high reflectivity were observed in the north and south, with 'ribbons' scattered across the 2025 survey area. Low reflectivity represented the baseline signature, while areas of mottled reflectivity in the north and northeast were identified against this baseline.

The seabed is predominantly composed of sand with shell fragments, forming the prevailing surface sediment across most of the site. Coarser deposits, ranging from gravelly sands to cobbles and boulders, occurred within localised depressions and on several bathymetric highs, particularly in the northern, southwestern, and southern sectors, where boulders are notably abundant (Table 3.1 and Figure 3.4). These sediment types were subsequently used to classify habitat types in accordance with JNCC guidance (Section 3.2).

A prominent feature in the southern portion of the current survey area displayed an elevation change of approximately 20-25m, with a coarse sediment signature atop the plateau. This raised area of seabed was surrounded by coarse sediment in ribbon bedforms, which are also present across other parts of the survey area and classified as 'Coarse to gravelly sand, including gravels, cobbles and boulders.

Outcrops appeared as localised seabed highs of bedrock or glacially derived sediments. Bedrock outcrops are observed in the north, northeast, southwest, south, and southeast, forming distinct bathymetric highs with moderate to high reflectivity and irregular, mottled surfaces. Some structural fabric was evident in the bathymetry, though acoustic data could not distinguish specific rock types across the site.

Seabed bedforms included ripples in northern and central depressions and on southern and southwestern highs, generally oriented north-northeast to south-southwest. Megaripples were widespread in the north, west, and south, often overlying dunes and sand waves, with asymmetry indicating southward or bidirectional flow.

A total of 16,219 boulders were identified across the survey area, with an average height of 0.42m but the largest reaching 5.49m. Densities were highest in the northern, southern, and southwestern parts of the site, correlating with coarse-grained substrates comprising gravelly sands, gravel, cobbles, and boulders. In contrast, the central and eastern sectors exhibited the lowest boulder concentrations, corresponding to sandy, shell-rich sediments.

A total of 612 debris contacts were interpreted from the SSS dataset, comprising 28 linear features and 584 isolated objects. The largest linear debris feature extended 353.2m and is interpreted as anthropogenic in origin, likely associated with the deployment of multiple fish traps.

A single wreck site was also detected north of the survey area, consistent with a previously recorded entry in the UK Admiralty database and is surrounded by a small debris field (Figure 3.3).

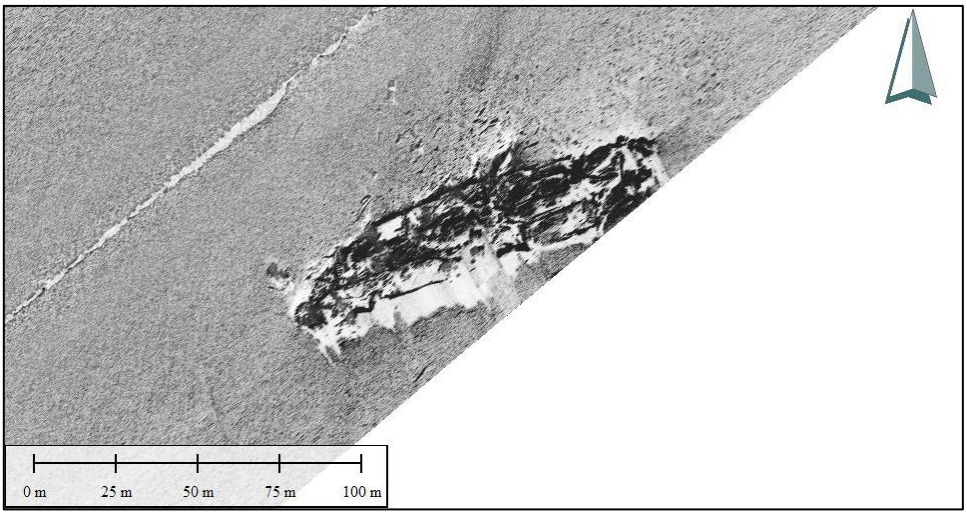
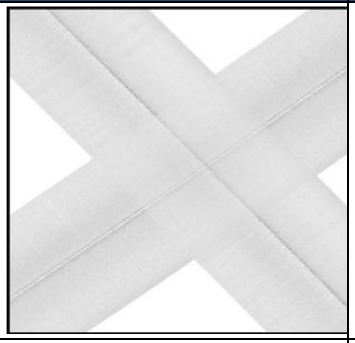
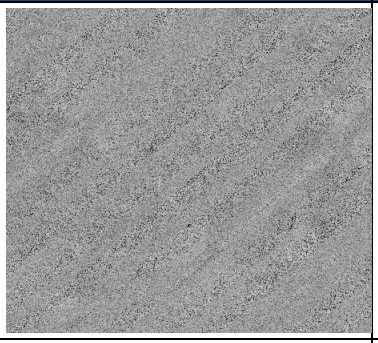
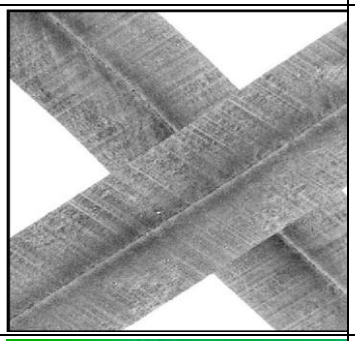
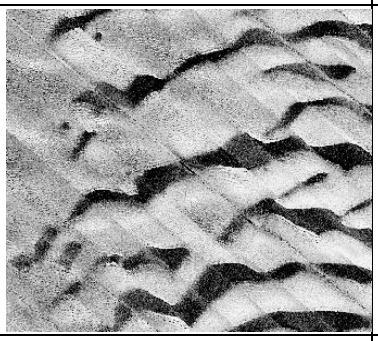
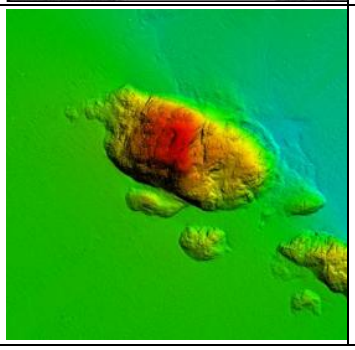


Figure 3.3: Wreck Identified within the Machair OWF (Source: Sulmara 2025)

Table 3.1: Summary of Sediment Classifications within the MachairWind OWF

Sediment Classification	SSS Signature Example Photos		Acoustic Description
	Fugro (2023)	Sulmara (2025)	
Sand with shell fragments			Low reflectivity, flat, featureless seabed.
Coarse to gravelly sand, including gravels, cobbles and boulders			High reflectivity areas of seabed, predominately in 'ribbon' formations.
Rocky Outcrop			Well-defined bathymetric highs; moderate–high reflectivity; irregular surfaces

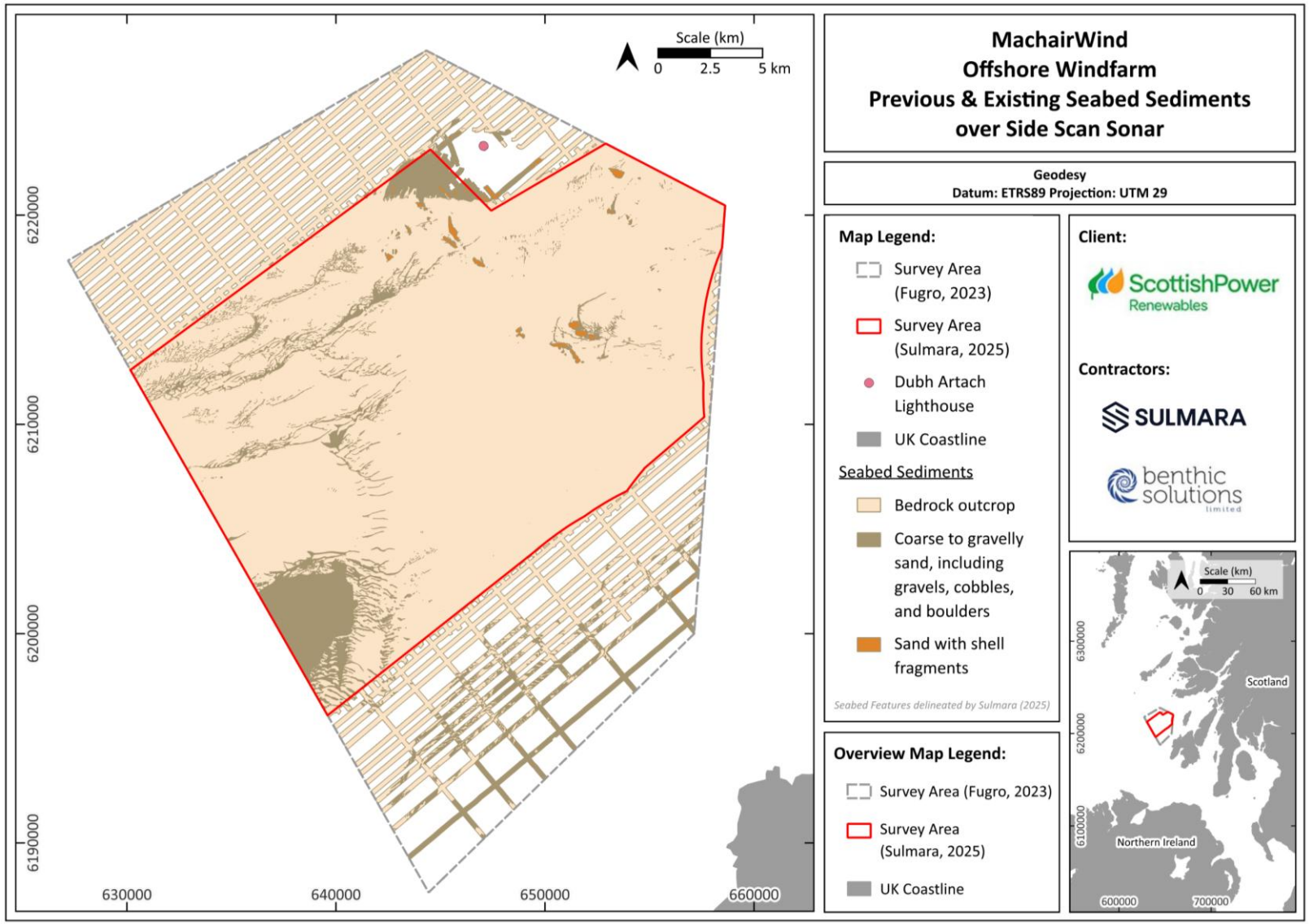


Figure 3.4: MachairWind OWF Seabed Features over SSS (Fugro, 2023 & BSL, 2025)

3.2 Habitat Characterisation

Analysis of previous and current survey data indicates that the dominant habitat across the MachairWind OWF area is the JNCC Level 4 habitat type 'Offshore circalittoral sand' (SS.SSa.OSa / MD52). This conclusion is based on SSS imagery, MBES bathymetry data, photographic evidence, macrofaunal observations, and particle size distribution (PSD) data from the Fugro (2023) and Sulmara (2025) surveys. Patches containing gravelly sand, shell fragments, pebbles, and occasional cobbles were classified as 'Offshore circalittoral coarse sediment' (SS.SCS.OCS / MC32).

Outcrops of bedrock were observed in the north, northeast, southwest, south, and southeast, forming distinct bathymetric highs with moderate to high reflectivity and irregular, mottled surfaces. These outcrops align with the broad habitat category 'Moderate energy circalittoral rock' (CR.MCR / MC12). They may also support 'Echinoderms and crustose communities' (CR.MCR.EcCr / MC122), previously identified by Fugro (2023). However, in the absence of camera-based ground-truthing, this cannot be confirmed for areas delineated as rocky outcrops.

These sediment characteristics are consistent with the interpretation of geophysical seafloor features, which indicated that the dominant sediments comprised sand with variable gravel and clay content, accompanied by numerous cobbles and boulders. Table 3.2 presents the classification hierarchy for the habitats observed within the survey area, with habitats illustrated in Figure 3.8.

Table 3.2: Summarised Habitat Classification

Sediment Type	JNCC (2022) Classification	EUNIS (2022) Classification
Sand with shell fragments	SS.SSa.OSa Offshore Circalittoral Sand	MD52 Atlantic Offshore Circalittoral Sand
Coarse to gravelly sand	SS.SCS.OCS Offshore Circalittoral Coarse Sediment	MD32 Atlantic Offshore Circalittoral Coarse Sediment
Rocky Outcrop	CR. MCR Moderate Energy Circalittoral Rock CR.MCR.EcCr Echinoderms and Crustose Communities	MC12 Atlantic Circalittoral Rock MC122 Echinoderms and Crustose Communities on Atlantic Circalittoral Rock

3.2.1 Offshore Circalittoral Sand (SS.SSa.OSa / MD52)

Most of the survey area was characterised by rippled sand with varying amounts of shell material and classified as the JNCC Level 4 biotope complex 'Offshore circalittoral sand' (SS.SSa.OSa). This habitat type corresponded to areas of low reflectivity in the SSS data, which was the predominant signature observed during the current geophysical survey campaign (Sulmara, 2025). Water depths across this habitat ranged from 44m to 106m below LAT.

Camera ground-truthing from the previous Fugro (2023) survey identified a range of epibenthic taxa. The most frequently observed species included starfish (*Asterias rubens, Luidia sarsii, Luidia ciliaris* and *Astropecten irregularis*), hermit crabs (Paguroidea), crabs (*Cancer pagurus* and *Liocarcinus* sp.), shrimp (Caridea), cephalopods (Cephalopoda including Loliginidae and *Sepiola* sp.), and rays (Rajiformes including *Raja clavata*). Fish species observed included dragonets (*Callionymus* sp.),

mackerel (*Scomber scombrus*), Atlantic herring (*Clupea harengus*), whiting (*Merlangius merlangus*), thickback sole (*Microchirus variegatus*), solenette (*Buglossidium luteum*), plaice (Pl*euronectes platessa*), and dab (*Limanda limanda*).

Example imagery is provided in Figure 3.5, and the spatial extent of the 'Offshore circalittoral sand' habitat is mapped in Figure 3.8.

MCW-D-ST73-02 Fugro, 2023	MCW-D-ST-82-24 Fugro, 2023

Figure 3.5: Example Images of 'Offshore Circalittoral Sand' Habitat

3.2.2 Offshore Circalittoral Coarse Sediment (SS.SCS.OCS / MD32)

Patches of mottled, higher-reflectivity signatures in the SSS data were interpreted as coarse sand and gravelly sand with shell fragments, grading in places to cobbles and boulders interspersed with slightly gravelly sand and shell debris. Coarser deposits occurred within localised depressions and on several bathymetric highs, particularly in the northern, southwestern, and southern sectors, where boulders are notably abundant. This habitat was recorded in water depths ranging between 49m and 60m below LAT.

Camera ground-truthing from the previous Fugro (2023) survey identified a range of epibenthic taxa. The most frequently observed epibiota included brittlestars (Ophiuroidea), sea urchins (*Echinus esculent*us), starfish (Asteroidea, including *Henricia* sp., *Crossaster papposus, Marthasterias glacialis*), squat lobsters (*Munida* sp.), crabs (*Necora puber, Atelecyclus rotundatus*), soft corals (*Alcyonium digitatum*), cup corals (Caryophylliidae), barnacles (*Sessilia*), serpulid worms (Serpulidae), and faunal turf (Hydrozoa/Bryozoa). Fish recorded included dragonets (*Callionymus* sp.), flatfish (Pleuronectiformes), mackerel (*Scomber scombrus*), and unidentified species.

Example imagery is provided in Figure 3.6, and the spatial extent of the 'Offshore circalittoral coarse sediment' habitat is mapped in Figure 3.5.

MCW-C-ST91_07
Fugro, 2023

MCW-A-ST08A_08
Fugro, 2023

Figure 3.6: Example Images of 'Circalittoral Coarse Sediment'

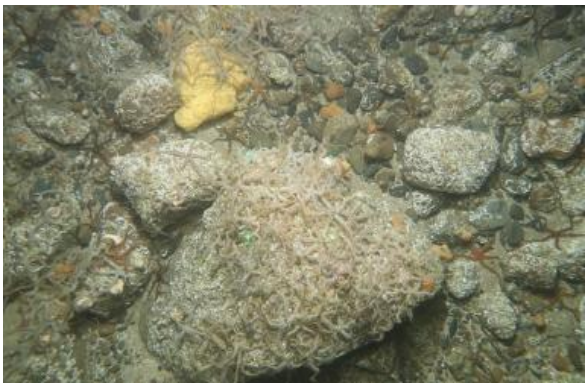
3.2.3 Moderate Energy Circalittoral Rock (CR.MCR/MC12)

Review of the current analogue dataset (Sulmara, 2025) identified bedrock outcrops in the north, northeast, southwest, south, and southeast, forming distinct bathymetric highs with moderate to high reflectivity and irregular, mottled surfaces. In the absence of camera ground-truthing, these features have been provisionally assigned to the broader habitat category 'Moderate energy circalittoral rock' (CR.MCR / MC12), although they are also likely to support 'Echinoderms and crustose communities' (CR.MCR.EcCr / MC122).

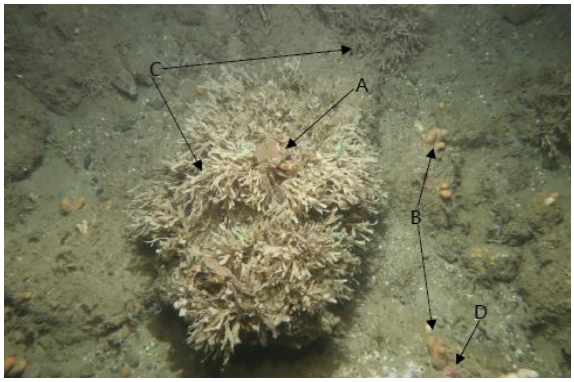
In the previous Fugro (2023) survey, the JNCC Level 5 biotope '*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment' (SS.SMx.CMx.OphMx) was considered due to the high observed densities of brittlestars (*Ophiothrix fragilis*). However, PSD analysis from these stations indicated that sediments comprised slightly gravelly sand with no fines, suggesting that a mixed sediment habitat type is unlikely.

Camera ground-truthing from Fugro (2023) identified a diverse assemblage of epibenthic taxa. The most frequently observed included brittlestars (Ophiuroidea, including *Ophiothrix fragilis*), sea urchins (*Echinus esculentus*), starfish (*Asterias rubens*), crabs (*Cancer pagurus*), soft corals (*Alcyonium digitatum*), and cup corals (Caryophylliidae). Fish species recorded included the snakeblenny (*Lumpenus lampretaeformis*).

Example imagery is provided in Figure 3.7, and the spatial extent of the 'Offshore circalittoral coarse sediment' habitat is mapped in Figure 3.5.



MCW-C-ST83
Fugro, 2023



MCW-D-ST73_34
Fugro, 2023
A: Crab (*Necora puber*); B: Soft coral (*Alcyonium digitatum*); C: Bryozoan (*Flustra foliacea*); D: Starfish (*Henricia* sp.)

Figure 3.7: Example Images of 'Echinoderms and Crustose Community' Habitat

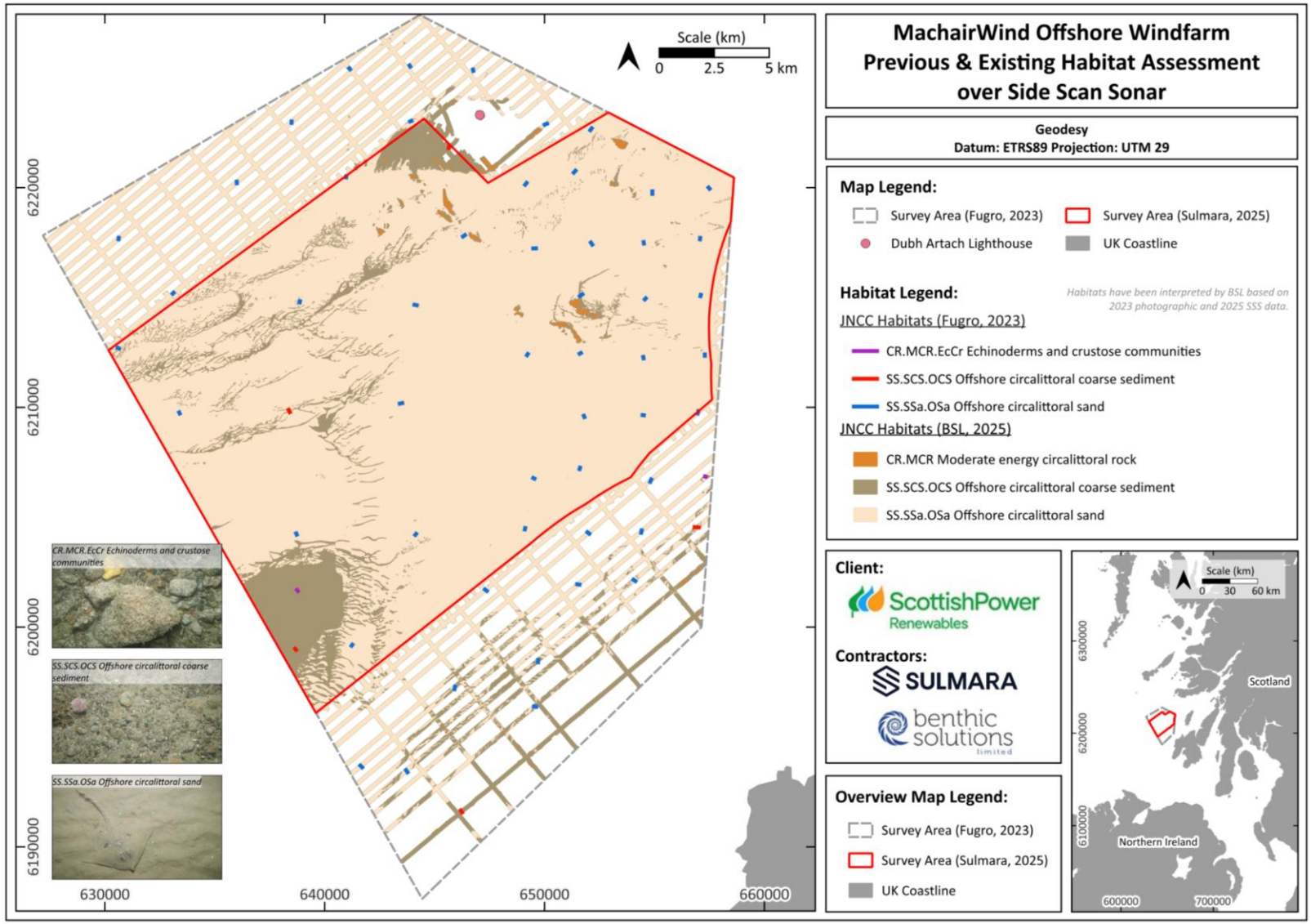


Figure 3.8: MachairWind OWF Habitat Assignments over SSS

3.3 Potential Sensitive Habitats and Species

3.3.1 Subtidal Sands and Gravels

The subtidal sands and gravel habitat is a priority habitat under the UK BAP and occurs in a wide variety of marine environments where sediments like sand, gravel and cobblestone accumulate. The habitat is home to a variety of species including polychaetes, crustaceans and fish which rely on the habitat for breeding, feeding and shelter. Offshore examples of these habitats are considered more diverse due to the reduction in natural disturbance and are characterised by a range of anemones, polychaetes, bivalves, amphipods as well as mobile and sessile epifauna. These areas support internationally important fish and shellfish fisheries and provide important ecosystem services by improving water quality and acting as a carbon sink (OSPAR, 2010).

Areas assigned as 'Offshore circalittoral sand' (SS.SSa.OSa) and 'Offshore circalittoral coarse sediment' (SS.SCS.OCS) were present within the survey area, and therefore the UKBF priority habitat and MCZ FOCI 'Subtidal sands and gravels' may be present.

Epifauna observed during the previous survey (Fugro, 2023) on sand within the survey area, included starfish (Asteroidea including *Asterias rubens*), hermit crabs (Paguroidea). crabs (Brachyura including *Cancer pagurus, Necora puber, Liocarcinus* sp.) and fish including flatfish, gurnards and dragonets (Osteichthyes including Pleuronectiformes, Triglidae and *Callionymus* sp.), all of which are characteristic of this priority habitat.

3.3.2 Annex I Geogenic Reefs

In the previous survey conducted by Fugro (2023), areas of cobbles and boulders along three transects (MCW-A-ST08A, MCW-D-ST73, and MCW-D-ST82) were assessed for potential resemblance to Annex I Stony Reef. Along transects MCW-D-ST73 and MCW-D-ST82, cobble and boulder cover ranged from medium (40–95%), with elevations also classified as medium (64mm to 5m) (Table 3.3). Observed patches of medium reef were generally <25m²; however, Annex I stony reef criteria require a minimum extent of >25m².

Several additional areas displayed medium elevation (64mm to 5m), though with low cobble and boulder cover (10–40%). Notably, one patch on transect MCW-D-ST73 (45m²) and one on transect MCW-D-ST82 (27m²) exceeded the 25m² threshold and were therefore classified as 'low reef'. When delineated, these extended into areas of 5,568m² (MCW-D-ST82) and 20,804m² (MCW-D-ST73), confirming the presence of low reef.

Across transects, numerous large boulders, cobbles, and pebbles were observed within sections classified as medium reef, interspersed with mixed sediments and low reef areas. Epifaunal communities typical of stony reefs ranged from rare (e.g., *Alcyonium digitatum* and Pectinidae) to abundant (Ophiuroidea, including *Ophiothrix fragilis*). Table 3.3 summarises the proportions of each reefiness classification reported by Fugro (2023).

A review of the more recent geophysical survey data (Sulamra, 2025) identified bedrock outcrops in the north, northeast, southwest, south, and southeast, forming distinct bathymetric highs with

moderate to high reflectivity and irregular, mottled surfaces. These features could represent potential Annex I geogenic reef (stony or rocky reef). Camera-based ground-truthing is recommended to determine reefiness in line with JNCC guidance (Irvin, 2009 and Golding *et al.,* 2020).

The presence of areas showing potential Annex I geogenic reef features is presented in Figure 3.9.

Table 3.3: Summary of 'Reefiness' Classification from Fugro (2023)

Geodetics: ETRS89, UTM Zone 29N									
Transect	**SOL Easting**	**SOL Northing**	**EOL Easting**	**EOL Northing**	**% Cover cobbles and boulders**	**Elevation**	**Area Observed [m²}**	**Biota**	**Overall Assessment**
MCW-A-ST08A	645 660	6 221 868	645 654	6 221 841	< 10	Flat seafloor	33	<80	Not a Reef
	645 654	6 221 841	645 647	6 221 804	< 10	Flat seafloor	45	<80	Not a Reef
MCW-D-ST73	657 310	6 206 853	657 324	6 206 850	< 10	Flat seafloor	18	<80	Not a Reef
	657 324	6 206 850	657 326	6 206 850	10 – 40	< 64	3	<80	Low reef
	657 326	6 206 850	657 328	6 206 849	10 – 40	64 - 5	2	<80	Low reef
	657 328	6 206 849	657 331	6 206 848	10 – 40	< 64	4	<80	Low reef
	657 331	6 206 848	657 335	6 206 847	10 – 40	64 - 5	5	<80	Low reef
	657 335	6 206 847	657 339	6 206 845	40 – 95	64 - 5	5	<80	Medium reef
	657 339	6 206 845	657 374	6 206 838	10 – 40	64 - 5	43	<80	Low reef
	657 374	6 206 838	657 376	6 206 838	40 – 95	64 - 5	2	<80	Medium reef
	657 376	6 206 838	657 386	6 206 835	10 – 40	64 - 5	13	<80	Low reef
	657 386	6 206 835	657 390	6 206 834	10 – 40	< 64	5	<80	Low reef
	657 390	6 206 834	657 399	6 206 831	10 – 40	64 - 5	12	<80	Low reef
	657 399	6 206 831	657 401	6 206 831	40 – 95	64 - 5	2	<80	Medium reef
	657 401	6 206 831	657 416	6 206 827	10 – 40	64 - 5	19	<80	Low reef
	657 416	6 206 827	657 422	6 206 826	40 – 95	64 - 5	7	<80	Medium reef
	657 422	6 206 826	657 436	6 206 822	10 – 40	64 - 5	18	<80	Low reef
MCW-D-ST82	656 830	6 204 546	656 834	6 204 545	10 – 40	64 - 5	6	<80	Low reef
	656 834	6 204 545	656 838	6 204 545	40 – 95	64 - 5	4	<80	Medium reef
	656 838	6 204 543	656 860	6 204 543	10 – 40	64 - 5	27	<80	Low reef
	656 860	6 204 543	657 023	6 204 537	< 10	Flat seafloor	197	<80	Not a Reef
Key:									
Not a Reef			**Low Reef**		**Medium Reef**			**High Reef**	

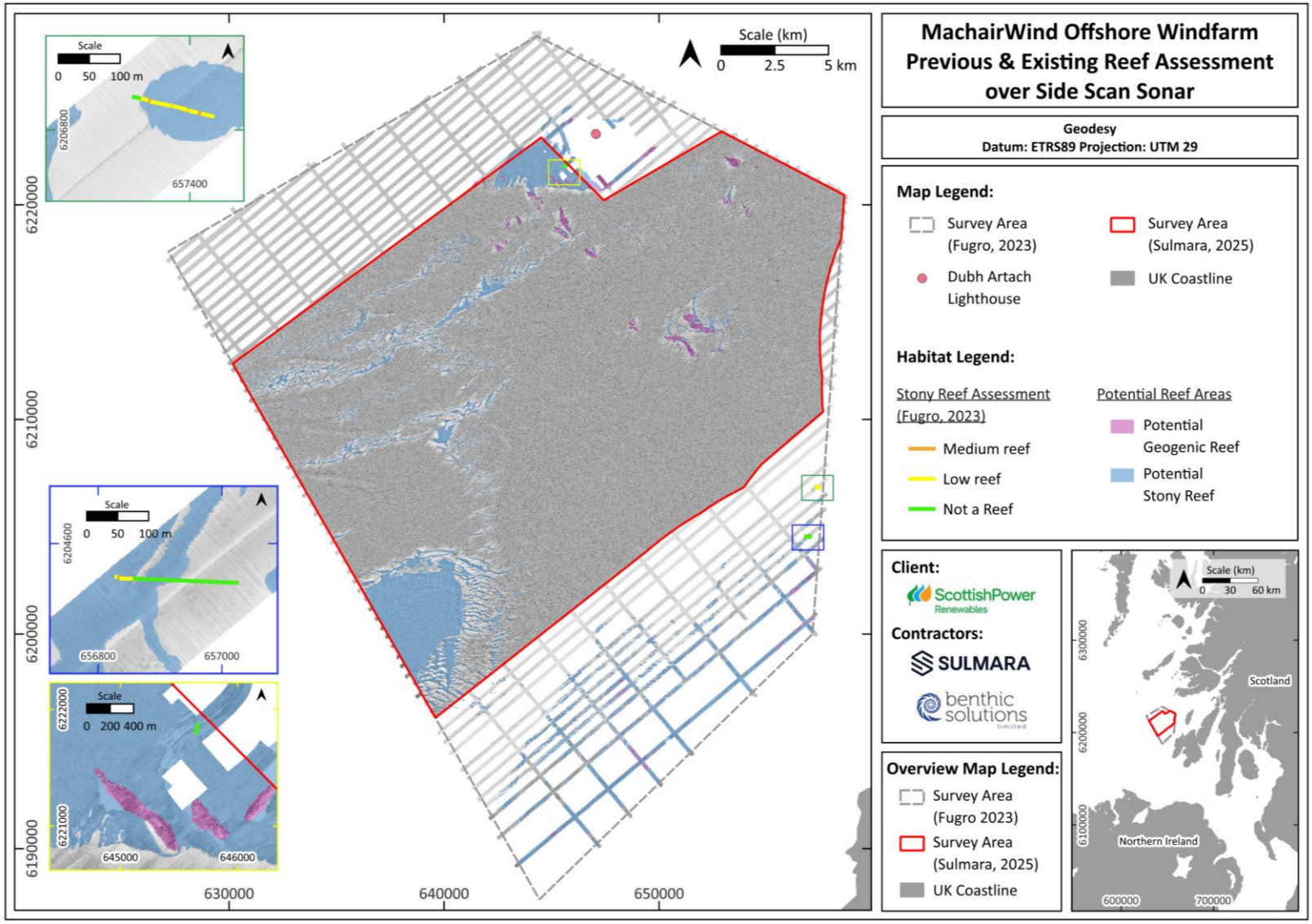


Figure 3.9: MachairWind OWF Geogenic Reef Assessment over SSS (Fugro, 2023 & BSL, 2025)

3.3.3 Sensitive Species

Sensitive species were identified during video analysis conducted in the previous survey by Fugro (2023), with results summarised below.

3.3.3.1 Pelagic and Demersal Fish

Gadidae individuals were observed at four transects, suggesting the presence of Atlantic cod (*Gadus morhua*), a UK Biodiversity Framework (UKBF) and Priority Marine Feature (PMF) species, also listed by OSPAR as threatened in Regions II and III, which includes the survey area.

Two Rajidae individuals were recorded at transects MCW-A-ST02 and MCW-D-ST88A, with the former confirmed as *Raja clavata*. These observations indicate the potential presence *of R. clavata, R. undulata,* and *R. montagui*, with *R. undulata* listed as a UKBF priority species and the other two included on the OSPAR threatened species list.

Additional UKBF and PMF species observed included mackerel (*Scomber scombrus*) at nine transects, Atlantic herring (*Clupea harengus*) at four, European plaice (*Pleuronectes platessa*) at four, and whiting (*Merlangius merlangus*) at two.

Sandeels (Ammodytidae), including the UKBF priority species *Ammodytes marinus*, were observed at four transects, though species-level identification was not possible from video alone. However, *A. marinus* was confirmed through macrofaunal analysis at transects MCW-C-ST42 and MCW-D-ST101.

3.3.3.2 Arctica islandica (Ocean Quahog)

The ocean quahog (*Arctica islandica*) is protected under the OSPAR Commission, listed as a threatened and/or declining species in the Greater North Sea (OSPAR, 2009), and is also recognised as a Scottish Priority Marine Feature (PMF) (Tyler-Walters *et al.,* 2016). This slow-growing bivalve is particularly vulnerable to bottom fishing gear, and its populations recover slowly once depleted. It typically inhabits offshore sand and muddy sand substrates, burying itself vertically within the top few centimetres of sediment, with siphons occasionally visible at the surface.

During the previous survey (Fugro, 2023), seafloor photography and macrofaunal data were analysed to assess the potential presence of *A. islandica*. Live siphons were observed at transects MCW-A-ST05 and MCW-C-ST79, while empty shells were recorded at 17 transects. Based on SACFOR abundance categories (3–15 cm adult size), *A. islandica* was classified as ‘occasional’ at four transects and ‘rare’ at MCW-B-ST10. However, due to the species’ tendency to retract siphons for extended periods, photographic estimates alone may be unreliable. In addition, both adult and juvenile *A. islandica* were identified in grab samples (Fugro, 2023), and the species was observed at 18 transects during video analysis.

4 Conclusion

Geophysical and environmental surveys for the MachairWind OWF were first undertaken by Fugro in 2023, covering a larger survey area with full ground-truthing, and later supplemented by a geophysical survey conducted by Sulmara Subsea Ltd, supported by Benthic Solutions Ltd, between April and July 2025 aboard the *Mainport Edge*. The 2025 operations included multibeam echosounder, side-scan sonar, sub-bottom profiling, magnetometry, and high-resolution seismic acquisition, though the planned programme of up to 20 drop-down video stations was cancelled due to persistent adverse weather. Combined, the 2023 and 2025 datasets provide complementary evidence for the characterisation of marine habitats, and the identification of potential Annex I features within the MachairWind OWF site.

Seabed mapping confirmed that the dominant habitat type across the MachairWind OWF is 'Offshore circalittoral sand' (SS.SSa.OSa / MD52). Coarser deposits, ranging from gravelly sands to cobbles and boulders, which were assigned as 'Offshore circalittoral coarse sediment' (SS.SCS.OCS / MC32) occurred in the northern, southwestern, and southern sectors. Bedrock outcrops in the north, northeast, southwest, south, and southeast were classified as 'Moderate energy circalittoral rock' (CR.MCR / MC12) and could potentially support Annex I geogenic reef communities.

Evidence of Annex I stony reef was reported in 2023, with patches exceeding the 25m² threshold at two transects. These areas, when delineated, extended into much larger low-reef features (up to 20,804m²). Epifaunal assemblages associated with stony reef ranged from sparse to abundant, including *Alcyonium digitatum*, Pectinidae, and *Ophiothrix fragilis*. While the 2025 data supported the presence of reef-like features, the absence of direct camera validation means that further ground-truthing is recommended to confirm reefiness in line with JNCC guidance.

The Fugro (2023) survey also confirmed the presence of several species of conservation importance. Gadidae, likely Atlantic cod (*Gadus morhua*), were observed at multiple transects, while *Raja* species, including *Raja clavata*, were recorded at two transects. Additional UKBF and PMF species included sandeels (*Ammodytes marinus* confirmed), mackerel, herring, plaice, and whiting. Populations of *Arctica islandica* were also recorded, though photographic evidence alone was considered insufficient to reliably assess abundance.

In conclusion, the MachairWind OWF survey area is dominated by sandy and coarse sediment habitats with localised gravel, cobble, and bedrock features. These environments support priority habitats such as 'subtidal sands and gravels', as well as several UKBF and OSPAR-listed species. Potential Annex I reef features have been identified, but further camera-based ground-truthing will be required to confirm their status.

5 References

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Appendix I – Service Warranty

This report, with its associated works and services, has been designed solely to meet the requirements of the contract agreed with you, our client. If used in other circumstances, some or all the results may not be valid, and we can accept no liability for such use. Such circumstances include different or changed objectives, use by third parties, or changes to, for example, site conditions or legislation occurring after completion of the work. In case of doubt, please consult Benthic Solutions Limited. Please note that all charts, where applicable should not be used for navigational purposes.