Cenos Offshore Windfarm Limited

Cenos EIA

Appendix 9 – Habitat Assessment Report - EICC

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Environmental Habitat Assessment Report ECC

Cenos OWF Array and Export Cable Corridor Geophysical Survey

In accordance with ISO14001:2015, ISO9001:2015 and ISO45001:2018

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Habitat Assessment Report ECC

Cenos OWF Array and Export Cable Corridor Geophysical Survey

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Commercial Security

Flotation Energy

CENOS Export Cable Corridor (ECC)

Habitat Assessment Report

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Abbreviations			
BDC	Biodiversity Committee	MOD4	BSL Camera System
BSL	Benthic Solutions Limited	MW	Megawatt
CAM	Camera	NB	Niskin Bottle
CBD	Convention on Biological Diversity	NMBAQC	National Marine Biology Analytical Quality Control Scheme
CTD	Conductivity Temperature and Depth	NMCAG	National Marine Chemistry Advisory Group
CNS	Central North Sea	NMCAQC	National Marine Chemical Analytical Quality Control Scheme
DDV	Drop-down Video	NMEAQC	National Marine Ecotoxicological Analytical Quality Control Scheme
DVV	Dual Van Veen	NMMP	UK National Marine Monitoring Programme
EBS	Environmental Baseline Survey	OSPAR	Oslo-Paris Commission
EC	European Council	OWF	Offshore Wind Farm
ECC	Export Cable Corridor	PAM	Passive Acoustic Monitoring
EEC	European Economic Community	PMF	Priority Marine Features
EMODnet	European Marine Observation and Data Network	PSA	Particle Size Analysis
EOL	End of Line	PSD	Particle Size Distribution
EU	European Union	RDL	Redox Discontinuity Layer
EUBS	European Union Biodiversity Strategy	SAC	Special Areas of Conservation
EUNIS	European Nature Information System	SACFOR	Superabundant, Abundant, Common, Frequent, Occasional, Rare and Less Than Rare
FOCI	Feature of Conservation Interest	SBF	Seabed Features
GW	Gigawatt	SBL	Scottish Biodiversity List
H_2S	Hydrogen Sulphide	SBP	Sub-bottom Profiler
HAS	Habitat Assessment Survey	SCI	Sites of Community Importance
HC	Hydrocarbons	SMTZ	Sulphate-Methane Transition Zone
HD	High Definition	SNH	Scottish Natural Heritage
HG	Hamon Grab	SOL	Start of Line
HM	Heavy Metals	SPA	Special Protection Areas
IMS	Industrial Methylated Spirit	SS.SMx.OMx	Offshore Circalittoral Mixed Sediment
JNCC	Joint Nature Conservation Committee	SS.SMu.OMu	Atlantic Offshore Circalittoral Mud
LAT	Lowest Astronomical Tide	SS.SSa.OSa	Offshore Circalittoral Sand

Abbreviations			
MAG	Magnetometry	SSS	Side Scan Sonar
MBES	Multi Beam Echosounder	THC	Total Hydrocarbon Content
MCZ	Marine Conservation Zone	UHR	Ultra-High Resolution
MD42	Offshore Circalittoral Mixed Sediment	UK	United Kingdom
MD421	Faunal communities Atlantic Offshore Circalittoral Mixed Sediment	UKBAP	UK Biodiversity Action Plan
MD521	Faunal Communities in Atlantic Offshore Circalittoral Sand	UKCS	United Kingdom Continental Shelf
MD62	Atlantic Offshore Circalittoral Mud	UTC	Universal Time Coordinated
MDAC	Methane-Derived Authigenic Carbonates	UTM	Universal Transverse Mercator
MMO	Marine Mammal Observer	WAS	*Wilson* Auto-siever
MNCR	Marine Nature Conservation Review		

Executive Summary

As part of plans by Flotation Energy to develop a 1.4 gigawatt (GW) floating offshore wind farm (OWF) and export cable corridor (ECC) installation in the Central North Sea (CNS), approximately 200 km off the east coast of Scotland, an environmental baseline survey (EBS) and habitat assessment survey (HAS) were undertaken by ROVCO in association with Benthic Solutions Limited (BSL). This report details the habitat investigation and environmental survey operations conducted at the CENOS ECC survey area aboard the *Glomar Supporter* between the 20th July to 22nd September 2023; the results detailing the proposed OWF are reported separately.

Environmental samples were collected from 20 sites across the ECC using either a double Van Veen grab (DVV) or mini-Hamon grab (HG). Six of these sampling locations were also selected for water sampling at bottom, middle and surface depths with corresponding CTD profiles obtained for each. Video footage was collected at 40 sites across the ECC using BSL MOD4 camera systems in order to ground truth sampling locations, facilitate the habitat assessment and ensure robust coverage of the differing habitats identified from review of the acquired geophysical data.

The seabed along the ECC route was relatively flat, with water depths ranging from 78m to 107m below LAT. The SSS data indicated low to moderate reflectivity across most of the ECC survey area with areas of high reflectivity. Lower reflectivity seabed of characterised the ambient muddy sand/sand/sandy mud substrate and a Munsell colour of dark reddish brown (5Y 3/2 and 2.5Y 3/3). Areas of high reflectivity were typically associated with patches of shell fragments and pebbles, with a Munsell colour of dark reddish grey (5YR 4/2). Smaller isolated areas contained mixed sediment, with varying dense matrices of pebbles and shell debris.

The seabed across the proposed CENOS ECC survey area was predominantly comprised of the JNCC/EUNIS habitat classification of SS.SSa.OSa/ MD52 'Offshore Circalittoral Sand'. This biotope equates to the delineated areas of 'Holocene 01' and 'Holocene 02' interpreted SBF within the survey area. As the ECC route progressed to the east the percentage of fines increased and gradually transitioned into the seabed habitat SS.SMu.OMu/MD62 'Offshore Circalittoral Mud'. Two variants of SS.SMu.OMu were delineated along the route based on the observed features, seabed texture and reflectivity within the SSS data. 'Offshore Circalittoral Mud Sediment' (SS.SMu.OMu/MD62) was typically assigned to areas delineated as 'Holocene 01'and 'Holocene 03' in the seabed features, with the appearance of shell fragments. While 'Offshore Circalittoral Mud Sediment with frequent patches of shelly mud' (SS.SMu.OMu/MD62) was assigned to areas that showed more visible aggregations of shell fragments, demonstrating an outcropping of the underlying Fitzroy and Whitehorn formations. Smaller areas conforming to the JNCC/EUNIS classification of 'Offshore Circalittoral Mixed Sediment' (SS.SMx.OMx/MD42) were identified along the route and were typically characterised by a poorly sorted mosaic of shell fragments and pebbles overlaying the predominant muddy substrate.

The high-definition video analysis revealed small aggregations of *Sabellaria spinulosa* along five transects exclusively in the western extent of the ECC. There were 15 areas delineated as 'Low Reef' with the remaining delineated as 'Not a Reef' The aerial extent of 'Low Reef' were significantly below the 'Medium' extent threshold of 10,000m^2, indicating the isolated patches present do not constitute Annex I reef habitat.

No live adult (shell diameter >5cm) specimens of *Arctica islandica* (ocean quahog) were observed during field operations, nor was there any evidence of their distinct siphons following review of the acquired video and photographic stills. Insights into the presence of juvenile specimens (shell diameter <5 cm) will be reviewed in the subsequent environmental baseline report once the macrofauna data becomes available.

Areas of 'Circalittoral Mixed Sediment' identified within the survey area could be considered to represent the UKBAP and Scottish PMF 'Subtidal Sands and Gravel' habitat. In addition, there was no evidence from ground-truthing data to suggest that the EC Habitats Directive Annex I habitat 'Submarine structures caused by leaking gases' occurs within the survey area.

1 Introduction

1.1 Project Information

Client:	Flotation Energy UK
Client Reference:	CEN001-ROV-01-CON-ENV-RPT-0021
Project:	CENOS Offshore Wind Farm and Export Cable Corridor EBS & HAS
Main Contractor:	ROVCO
Main Contractor Reference:	23014-SB-SU-MS-004
Sub Contractor:	Benthic Solutions Limited (BSL)
Sub Contractor Reference:	2337
Survey Areas:	UK Continental Shelf (UKCS) Quadrant 19-22, Central North Sea
Survey Type:	Environmental Baseline (EBS) and Habitat Survey (HAS)
Survey Period:	July 20th – September 22nd 2023
Survey Vessel:	*Glomar Supporter*
Survey Equipment:	Environmental: Mini-Hamon grab, dual Van Veen grab, *Wilson* auto-siever (WAS), Mare winch, 10 ft container lab, 5 L Niskin bottles, MOD4 underwater camera systems, Vanishing Point PAM hydrophone, Valeport CTD
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1.2 Project Description

At the request of Flotation Energy, an environmental baseline (EBS) and habitat assessment survey (HAS) was performed by ROVCO, supported by Benthic Solutions Limited (BSL), across the proposed CENOS OWF and ECC sites situated in the CNS. Survey operations were carried out aboard the *Glomar Supporter* between the 20th July to 22nd September 2023.

A geophysical survey was conducted across both the OWF and ECC with the spread consisting of hull-mounted multibeam echosounder (MBES), towed side scan sonar (SSS), magnetometry (MAG) and hull-mounted sub-bottom profiler (SBP).

The environmental survey was required to characterise the marine habitats across the proposed area of development and to gather information on the current physico-chemical and biological condition of the site, including the identification of any protected habitats within the survey area. Seabed sediment samples were acquired using a double Van Veen grab (DVV) or mini-Hamon grab (HG); whilst seawater samples were collected using Niskin bottles (NB) in tandem with a conductivity, temperature and depth (CTD) probe to yield corresponding seawater profiles. Seabed video footage was captured using BSL MOD4 camera system fitted with a 95 mm laser scale.

This report is focussed on the habitat investigation and environmental survey operations conducted along the proposed CENOS ECC located in UKCS Quadrants 19, 20, 21 and 22 of the CNS (Figure 1.1). The survey operations and habitat investigation relating to the OWF will be reported on separately (Doc ref: CEN001-ROV-01-CON-ENV-RPT-0020).

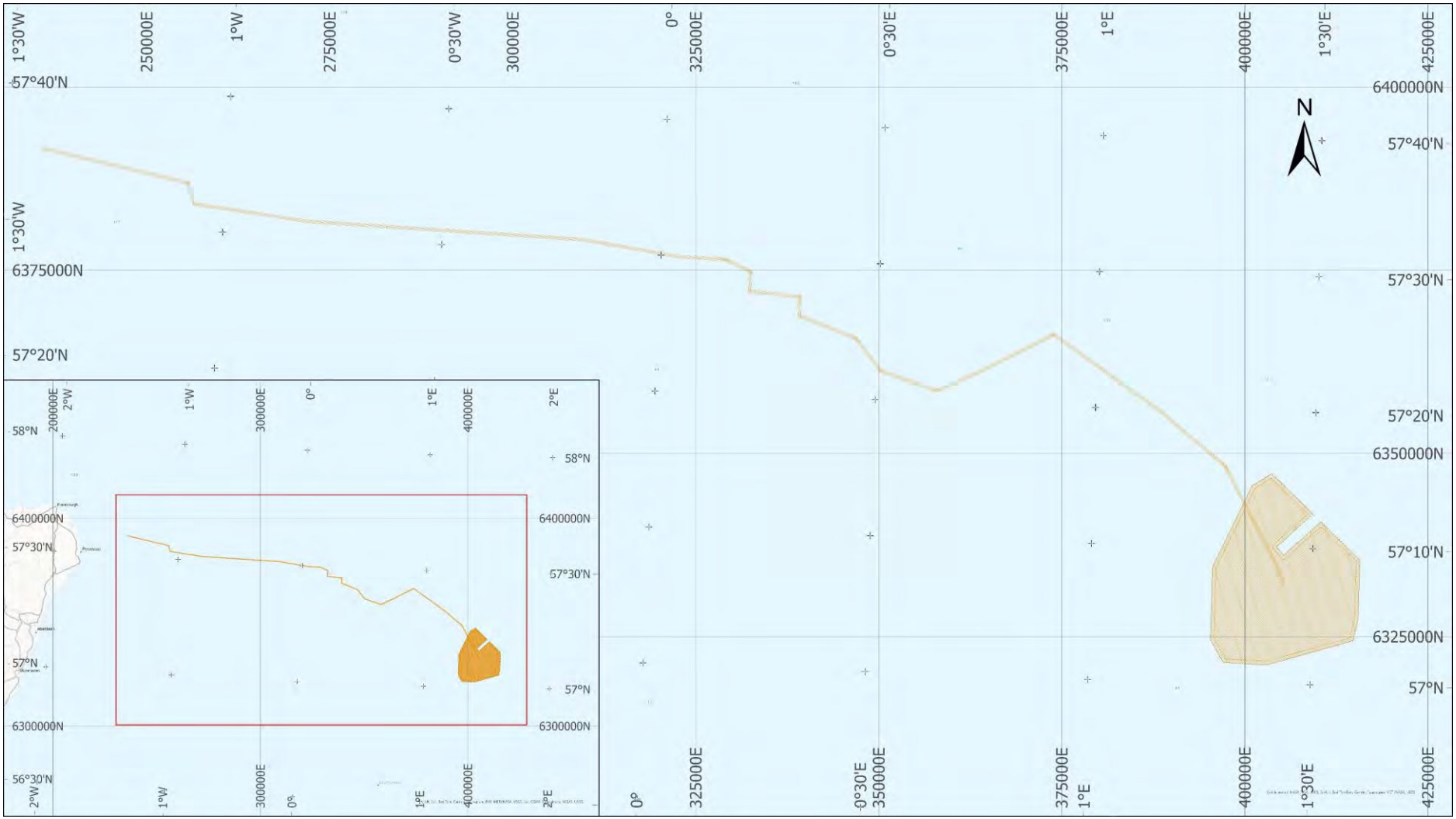


Figure 1.1 CENOS OWF and Export Cable Corridor Area Survey Overview

1.3 Scope of Work

BSL was contracted by ROVCO on behalf of Flotation Energy to conduct the environmental sampling, analysis, interpretation and reporting for the environmental baseline and habitat assessment across the CENOS OWF and ECC proposed site locations.

The survey included characterisation of the benthos and investigation of the sediment and water column physico-chemistry (PC) and sediment benthic macrofauna to provide an understanding of baseline conditions at the CENOS OWF area and along the ECC.

The specific objectives of the benthic survey were to:

- Undertake a review of the acquired geophysical data within the survey area to preliminary identify all habitats for further investigation and characterisation;
- Follow a benthic sampling plan and methodology agreed with the client; to support consenting and environmental impact assessment (EIA) requirements.
- Acquire baseline data of sediment and water PC and sediment biological characteristics across the survey area;
- Characterise the benthic environment across the sites to assign habitat types to biological level according to JNCC/EUNIS habitat classification systems;
- Identify habitats and species 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, the UK Post-2010 Biodiversity Framework (formerly the UK Biodiversity Action Plan Priority Habitat descriptions).

1.4 Reporting Structure

The following reports will be provided by BSL, relating to the environmental baseline and habitat assessment survey conducted across the proposed CENOS OWF and ECC sites:

- CEN001-ROV-01-CON-ENV-RPT-0002 (23014-SB-SU-MS-002): Environmental Field Report
- CEN001-ROV-01-CON-ENV-RPT-0020 (23014-SB-SU-MS-003): Environmental Habitat Assessment Report OWF
- **CEN001-ROV-01-CON-ENV-RPT-0021 (23014-SB-SU-MS-004): Environmental Habitat Assessment Report ECC**
- CEN001-ROV-01-CON-ENV-RPT-0022 (23014-SB-SU-MS-005): Environmental Baseline Survey Report OWF
- CEN001-ROV-01-CON-ENV-RPT-0023 (23014-SB-SU-MS-006): Environmental Baseline Survey Report ECC
- CEN001-ROV-01-CON-ENV-RPT-0035 (23014-SB-SU-MS-007): MMO/PAM Report

1.5 Background and Existing Information

1.5.1 Background Information on the CENOS ECC Survey Area

Contributing to the UK governments target of delivering 5 gigawatts (GW) of floating wind by 2030, the CENOS OWF project aims to install up to 100 floating wind turbines with a capacity up to 1400 megawatts (MW) across an area of approximately 333km^2. The power generated will be routed to an offshore substation platform which will subsequently be exported to select oil and gas platforms as part of a drive for decarbonisation of the oil and gas sector. Any remaining surplus will then be converted and exported to the UK grid via a proposed export cable spanning ~225km, making landfall to the south of Peterhead, Scotland. This surplus will also serve as a source of reliable power to the oil rigs when there is insufficient wind to power the turbines.

The proposed ECC route site sits within UKCS Quadrant 19, 20, 21 and 22 which is a site of current and historical oil and gas activity. Historical and operational wells situated in proximity to the proposed ECC survey area (~1km) are displayed below in Table 1.1, whilst pipelines that fall within the same radius are displayed in Table 1.2.

Table 1.1 Historical Well Information

Well Number	Well Spud Date	Completion Date	Original Well Intent	Current Status	Water Depth (m)
22/16b- 5	25/02/1999	18/03/1999	Exploration	Decommissioned	95.4
21/17a- 6	20/02/2011	15/03/2011	Exploration	Decommissioned	80.8
21/17- 4Z	18/10/1986	16/11/1986	Exploration	Decommissioned	84.1
21/17- 4	14/09/1986	16/10/1986	Exploration	Decommissioned	84.1
21/11/2007	23/06/1995	18/07/1995	Appraisal	Decommissioned	89.3

Table 1.2 Pipelines within the proposed CENOS ECC survey area

Name	Diameter (Inch)	Fluid Transported	Status	Trenched Status	Date Laid
PL4106 Culzean 22 Inch Gas Export Flowline	22	Gas	Active	-	-

1.5.2 Existing Information Relating to the CENOS ECC Survey Area

Existing information considered as part of this assessment includes a geophysical processing report across the OWF survey area (RockWave Geophysical Processing Report UKCS BLOCKS 22/23 Project ID: 2023-0173). The report provides details of seabed elevation, seabed features and identifies potential hazards present in the nearby OWF survey area, utilising UHR and SBP seismic survey data.

1.5.3 Reference Sources

1.5.3.1 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, 2019). Formulated through international (OSPAR) and national monitoring programmes in collaboration with European projects such as MESH or MESH Atlantic, the predicted seabed habitat map can be a useful resource to aid assignment of habitats within a given survey area (Figure 1.2).

1.5.4 Legislative Background

1.5.4.1 UK Post-2010 Biodiversity Framework

The 'UK Post-2010 Biodiversity Framework' was published in July 2012 to succeed the UKBAP and 'Conserving Biodiversity – the UK Approach' and is the result of a change in strategic thinking following the publication of the CBDs 'Strategic Plan for Biodiversity 2011-2010' and the launch of the EU Biodiversity Strategy (EUBS) in May 2011. The UKBAP (2008) lists priority species and habitats remain, with 22 principally important marine and coastal habitats included. Key habitats that may occur in an open water marine environment are as follows:

- Carbonate Mounds,
- Deep-sea Sponge Communities,
- Cold-water Coral Reefs,
- Fragile Sponge and Anthozoan Communities on Subtidal Rocky Habitats,
- Blue and Horse Mussel Beds,
- Mud Habitats in Deep Water.

1.5.4.2 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. The work is being coordinated by the Joint Nature Conservation Committee (JNCC). Key OSPAR habitats that may occur in an open water marine environment are essentially the same as listed under the UKBAP, with the 'Mud Habitats in Deep Water' listed as "Seapens and Burrowing Megafauna Communities".

1.5.4.3 European Habitats Directive

The United Kingdom is a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979). To meet their obligations under the convention, the European Community Habitats Directive was adopted in 1992. The provisions of the Directive require Member states to introduce a range of measures including the protection of species listed in the Annexes; to undertake surveillance of habitats and species and produce a report every six years on the implementation of the Directive. The 189 habitats listed in Annex I of the Directive and the 788 species listed in Annex II, are to be protected by means of a network of sites. Each Member State is

required to prepare and propose a national list of sites, which will be evaluated in order to form a European network of Sites of Community Importance (SCIs). These will eventually be designated by Member States as Special Areas of Conservation (SACs) and, along with Special Protection Areas (SPAs) classified under the EC Birds Directive (2009), form a network of protected areas known as Natura 2000. The Directive was amended in 1997 by a technical adaptation Directive and latterly by the Environment Chapter of the Treaty of Accession 2003.

The implementation of the Habitats Directive (92/43/EEC) in offshore waters commenced in 2000 and highlighted a number of potential habitats for which SACs may be selected in UK offshore waters. The Annex I habitats of particular relevance to this region of UK waters are as follows:

- Subtidal reefs (e.g. biogenic reefs formed by *Sabellaria spinulosa* or *Modiolus* and rocky reefs formed from iceberg scour or moraine deposits).
- Submarine structures made by leaking gases (including, *inter alia*, carbonates formed within pockmarks).

The Habitats Directive introduced the precautionary principle to protect sensitive areas whereby projects can only be permitted where no adverse effect on the integrity of the site can be shown.

Following the UK's exit from the European Union (EU), new regulations have been put into effect that have transposed the land and marine aspects of the Habitats Directive (Council Directive 92/43/EEC) and Wild Birds Directive (Directive 2009/147/EC). It is important to note that following the UK's exit from the EU, habitat and species protection and standards are implemented in the same or an equivalent way and there is no change in terms of policy. Amendments to parts of the 2017 regulations were applied by the 'Conservation of Habitats and Species (EU exit) Regulations 2019' which became operable from 1st January 2021 (GOV.UK, 2022). The amendments to the legislation were applied to ensure that the regulations continued to function after leaving the EU. Most of these changes involved transferring functions from the European Commission to the appropriate authorities in England and Wales. All other processes or terms in the 2017 regulations remain unchanged and existing guidance is still relevant (GOV.UK, 2022).

1.5.4.4 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 deep sea environment consist of 'Carbonate Mound Communities' and 'Coral Gardens'.

1.5.4.5 The UK Marine Monitoring Programme

The UK National Marine Monitoring Programme (NMMP) was established in response to the 1986 House of Lords select committee on marine science and technology, who recommended that a common approach to marine monitoring should be established to comply with the international and national commitments (OSPAR Convention and EC Directives). The NMMP focuses on stable depositional sites and records data on sediment chemistry, biological communities, the

bioaccumulation of heavy metals (cadmium, mercury and lead) and their ecological effects (Bordin *et al.*, 1992; McLeese *et al.,* 1987).

A National Marine Biology Analytical Quality Control Scheme (NMBAQC) was established in 1992 to establish quality assurance standards for the biological aspects of the NMMP. Similar schemes were set up for chemical (NMCAQC) and ecotoxicological monitoring (NMEAQC) (Davies *et al.,* 2001). The NMCAQC scheme was subsequently renamed the National Marine Chemistry Advisory Group (NMCAG) and the terms of reference for this group were updated in 2007 (MARG, 2020).

1.5.5 Habitat Investigation

1.5.5.1 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, 2019), 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, 2019).

Habitat descriptions have been interpretated from information on seabed sediment types and faunal communities from seabed photography and grab sampling, and the predicted seabed habitat map produced by EMODnet was utilised in the habitat investigation across the CENOS ECC survey area. As illustrated in Figure 1.2, the predicted EUNIS habitat around the ECC survey area is predominantly ‘Atlantic Offshore Circalittoral Sand’ (MD52/ SS.SSa.OSa) with an isolated patch of ‘Atlantic Circalittoral Coarse Sediment’ (MD32/ SS.SCS.OCS) in the eastern end of the ECC close to the OWF site. The ECC survey area also enters the OWF survey area predicted to comprise of a patch of ‘Atlantic Offshore Circalittoral Mud’ (MD62/ SS.SMu.OMu).

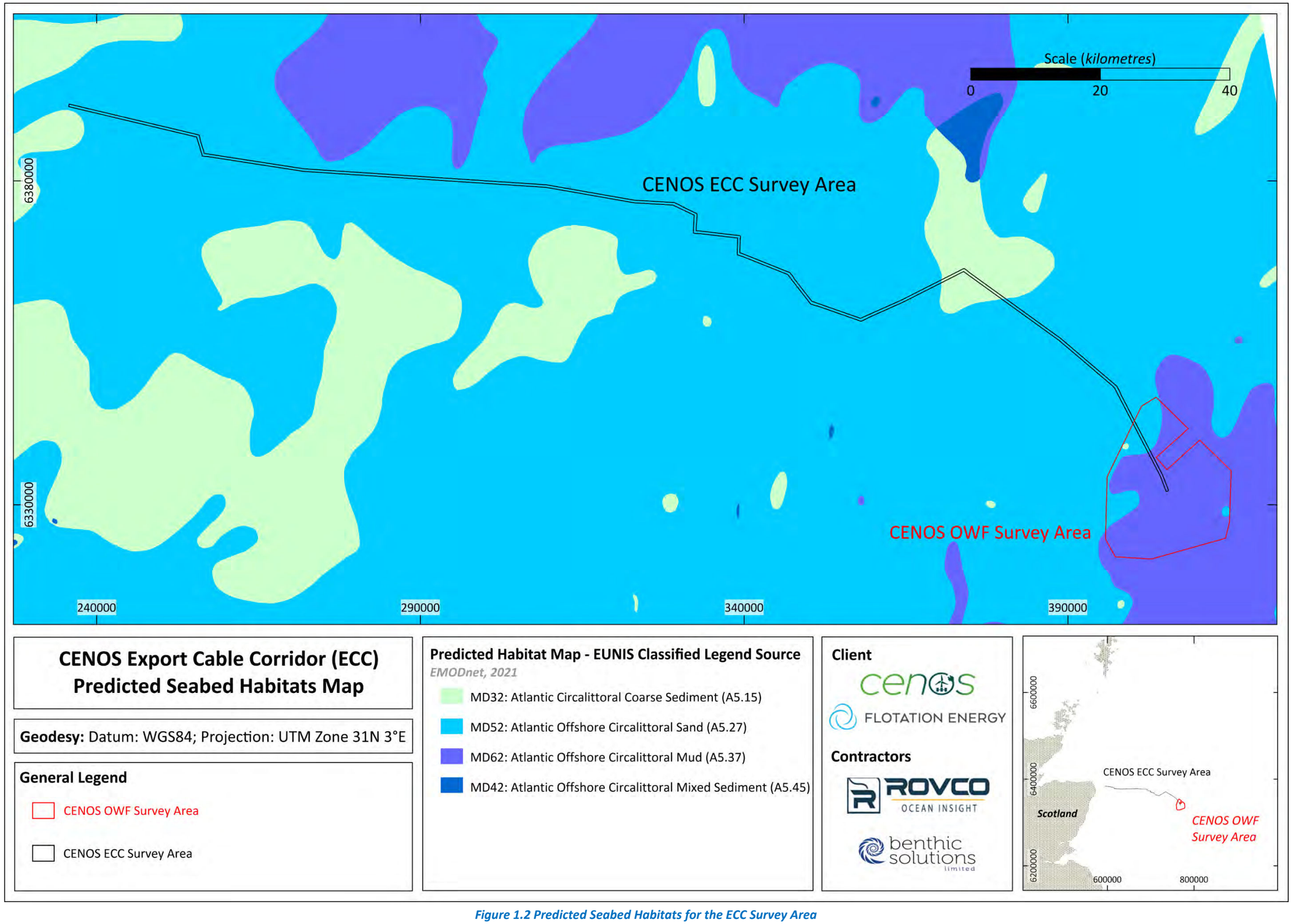


Figure 1.2 Predicted Seabed Habitats for the ECC Survey Area

1.5.5.2 Expected Habitat Sensitivities

A section of the proposed CENOS ECC survey area lies within the East of Gannet and Montrose (EGM) Fields Marine Protected Area (MPA) designated for the occurrence of ocean quahog (*Arctica islandica*) and the presence of the UK BAP habitat 'Offshore Deep Sea Muds' (Figure 1.3). The western extent of the ECC is also in close proximity to the Southern Trench MPA, which lies off the Aberdeenshire coast, and is designated for the presence of minke whales (*Balaenoptera acutorostrata*) and the UK BAP habitat 'Offshore Deep Sea Muds' (Figure 1.3). The nearby MPAs to the survey area as well as the primary features for which they were designated are summarised in in Table 1.3.

Table 1.3 Key Aspects of Nearby Protected Areas

SAC / MPA	Designated Site	Designation Year	Site Area (km^2)	Closest Distance to Survey Site (km)	Key Aspects
MPA	East of Gannet and Montrose Fields	2014	1,839	Within	An area with half the seabed being dominated by sand and gravels, the preferred habitat of the ocean quahog (*Arctica islandica*). The MPA also protects the full extent of an area of offshore deep-sea mud; a Priority Marine Feature (PMF).
	Norwegian Boundary Sediment Plain	2014	163	60 NE	This MPA is designated for the OSPAR Threatened and/or Declining species, the long-lived ocean quahog (*Arctica islandica*), which prefer sand and gravel habitats. Ocean quahog is an important food source for several species of fish including cod.
	Southern Trench	2020	2,398	0.5 W	A 58km long, 9km wide and 250m deep glacially derived trench running parallel to the coast. The MPA is designated for the presence of minke whales as well as an area of offshore deep-sea mud; a Priority Marine Feature (PMF). The sand covering much of the seabed also provides abundant habitat for sandeels (a PMF species).
	Turbot Bank	2014	251	Adjacent to the South	Turbot Bank is important spawning and nursery ground for sandeels (a PMF species). live buried sand habitats for months at a time.

1.5.5.3 Protected Habitat Assessment

Based on the features that were granted in the above areas, the habitats, and species of particular relevance to this region of UK waters are:

- Subtidal Sands and Gravels (UK Post-2010 Biodiversity Framework Habitat, Scottish PMF);
- Seapen and Burrowing Megafauna Communities (Scottish PMF – as 'Burrowed Mud', Habitat FOCI, OSPAR threatened and/or declining Habitat);
- Ross worm (*Sabellaria spinulosa*) biogenic reef (EC Habitats Directive Annex I, Habitat FOCI, OSPAR Threatened and/or Declining Habitat, UKBAP Priority Habitat);
- Ocean Quahog (*Arctica islandica*) (Scottish PMF, Species FOCI, OSPAR threatened and/or declining Species).

1.5.5.4 Legislative Species Protection Assessment

The epifaunal taxa recorded from review of the underwater video footage and taxonomic analysis were input into a database developed and curated by BSL staff which identifies any species that are afforded protection under several legislative conventions/directives implemented in the UK, including the UK Post-2010 Biodiversity Framework.

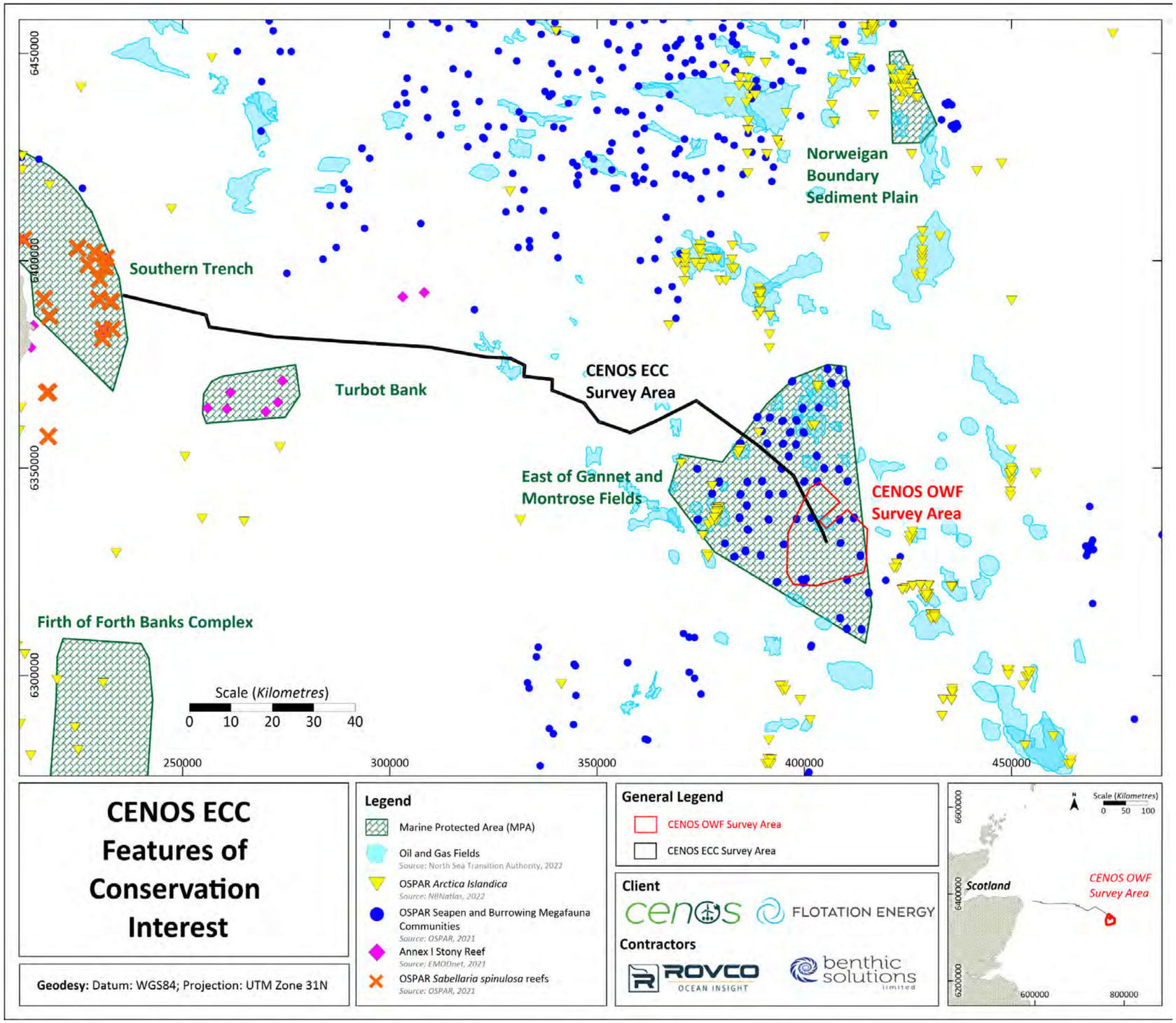


Figure 1.3 Locations of Features of Conservation Interest in Relation to the CENOS ECC Survey Area

2 Field Survey and Analytical Methods

2.1 Geodetic Parameters

The horizontal datum will be referenced to WGS84 Datum, UTM 31N projection. The geodetic parameters used are provided below in Table 2.1.

Table 2.1 Geodetic Parameters

Required Datum	
GPS Datum	WGS84
Projection Parameters	
Projection	UTM 31N
Central Meridian	03° 00’ 00.0” E
Latitude of Natural Origin	00° 00’ 00.0” E
False Easting	500 000 m
False Northing	0 m
Scale Factor at Origin	0.9996 at CM

2.2 Vertical Datum

All depth measurements were reduced to the Lowest Astronomical Tide (LAT) level.

2.3 Geophysical Data

The geophysical survey spread comprised hull-mounted multibeam echosounder (MBES) to acquire bathymetry and backscatter data, towed side scan sonar (SSS), magnetometry (MAG) and a hull-mounted sub-bottom profiler (SBP) within the approximately 225 km long ECC survey area.

The following datasets were available for review during the preparation of this report:

- Bathymetric data was acquired using a dual head R2Sonic 2026 at 400kHz which was reduced and processed offshore to provide a digital terrain model (0.5 m bin size) where major bathymetric features and minor bathymetric changes could be identified and highlighted. This included the identification of debris and obstructions within the survey area (e.g., seabed scars, possible anthropogenic debris).

- Side scan sonar data was acquired using an Edgetech 4205 tri-frequency system of 230/540/850 kHz operating. The SSS data acquired was supplemented by swathe bathymetry data gridded to a 0.2 m cell size. Changes in sediment type and hardness, along with features observed through low level relief and discrete objects were delineated.

2.4 Environmental Ground-Truthing and Sampling

The environmental sampling survey strategy was outlined in the Environmental Operations Procedure/ Method Statement (23014-SB-SU-MS-001). All amendments to the environmental data acquisition were agreed prior to sampling.

A total of 20 environmental sampling stations were proposed across the ECC survey area prior to the commencement of sampling operations, all with collocated 300m camera transects. An additional 20 camera transects were subsequently proposed following review of the acquired geophysical data to ensure a robust understanding of the different habitats identified across the site. Six of the sampling stations were also selected for water sampling, at bottom, mid and surface depths with corresponding CTD profiles obtained for each. Acquired environmental and water samples are detailed in Table 2.2 whilst the camera transects are detailed in Table 2.3, with both displayed in Figure 2.1.

Benthic environmental baseline stations underwent the following sampling/sub-sampling:

- 1 x 0.1m^2 physico-chemical replicate, subsampled for particle size distribution (PSD), heavy and trace metals (HM), and hydrocarbons (HC), at a single surface depth of 0-2cm.
- 1 x 0.1m^2 macro-invertebrate replicate samples processed over a 0.5mm aperture sieve in the field.

Seabed photography/videography was used to ground-truth (provide direct visual observation/information of the seabed) each environmental sampling location and at all key seabed features identified from review of the analogue data. Survey operations were conducted using BSL MOD4 systems fitted with 9.5 cm laser scales.

The survey field operations are detailed in Appendix I, with grab sampling logs and deck observations in Appendix II, and camera transect logs in Appendix III.

Table 2.2 Summary of Station Sample Acquisition

Station	Proposed		Acquired		Rationale	Grab Sampling		Water Sampling
	Easting (m)	Northing (m)	Easting (m)	Northing (m)		PC	Fauna	Chemistry / CTD
ECC_02	240 171	6 390 584	240 237	6 390 456	5 km spacing. Adjusted to be moved outside of suspected area of *Sabellaria*	✓	✓	✓
ECC_04	249 901	6 388 274	249 900	6 388 274	5 km spacing	✓	✓	-
ECC_06	257 598	6 383 870	257 916	6 383 781	5 km spacing. Moved so the transect can target a depression and high reflectivity contact on the SSS	✓	✓	✓
ECC_08	267 481	6 382 347	267 480	6 382 342	5 km spacing	✓	✓	-
ECC_09	272 427	6 381 626	272 424	6 381 624	5 km spacing	✓	✓	✓
ECC_11	282 177	6 380 983	282 178	6 380 985	5 km spacing	✓	✓	-
ECC_12	289 881	6 380 475	289 880	6 380 476	7.72 km spacing	✓	✓	-
ECC_14	305 287	6 379 458	305 289	6 379 458	7.72 km spacing	✓	✓	-
ECC_15	312 945	6 378 571	312 945	6 378 572	7.72 km spacing	✓	✓	-
ECC_17	328 223	6 376 504	328 292	6 376 620	7.72 km spacing. Moved to cover data extent of geophysics	✓	✓	-
ECC_18	331 981	6 375 054	331 982	6 375 056	Grab at western end of new section of the route	✓	✓	✓
ECC_21	344 121	6 366 794	344 120	6 366 792	Grab at eastern end of new section of the route	✓	✓	-
ECC_22	348 579	6 363 475	348 580	6 363 473	7.72 km spacing	✓	✓	-
ECC_23	353 138	6 360 258	353 140	6 360 259	7.72 km spacing	✓	✓	-
ECC_25	-	-	365 643	6 362 054	7.72 km spacing	✓	✓	✓
ECC_25_A	365 639	6 362 053	365 688	6 362 048	7.72 km spacing	✓	✓	-
ECC_26	372 529	6 365 536	373 002	6 365 554	7.72 km spacing. Moved to cover coarser area of sediment	✓	✓	-
ECC_27	378 918	6 362 617	378 918	6 362 619	7.72 km spacing	✓	✓	-
ECC_29	388 387	6 355 794	388 386	6 355 794	3.85 km spacing	✓	✓	-
ECC_31	394 893	6 350 317	393 670	6 351 310	3.85 km spacing. Moved to cover area of higher reflectivity approximately 1 km around the Langeled pipeline. Moved so grab coverage of this sediment type could be obtained.	✓	N/S	-
ECC_33	399 026	6 344 960	399 028	6 344 959	3.85 km spacing	✓	✓	-
ECC_37			247 051	6 388 885	Additional DDV location targeting suspected area of *Sabellaria*	-	-	✓

Notes:
The suffix '_A' denotes where sampling locations had to be moved from the original proposed location to acquire the sample.
N/S = No sample acquired

Table 2.3 Summary of Camera Transect Acquisition

WGS84 UTM 31N							
Transect		Date	Time (UTC)	Easting (m)	Northing (m)	Video footage (mm: ss)	Number of stills
ECC_01	SOL	01/09/2023	00:52	235 985	6 391 732	23:06	134
	EOL	01/09/2023	01:15	235 680	6 391 842		
ECC_02	SOL	01/09/2023	03:17	239 984	6 390 525	23:11	102
	EOL	01/09/2023	03:40	240 297	6 390 437		
ECC_03	SOL	01/09/2023	07:21	244 882	6 389 380	28:14	93
	EOL	01/09/2023	07:49	245 189	6 389 477		
ECC_04	SOL	01/09/2023	11:41	249 722	6 388 287	30:17	68
	EOL	01/09/2023	12:13	250 070	6 388 258		
ECC_05	SOL	01/09/2023	13:14	254 596	6 387 110	27:03	64
	EOL	01/09/2023	13:41	254 913	6 387 119		
ECC_06	SOL	01/09/2023	14:52	257 918	6 383 552	27:29	58
	EOL	01/09/2023	15:21	257 917	6 383 900		
ECC_07	SOL	01/09/2023	16:58	262 516	6 383 155	27:49	102
	EOL	01/09/2023	17:26	262 669	6 382 870		
ECC_08	SOL	01/09/2023	18:37	267 426	6 382 438	31:21	140
	EOL	01/09/2023	19:09	267 617	6 382 134		
ECC_09	SOL	01/09/2023	20:12	272 493	6 381 657	29:22	116
	EOL	01/09/2023	20:42	272 190	6 381 528		
ECC_10	SOL	30/08/2023	17:26	277 575	6 381 300	28:38	37
	EOL	30/08/2023	17:55	277 245	6 381 309		
ECC_11	SOL	30/08/2023	15:51	282 332	6 380 973	24:30	44
	EOL	30/08/2023	16:16	282 013	6 380 997		
ECC_12	SOL	30/08/2023	13:58	290 040	6 380 456	23:40	35
	EOL	30/08/2023	14:23	289 708	6 380 499		
ECC_13	SOL	30/08/2023	12:32	297 750	6 379 941	22:56	43
	EOL	30/08/2023	12:54	297 428	6 379 992		
ECC_14	SOL	30/08/2023	10:36	305 450	6 379 440	23:29	46
	EOL	30/08/2023	10:59	305 122	6 379 476		
ECC_15	SOL	30/08/2023	08:16	313 175	6 378 453	23:53	38
	EOL	30/08/2023	08:40	312 886	6 378 600		
ECC_16	SOL	30/08/2023	07:00	320 638	6 377 229	24:20	37
	EOL	30/08/2023	07:19	320 377	6 377 262		
ECC_17	SOL	30/08/2023	04:33	328 523	6 376 723	24:09	58
	EOL	30/08/2023	04:57	328 227	6 376 589		
ECC_18	SOL	29/08/2023	03:25	332 142	6 374 984	27:53	119
	EOL	29/08/2023	03:53	331 848	6 375 113		
ECC_19	SOL	29/08/2023	02:08	335 619	6 371 693	30:35	110
	EOL	29/08/2023	02:39	335 295	6 371 719		
ECC_20	SOL	29/08/2023	00:33	341 107	6 367 820	31:30	112
	EOL	29/08/2023	01:04	340 806	6 367 942		
ECC_21	SOL	28/08/2023	22:48	344 188	6 366784	25:47	57
	EOL	28/08/2023	23:14	343 845	6 366 822		
ECC_22	SOL	28/08/2023	20:52	348 760	6 363 409	24:46	39
	EOL	28/08/2023	21:17	348 419	6 363 535		
ECC_23	SOL	28/08/2023	19:05	353 298	6 360 205	25:23	36
	EOL	28/08/2023	19:30	352 993	6 360 307		
ECC_24	SOL	28/08/2023	17:31	358 788	6 358 908	28:56	37
	EOL	28/08/2023	18:01	358 469	6 358 794		
ECC_25	SOL	28/08/2023	14:31	365 920	6 362 036	29:33	33
	EOL	28/08/2023	14:57	365 582	6 362 060		
ECC_26	SOL	28/08/2023	12:20	373 155	6 365 620	24:42	31
	EOL	28/08/2023	12:45	372 852	6 365 489		

WGS84 UTM 31N							
Transect		Date	Time (UTC)	Easting (m)	Northing (m)	Video footage (mm: ss)	Number of stills
ECC_27	SOL	28/08/2023	10:16	379 071	6 362 509	20:46	30
	EOL	28/08/2023	10:38	378 804	6 362 698		
ECC_28	SOL	28/08/2023	08:02	385 125	6 357 827	22:18	30
	EOL	28/08/2023	08:25	385 297	6 358 101		
ECC_29	SOL	28/08/2023	06:42	388 293	6 355 556	24:26	30
	EOL	28/08/2023	07:07	388 411	6 355 855		
ECC_30_A	SOL	28/08/2023	05:18	391 917	6 352 761	22:57	59
	EOL	28/08/2023	05:41	392 177	6 352 566		
ECC_31	SOL	28/08/2023	02:34	393 857	6 351 159	24:07	84
	EOL	28/08/2023	02:58	393 614	6 351 365		
ECC_32	SOL	28/08/2023	00:35	397 473	6 347 932	25:21	61
	EOL	28/08/2023	01:00	397 328	6 348 219		
ECC_33	SOL	27/08/2023	22:15	399 072	6 344 925	23:05	48
	EOL	27/08/2023	22:37	398 813	6 345 126		
ECC_34	SOL	28/08/2023	01:47	395 016	6 350 214	22:30	38
	EOL	28/08/2023	02:09	394 767	6 350 421		
ECC_35	SOL	28/08/2023	09:18	381 260	6 360 851	22:20	37
	EOL	28/08/2023	09:42	380 975	6 361 002		
ECC_36	SOL	02/09/2023	15:35	332 717	6 371 881	25:46	65
	EOL	02/09/2023	15:35	332 717	6 371 881		
ECC_37	SOL	01/09/2023	09:29	247 014	6 389 182	26:11	65
	EOL	01/09/2023	09:56	247 050	6 388 860		
ECC_38	SOL	01/09/2023	08:20	245 700	6 389 314	28:27	75
	EOL	01/09/2023	08:49	246 019	6 389 254		
ECC_39	SOL	01/09/2023	06:05	242 310	6 390 263	24:34	79
	EOL	01/09/2023	06:31	242 631	6 390 206		
ECC_40	SOL	01/09/2023	02:09	237 991	6 391 192	23:48	102
	EOL	01/09/2023	02:31	238 305	6 391 100		

Notes:
The suffix "_A" denotes where camera transect was re-run to acquire high-definition footage. Transects of the same name without the suffix recorded only still and standard definition footage.
**No HD footage available for OWF_19 due to file corruption onshore*

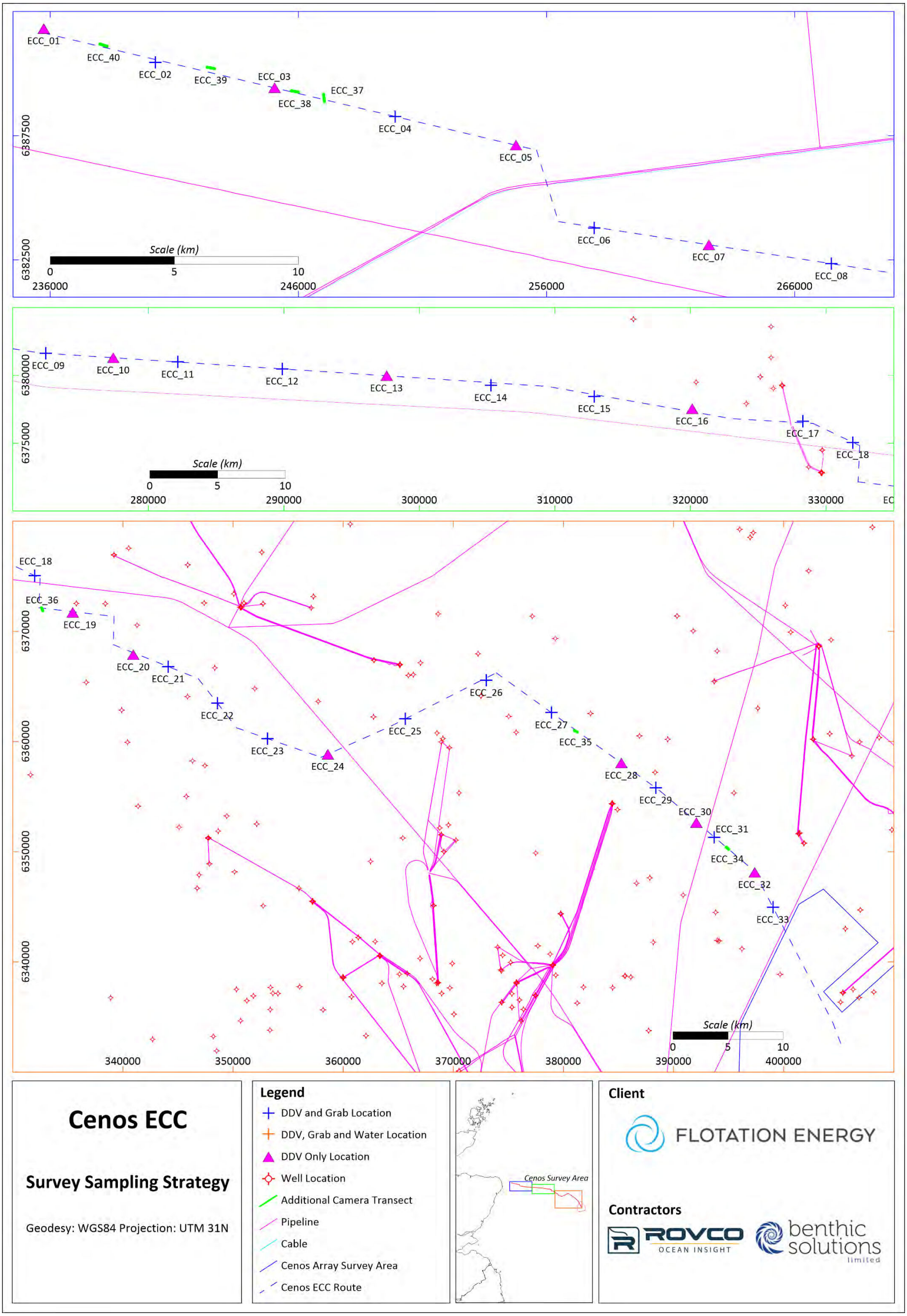


Figure 2.1 ECC Site SSS Data and Acquired Sediment Samples and Camera Transects

3 Results and Interpretation

3.1 Survey Bathymetry and Seabed Features

The following text utilises information from the environmental fieldwork report for the ECC area (Doc Ref: 23014-SB-SU-MS-006) and geophysical interpretation by ROVCO (2023) to aid in descriptions of the bathymetry and seabed features across the survey area. Environmental grab samples and regional geological information have been considered in seabed features interpretation. Figure 3.1 and Figure 3.2 illustrates the seabed features over side scan sonar (SSS) data interpreted within the ECC survey area.

The water depth across the ECC ranged approximately from 78m to 107m below LAT. The SSS data indicated low to moderate reflectivity across most of the ECC survey area with areas of high reflectivity. Lower reflectivity seabed of characterised the ambient muddy sand/sand/sandy mud substrate and a Munsell colour of dark reddish brown (5Y 3/2 and 2.5Y 3/3). Areas of high reflectivity were typically associated with patches of shell fragments and pebbles, with a Munsell colour of dark reddish grey (5YR 4/2). Smaller isolated areas contained mixed sediment, with varying dense matrices of pebbles and shell debris.

The vast majority of the site area was interpreted to be comprised of clayey, silty sand with occasional gravel and isolated to scattered cobbles and boulders. This substrate, described as 'Holocene 01' was prevalent across the entire ECC survey area with smaller patches of differing substrate types, influenced by the presence of six other geological layers at or near to the seabed surface (Figure 3.1 and Figure 3.2).

Two other 'Holocene' sediments, 'Holocene 02' and 'Holocene 03'were present in distinct bands in a small section of the eastern extent of the ECC (Figure 3.2). 'Holocene 02' was interpreted to contain sediments of sand with occasional gravel while 'Holocene 03' was described as sandy silty clay with isolated cobbles and boulders.

Areas of clayey silty sandy gravel with isolated to scattered cobbles and boulders were present in areas of moderate to high reflectivity in areas of the eastern ECC. These features were elevated above the surrounding Holocene sediment and were interpreted to be related to the outcropping of the 'Forth Formation Whitehorn Member'. Moreover, areas of slightly gravelly silty clayey sand with isolated to scattered cobbles and boulders were located between areas of 'Holocene 03' and 'Forth Formation Whithorn Member'. These areas were interpreted to be related to the outcropping of the 'Forth Formation Fitzroy Member'.

Smaller areas of sandy silty clay and silty sand with pebbles, shell fragments and scattered boulders were interpreted to be outcropping of the 'Coal Pit Formation' and was located in patches along the western section of the ECC and in a single patch along the eastern section of the ECC between 'Holocene 02' and 'Holocene 03'. These areas were not ground-truthed by camera transects along the ECC but can be expected to be similar to the 'Coal Pit Formation' ground-truthed in the OWF.

A section at the western extent of the ECC contained a number of outcrops of the Wee-Bankie Formation and Coal Pit Formation, with areas of surficial sediment build-up overlying these units, in between the outcrops.

Hard contacts detected by SSS are also mapped in (Figure 3.1 and Figure 3.2) and represent points of higher reflectivity than their surrounding area caused by relatively large dense substrates such as boulders. Numerous boulders were present exclusively towards the western end of the ECC. Associated with this was an increased presence of sediment ribbons, sandwaves and linguoid ripples in these areas.

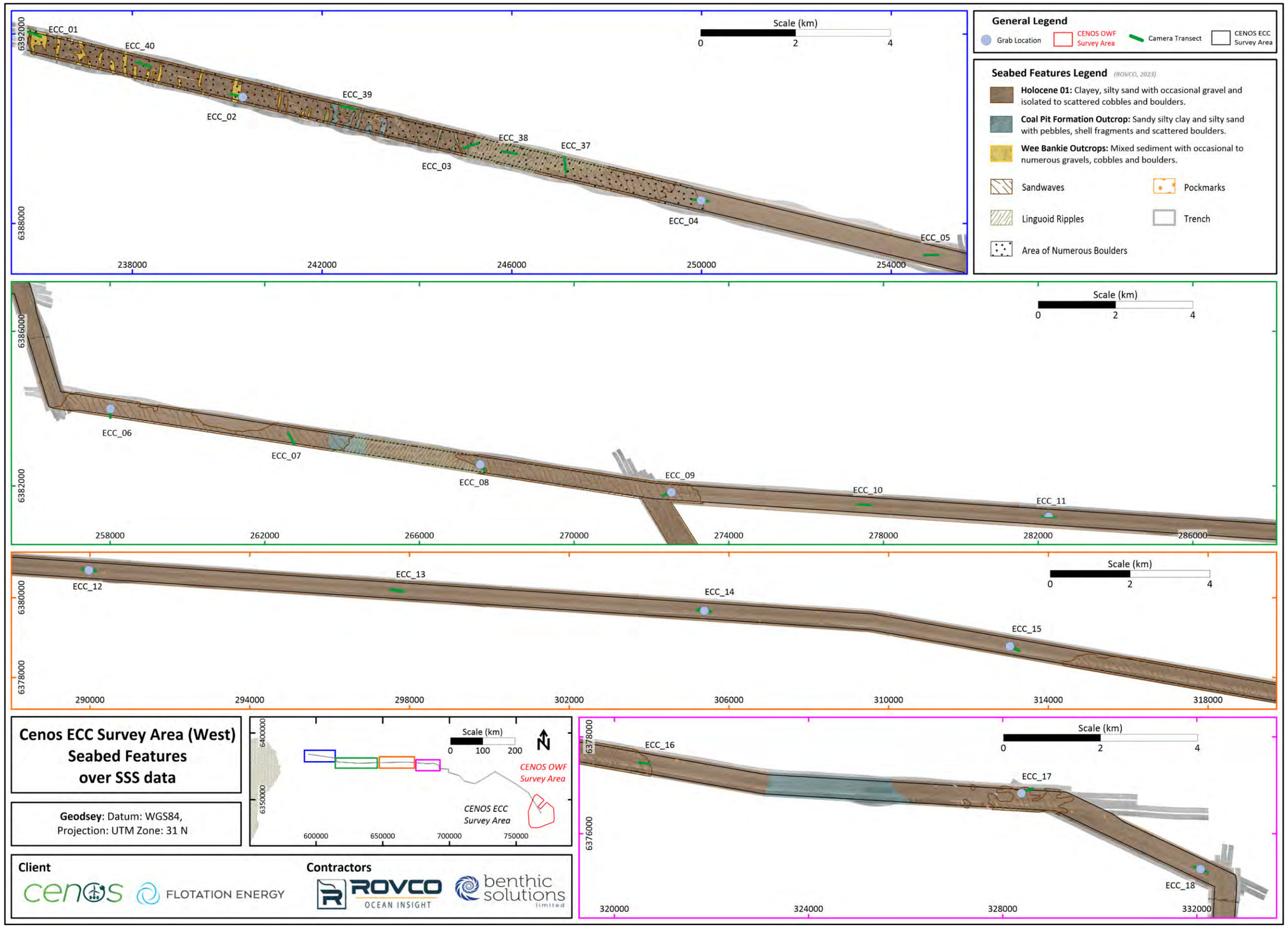


Figure 3.1 ECC Survey Area (West) Seabed Features over SSS

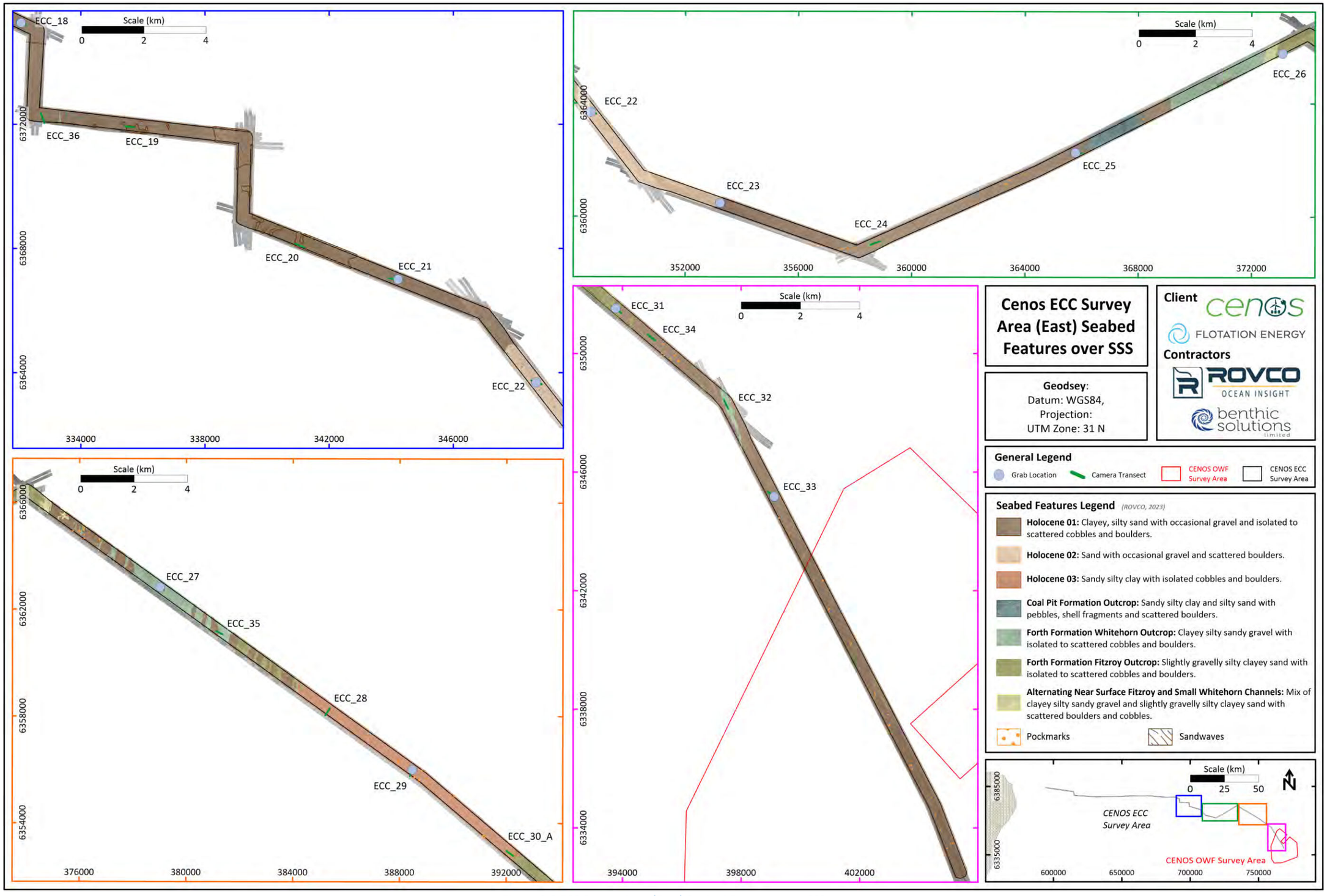


Figure 3.2 ECC Survey Area (East) Seabed Features over SSS

3.2 Habitat Classification

Sidescan sonar imagery, as well as video and still photographic ground-truthing from the 40 camera transects across the ECC survey area, and particle size analysis (PSA) were utilised in the assignment of benthic habitats.

The outcropping underlying geological structures delineated in the SBF were utilised within the habitat assessment following their associated geophysical sediment description. Based on the datasets obtained, the ECC area was determined to be predominantly comprised of the JNCC/EUNIS habitat classification of SS.SSa.OSa/ MD52 'Offshore Circalittoral Sand' (Table 3.1). This habitat conformed to the mapped classification predicted by EMODnet (Figure 1.2) and applied to a large proportion of 'Holocene_01' interpreted SBF. As the ECC route progressed to the east the percentage of fines increased and gradually transitioned into the seabed habitat SS.SMu.OMu/MD62 'Offshore Circalittoral Mud'. Two variants of SS.SMu.OMu were delineated along the route based on the observed features, seabed texture and reflectivity within the SSS data. 'Offshore Circalittoral Mud Sediment' (SS.SMu.OMu/MD62) was typically assigned to areas delineated as 'Holocene 01'and 'Holocene 03' in the seabed features, with the appearance of shell fragments. While 'Offshore Circalittoral Mud Sediment with frequent patches of shelly mud' (SS.SMu.OMu/MD62) was assigned to areas that showed more visible aggregations of shell fragments, demonstrating an outcropping of the underlying Fitzroy and Whitehorn formations. Smaller areas conforming to the JNCC/EUNIS classification of 'Offshore Circalittoral Mixed Sediment' (SS.SMx.OMx/MD42) were identified along the route and were typically characterised by a poorly sorted mosaic of shell fragments and pebbles overlaying the predominant muddy substrate.

Table 3.1 Summarised Habitat Classifications for the ECC Area

BGS Modified Folk Classification of Particle Size Analysis	JNCC Classification	EUNIS Classification
Sandy Mud, Muddy Sand, Slightly Gravelly Muddy Sand	SS.SMu.OMu Offshore Circalittoral Mud	MD62 Atlantic Offshore Circalittoral Mud
Muddy Sand, Slightly Gravelly Sand, Slightly Gravelly Muddy Sand	SS.SSa.OSa Offshore Circalittoral Sand	MD52 Atlantic Offshore Circalittoral Sand
Muddy Sandy Gravel	SS.SMx.OMx Offshore Circalittoral Mixed Sediment	MD42 Atlantic Offshore Circalittoral Mixed Sediment

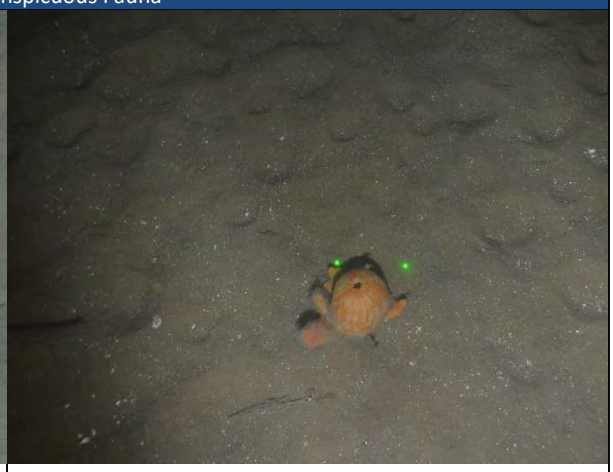
Conspicuous fauna within the ECC survey area revealed a moderate diversity and density for an overarching sand dominated seabed, with comparable fauna assemblages across most stations. Sessile faunal assemblages noted across stations included several species of seapens (*Pennatula phosphorea*, *Virgularia mirabilis* and *Funiculina quadrangularis*), several species of anemone (*Synarachnactis lloydii*) and scallop (Pectinidae). Mobile fauna included hermit crabs (*Pagurus* sp.), sea stars (Asteroidea, *Asterias rubens*), brittlestars (Ophiuroidea), urchin (Echinoidea), whelk (Buccinidae), Norway lobster (*Nephrops norvegicus*), squat lobster (Munididae), spider crab (Majidae) and sea slugs (Nudibranchia). Free-swimming megafauna mainly consisted of unidentified flatfish (Pleuronectiformes), lemon sole (*Microstomus kitt*), gadoid fish (Gadidae) and the hagfish (*Myxine glutinosa*); with gurnards (Triglidae), and rays (Batoidea) also observed on occasion. A notable

increase in sessile epifauna including sponges (erect and encrusting morphologies), anemones, barnacles (Cirripedia), Hydrozoa and Bryozoa were associated with areas of mixed sediments owing to the attachment opportunities provided. Small aggregations of the Ross Worm (*Sabellaria spinulosa*) were present across the stable mixed sediment transects.

Example images of conspicuous fauna within the survey area are presented below in Figure 3.3, while example seabed images for each transect are provided in Appendix VIII.

Examples of Conspicuous Fauna

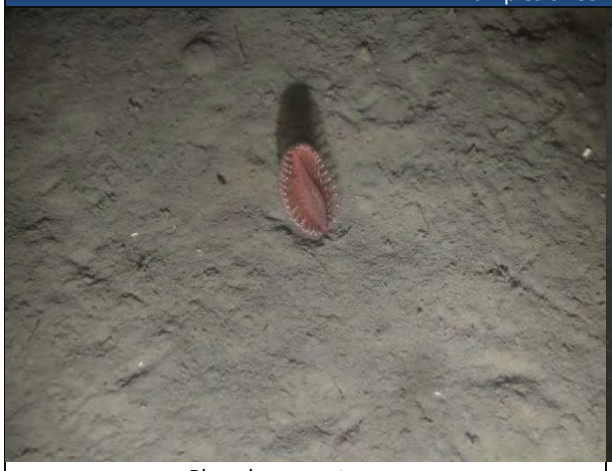
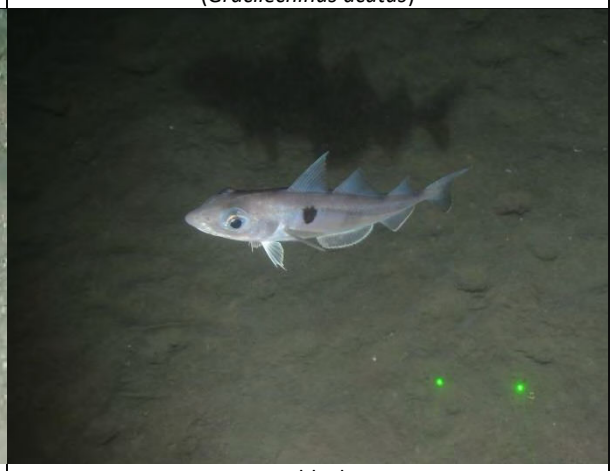
Hermit crab
(Paguridae)

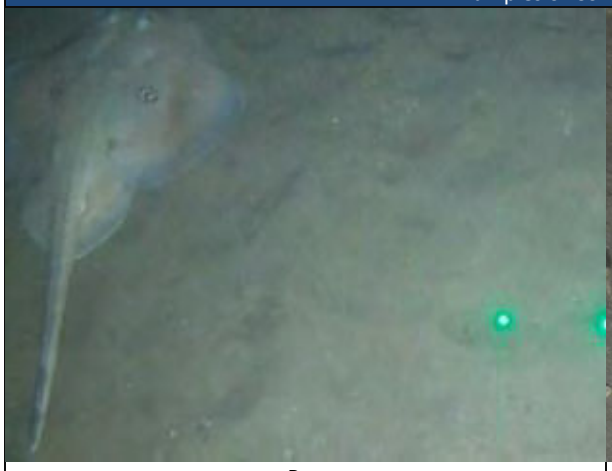


Anemone
(Actiniaria sp.)

Lemon sole
(*Microstomus kitt*)

Hagfish
Myxine glutinosa

Examples of Conspicuous Fauna	
	
Phosphorescent seapen *(Pennatula phosphorea)*	White Sea Urchin (*Gracilechinus acutus*)
	
Grey Gurnard (*Eutrigla gurnardus*)	Haddock *(Melanogrammus aeglefinus)*
	
Common Starfish *(Asterias rubens)*	Bristle Worm (*Oxydromus flexuosus*)

Examples of Conspicuous Fauna	
	
Ray (Batoidea)	Scallop (Pectinidae)
	
Dead Man's Fingers and anemone *(Alcyonium digitatum* and Actinaria*)*	North Sea Tube Anemone *(Synarachnactis lloydii)*
	
Sea Beard *(Nemertesia antennina)*	Ross Worm *(Sabellaria spinulosa)*

Examples of Conspicuous Fauna	
	
Squat Lobster (Munididae)	Edible Sea Urchin (*Echinus esculentus*)

Figure 3.3 Examples of Epifaunal and Megafauna Species Recorded within the Survey Area

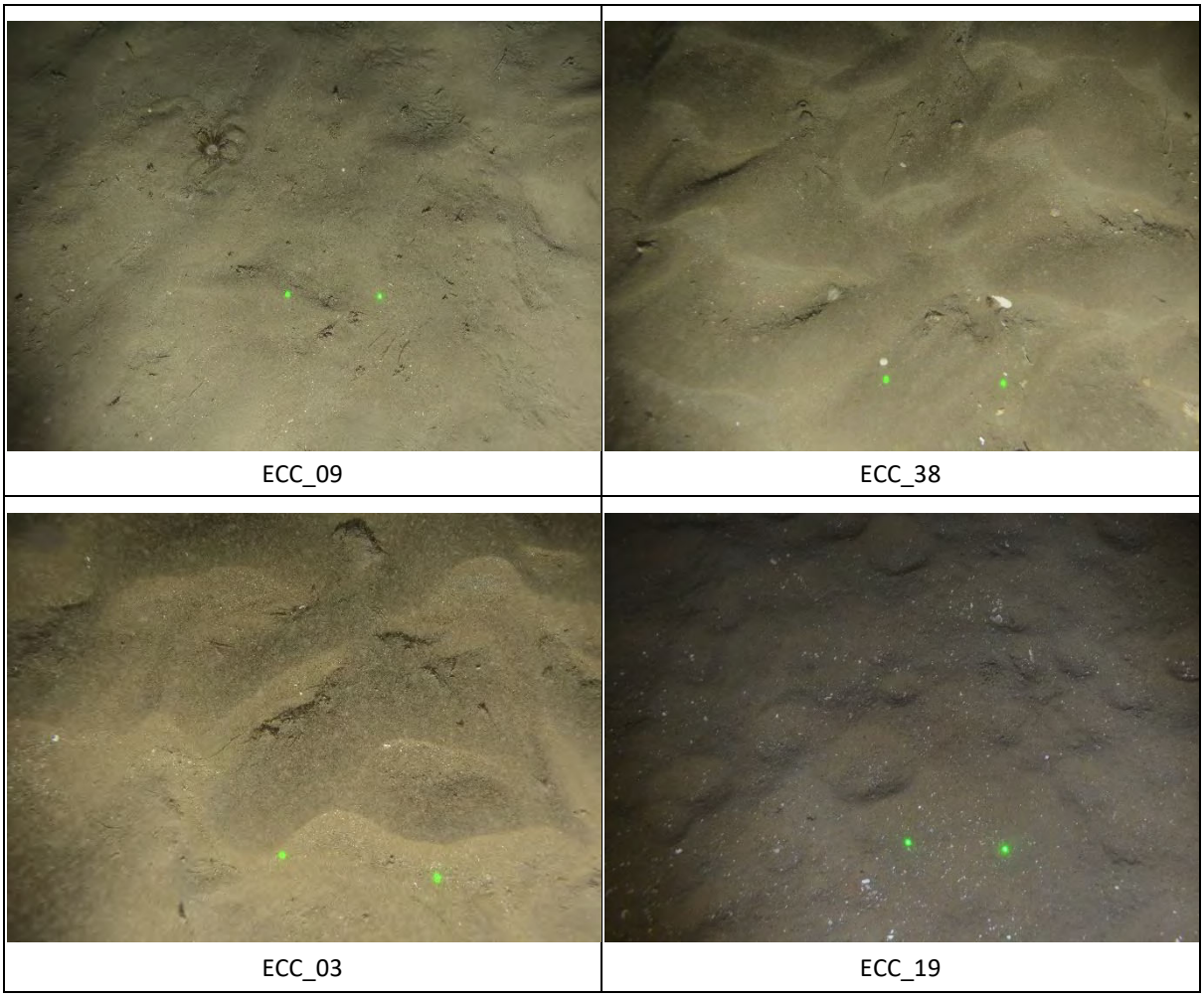
3.2.1 Offshore Circalittoral Sand (SS.SSa.OSa/MD521/A5.27)

This biotope is described by the JNCC as "*Offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. Very little data is available on these habitats however they are likely to be more stable than their shallower counterparts and characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms. This habitat is found in water depths of between 20-200m".* This habitat was widespread across most stations within the western extent of the ECC, with the sediment comprised of Muddy Sand, Slightly Gravelly Sand, and Slightly Gravelly Muddy Sand. This biotope equates to the delineated areas of 'Holocene 01' up to station ECC_25, and all areas delineated as 'Holocene 02' interpreted SBF within the survey area.

Fauna observed on the seabed video included echinoderms such as the seven-armed sea star (*Luidia ciliaris)*, sea stars (Asteroidea*)* and brittle stars (Ophiuroidea). No burrows or burrowing megafauna were observed throughout these areas, but the slender (*Virgularia mirabilis*) and phosphorescent seapens (*Pennatula phosphorea*) were observed across some transects. The Ross worm (*Sabellaria spinulosa*) was also observed as small, isolated aggregations. Mobile epifauna included species of flatfish (Pleuronectiformes), Gadoid sp. and Haddock (*Melanogrammus aeglefinus*). Lists of the fauna observed along each transect are included within the seabed and sample photos included in Appendix V.

The sediment characteristics and faunal records indicate a conformance towards the level four EUNIS habitat classification MD521 describing 'Faunal Communities in Atlantic Offshore Circalittoral Sand', corresponding with the JNCC classification 'SS.SSa.OSa'. Areas of Offshore Circalittoral Sand were identified across 30 different transects along the ECC, with 22 of those located in the western ECC survey area. Two level five biotopes exist within the 'Offshore Circalittoral Sand' habitat; these are infauna dominated and therefore, their potential presence in the survey area will be assessed in the subsequent environmental baseline reports, which will incorporate infaunal data to aid in assigning level five biotope classification.

Example images are provided in Figure 3.4 and the spatial extent of the 'Offshore Circalittoral Sand' (MD521) habitat is mapped in Figure 3.7 and Figure 3.8.



ECC_09 | ECC_38

ECC_03 | ECC_19

Figure 3.4 Example Images of 'Offshore Circalittoral Sand' Habitat

3.2.2 Offshore Circalittoral Mud (SS.SMu.OMu/MD62/A5.37)

This habitat is described by the JNCC as follows: "*In mud and cohesive sandy mud in the offshore circalittoral zone, typically below 50-70 m, a variety of faunal communities may develop, depending upon the level of silt/clay and organic matter in the sediment. Communities are typically dominated by polychaetes but often with high numbers of bivalves such as Thyasira spp., echinoderms and foraminifera.".* This habitat was located towards the eastern end of the ECC survey area close to the OWF site, where the proportion of sedimentary fines increased. The sediment comprised of Sandy Mud, Muddy Sand, Slightly Gravelly Muddy Sand. This biotope reflects the ambient background habitat for the CNS.

Fauna observed on the seabed video included echinoderms, such as starfish (Asteroidea) and the white sea urchin (*Gracilechinus acutus*). The slender (*Virgularia mirabilis*), tall seapen (*Funiculina quadrangularis)* and phosphorescent seapens (*Pennatula phosphorea*) were observed across the majority of transects. No burrows were visible. Moreover, mobile epifauna included species of flatfish

(Pleuronectiformes), haddock (*Melanogrammus aeglefinus*) and Gadoid sp. Lists of the fauna observed along each transect are included within the seabed and sample photos included in Appendix V.

The sediment characteristics and faunal records indicated a conformance towards the level four EUNIS habitat classification MD62 describing 'Atlantic Offshore Circalittoral Mud', corresponding with the JNCC classification SS.SMu.OMu. This biotope was identified across several transects all in the western extent of the ECC (ECC_26, 27, 35, 28, 29, 30, 31, 32, 33). Two variants of SS.SMu.OMu were delineated along the route based on the observed features, seabed texture and reflectivity within the SSS data. 'Offshore Circalittoral Mud Sediment' (SS.SMu.OMu/MD62) was typically assigned to areas delineated as 'Holocene 01'and 'Holocene 03' in the seabed features, with the appearance of shell fragments. While 'Offshore Circalittoral Mud Sediment with frequent patches of shelly mud' (SS.SMu.OMu/MD62) was assigned to areas that showed more visible aggregations of shell fragments, demonstrating an outcropping of the underlying Fitzroy and Whitehorn formations.

Eight level five biotopes exist within the 'Offshore Circalittoral Mud' habitat these are; SS.SMu.OMu.AfalPpin '*Ampharete falcata* turf with *Parvicardium pinnulatum* on cohesive muddy sediment near margins of deep stratified seas', SS.SMu.OMu.ForThy 'Foraminiferans and *Thyasira* sp. in deep circalittoral fine mud', SS.SMu.OMu.StyPse '*Styela gelatinosa*, *Pseudamussium peslutrae* and solitary ascidians on sheltered deep circalittoral muddy sediment', SS.SMu.OMu.CapThy '*Capitella capitata* and *Thyasira spp.* in organically-enriched offshore circalittoral mud and sandy mud', SS.SMu.OMu.LevHet '*Levinsenia gracilis* and *Heteromastus filiformis* in offshore circalittoral mud and sandy mud', SS.SMu.OMu.PjefThyAfil '*Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud', SS.SMu.OMu.MyrPo '*Myrtea spinifera* and polychaetes in offshore circalittoral sandy mud' and SS.SMu.OMu.CalPol '*Calocaris macandreae* and polychaetes in offshore circalittoral mud and sandy mud'. The last five of the listed level five biotopes are more likely to occur within the ECC site due to the alignment towards a Mud and Sandy Mud seabed, which is more akin to ECC site seabed sediments. The other three level five biotopes move towards a seabed made of more cohesive soft muds. However, all of the above biotopes are infauna dominated, so their potential occurrence within the survey area will be reviewed within the subsequent environmental baseline survey report (Doc Ref: CEN-ROV-01-CON-ENV-RPT-0023) when the infauna data will be available to aid in a level five classification. However, it should be noted that not all camera transects have corresponding biological data due to unsuccessful sampling at the corresponding grab location.

Example images are provided in Figure 3.5 and the spatial extent of the 'Offshore Circalittoral Mud' (MD62) habitat is mapped in mapped in Figure 3.7 and Figure 3.8.

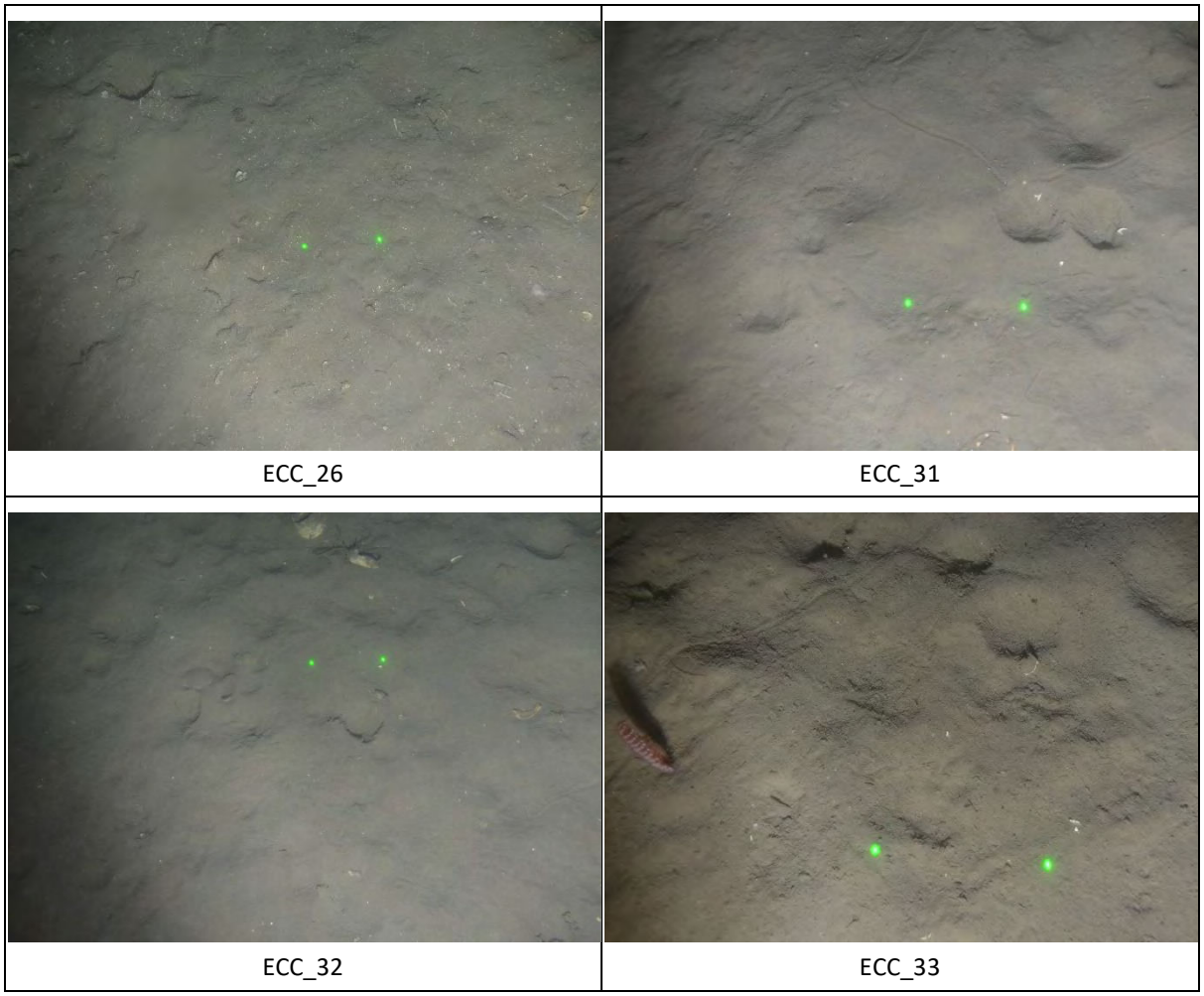


Figure 3.5 Example Images of 'Offshore Circalittoral Mud' Habitat

3.2.3 Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD421/A5.45)

The JNCC describes this biotope as "*Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel*". This biotope was present predominantly at the western end of the ECC, with small patches also across some transects in the eastern ECC. This biotope was typically associated with the 'Wee Bankie' formation as delineated in the seabed feature type.

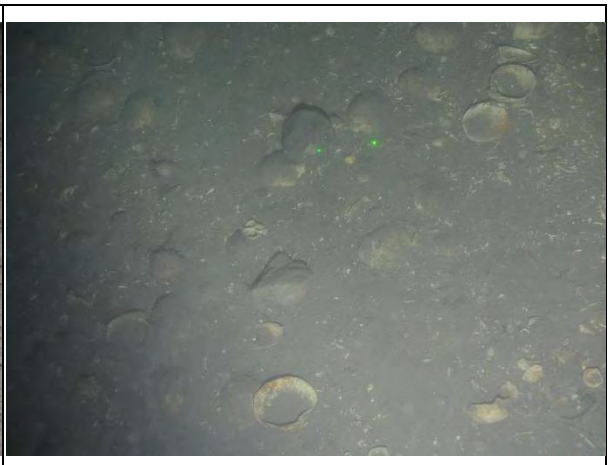
The most abundant fauna observed within this habitat on the seabed photographs and video included the common sea urchin (*Echinus esculentus*.), brittlestars (Ophiuroidea), Dead man's fingers (*Alcyonium digitatum*), hydrozoans and bryozoan turf. Moreover, mobile epifauna included species of flatfish (Pleuronectiformes), haddock (*Melanogrammus aeglefinus*) and Gadoid sp.

The mixed sediment patches in the ECC conformed to the JNCC/EUNIS classification of SS.SMx.OMx/MD42 'Offshore Circalittoral Mixed Sediment' and were present across four transects (ECC_01, 02, 06, 30_A). Only one level five biotope exists within the 'Offshore Circalittoral Mixed Sediments' habitat: the biotope SS.SMx.OMx.PoVen 'Polychaete-rich Deep *Venus* Community in

Offshore Mixed Sediments'. The potential for this habitat to occur within the survey area will be reviewed in the subsequent environmental baseline report (Doc Ref: CEN-ROV-01-CON-ENV-RPT-0023), when the infauna data will be available to aid in a level five classification.

Example images of the natural accumulation of shell mixed sediment are provided in Figure 3.6. The spatial extent of the 'Offshore Circalittoral Mixed Sediment' (MD42) habitat across the ECC survey area is mapped in mapped in Figure 3.7 and Figure 3.8.

ECC_01



ECC_30

ECC_06

ECC_02

Figure 3.6 Example Images of 'Offshore Circalittoral Mixed Sediment' Habitat

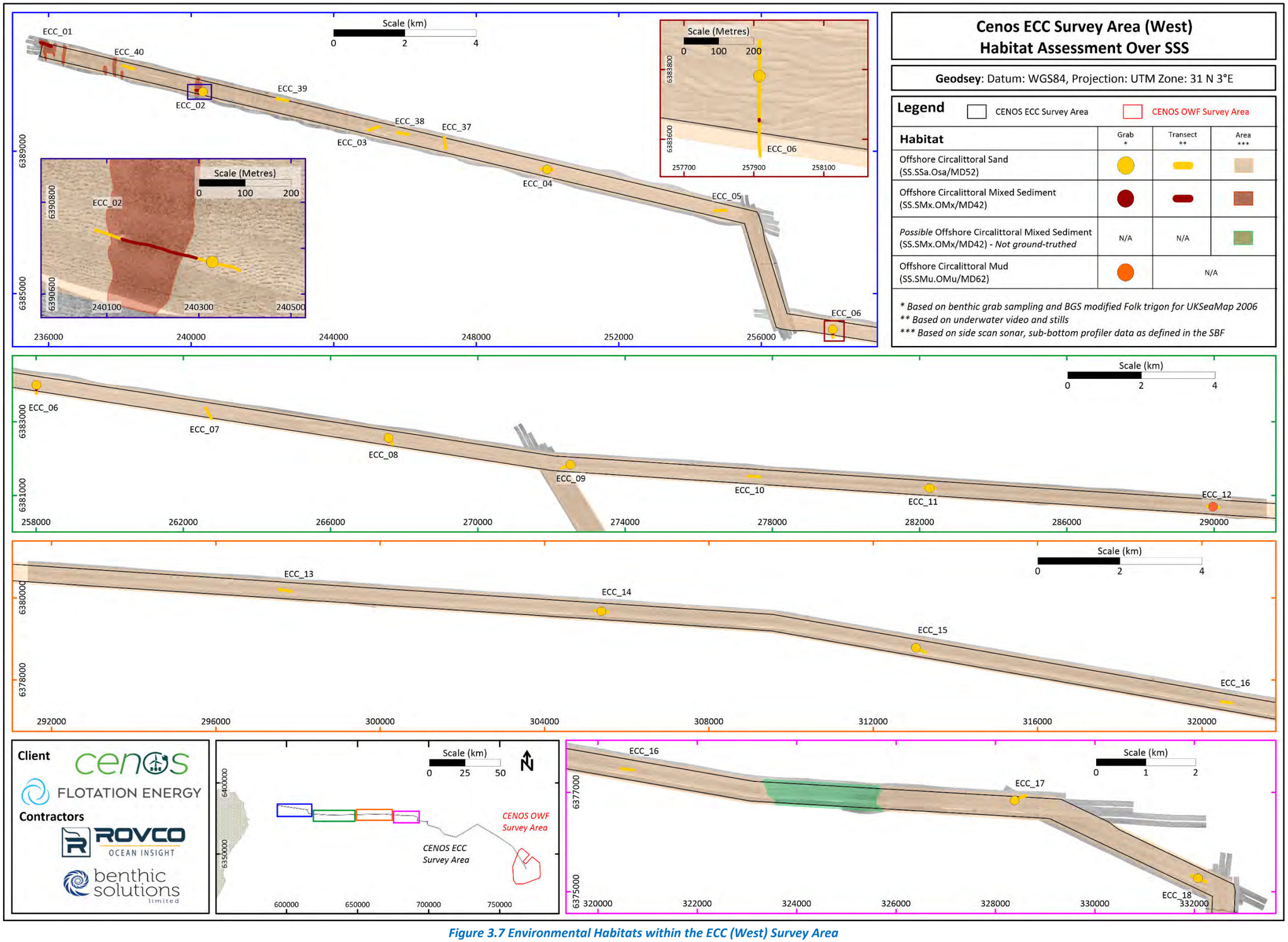


Figure 3.7 Environmental Habitats within the ECC (West) Survey Area

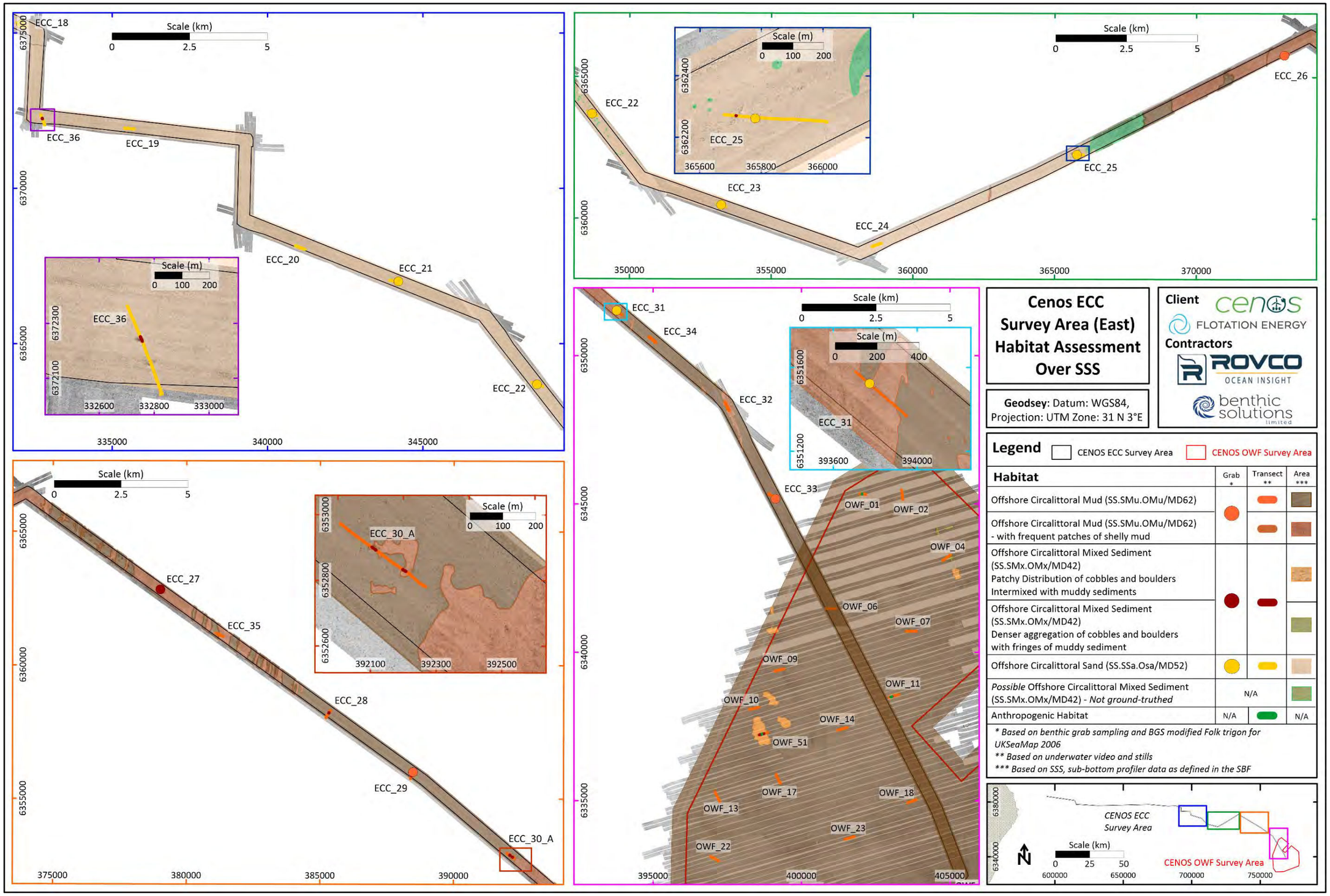


Figure 3.8 Environmental Habitats within the ECC (East) Survey Area

3.3 Potential Sensitive Habitats and Species

As previously discussed (Section 1.5.5), there are several potentially sensitive habitats and species which are known to occur in the wider region (northern North Sea), including:

- Subtidal Sands and Gravels (UK Post-2010 Biodiversity Framework Habitat, Scottish PMF);
- Seapen and Burrowing Megafauna Communities (Scottish PMF, English and Welsh Habitat FOCI, OSPAR threatened and/or declining Habitat);
- Ocean quahog, *Arctica islandica* (Scottish PMF, English and Welsh Species FOCI, OSPAR threatened and/or Declining Species);
- Ross worm, (*S. spinulosa*) biogenic reef (EC Habitats Directive Annex I, Habitat FOCI, OSPAR Threatened and/or Declining Habitat, UKBAP Priority Habitat).

In addition to the above habitats and species, review of the geophysical and environmental ground-truthing data from the ECC survey area indicated the presence of potential pockmarks, which warranted further assessment as to whether the EC Habitats Directive Annex I feature 'Submarine Structures Made by Leaking Gases' was present in the survey area.

The aforementioned habitats and species are listed by one or more International Conventions, European Directives or UK Legislation (including devolved UK administrations). Note: while European Directives are no longer directly relevant following the UK's exit from the European Union, UK legislation implementing these directives is still applicable and there has not yet been any policy change (GOV.UK, 2022).

3.3.1 Legislative Species Protection

To assess if any species afforded legislative protection in the UK were present within the survey area, the epifauna data recorded from the underwater video assessment were run through a listed species database developed by BSL staff. The tall sea pen (*Funiculina quadrangularis* is listed on the Scottish Biodiversity List (SBL), as an English and Welsh Feature of Conservation Interest (FOCI) and a UK Biodiversity Action Plan (UKBAP) priority species. The flat fish, plaice (*Pleuronectes platessa*), is also listed on Scottish Biodiversity List (SBL) and a UK Biodiversity Action Plan (UKBAP) priority species.

3.3.2 Subtidal Sands and Gravels

The subtidal sands and gravel habitat is a priority habitat under the UK BAP and Scottish PMF 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 provides important ecosystem services by improving water quality and acting as a carbon sink. This habitat is at risk from pollutants in riverine discharge, trawling and dredging activities and aggregate extraction.

Upon review of the high-definition video data, areas of 'Circalittoral Sand' and 'Circalittoral Mixed Sediment' could be considered as 'Subtidal Sands and Gravel' UKBAP priority habitat/ PMF.

3.3.3 Annex I Biogenic Reef formed by *Sabellaria spinulosa*

Sabellaria spinulosa is a tube-building polychaete worm and can occur as isolated individuals, small aggregations, thin crust-like veneers, or when in large numbers can form hard reef-like structures which can act to stabilise the surrounding seabed (Gibb *et al.,* 2014). As their tubes are built of sand, a high suspended sediment content is essential for growth of reef like structures and the mobile sandy seabed within the survey area may provide this.

The presence of *S. spinulosa* was noted on five camera transects (ECC_40, 39, 03, 38 and 37) along the ECC acquired during the current survey. One transect revealed an encrusting layer of relic *Sabellaria* (ECC_01), the difference between a relic and living aggregation is displayed in Table 3.2. Thus, no biogenic reef assessment was carried out at ECC_01. The remaining transects were therefore investigated further to assess whether any areas have the potential to be classified as Annex I Biogenic reefs.

Table 3.2 Comparison of relic (ECC_01) and living (ECC_39) Sabellaria aggregations

	
ECC_01	ECC_39

An assessment of 'reefiness' as described by Gubbay (2007) and presented in Table 3.3 was performed to describe the habitat, focusing on transects where *S. spinulosa* was recorded during review of video footage and stills photographs. Changes in *Sabellaria* 'elevation' (average tube height in cm) and patchiness (percentage cover) were noted during review of camera ground-truthing data.

Table 3.3 Sabellaria reefiness criteria as outlined by Gubbay (2007)

Measure of 'Reefiness'	Not a Reef	Low	Medium	High
Elevation (average tube height, cm)	<2	2-5	5-10	>10
Area (m^2)	<25	25-10,000	10,000–1,000,000	>1,000,000
Patchiness (%Cover)	<10	10-20	20-30	>30

To apply the Gubbay (2007) protocol to the acquired data, this was further split into separate assessments of reef 'structure' and overall 'reefiness' (Table 3.4 and Table 3.5). The advantage of this method is that it provides a way of combining the three criteria for reefiness: 'elevation' (average tube

height in cm), 'area' (m^2) and patchiness (percentage cover). Using this method, patches of *S. spinulosa* aggregations can be classified as 'not a reef', 'low', 'medium' or 'high' reefiness. This method was initially devised by BSL staff and later approved by the JNCC in 2010 (see Jenkins *et al.* (2015) for an example of application by JNCC and Cefas).

HD stills from the MOD4 camera were utilised which provided a good spatial coverage along transects, but which may have missed small scale variability in *Sabellaria* aggregations by providing an underwater image every 15 to 30 seconds. This approach was taken due to the high turbidity and the inability to land the camera on the seabed. Nevertheless, each HD still was assessed for *Sabellaria* patchiness and tube elevation, which were then combined to assess reef structure (Appendix V).

The first stage is the assessment of reef structure from the patchiness (i.e. percent coverage) and tube elevation reefiness levels, these measures being loosely correlated due to the tendency for *Sabellaria* tubes to grow upwards when present at higher densities (Table 3.4).

Table 3.4 Sabellaria reef structure matrix (after Gubbay, 2007)

Reef Structure Matrix			Elevation (cm)			
			<2	2 to 5	5 to 10	>10
			Not a Reef	Low	Medium	High
Patchiness	<10%	Not a Reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-20%	Low	Not a Reef	Low	Low	Low
	20-30%	Medium	Not a Reef	Low	Medium	Medium
	>30%	High	Not a Reef	Low	Medium	High

Table 3.5 Sabellaria reef structure vs area matrix (after Gubbay, 2007)

Reef Structure vs Area		Area (m^2)			
		<25	25 to 10,000	10,000 to 1,000,000	>1,000,000
		Not a Reef	Low	Medium	High
Reef Structure (incl. Patchiness and Elevation)	Not a Reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	Low	Not a Reef	Low	Low	Low
	Medium	Not a Reef	Low	Medium	Medium
	High	Not a Reef	Medium	High	High

The HD stills indicated that *S. spinulosa* occurred exclusively in the western extent of the ECC route. Out of the 403 images reviewed for *S. spinulosa* (Table 3.6), the vast majority (79.9%, equivalent to 322 stills) did not show any evidence of *S. spinulosa* aggregations and were labelled as areas of 'No Reef'. Of the images showing *S. spinulosa*, 60 (14.9%) were classed as 'Not a Reef', 18 (4.5%) as 'Low Reef', 2 (0.5%) as 'Medium Reef' and 1 (0.2%) as 'High Reef' in terms of percentage cover. A different pattern was evident for tube elevation with 25 images (6.2%) classed as 'Not a Reef', 19 (4.7%) as 'Low Reef', 30 (7.4%) as 'Medium Reef', and 6 (1.5%) as 'High Reef' When both patchiness and elevation were taken into account, by examining reef 'structure', 61 (15.1%) were classed as 'Not a Reef', 17

(4.2%) were classed as 'Low Reef', 1 (0.3%) was classed as 'Medium Reef' and 1 (0.3%) was classed as 'High Reef'.

Table 3.6 Summary of Sabellaria reefiness image results (after Gubbay, 2007)

'Reefiness' of Video Screengrabs	No Reef		Not a Reef		Low		Medium		High		Unclear footage	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Patchiness (% cover)	322	79.9	60	14.9%	18	5.4%	2	0.6%	1	0.3%	1	0.2%
Elevation (Tube height)			25	6.2%	19	4.7%	30	7.5%	6	1.5%		
Reef Structure			61	15.1%	17	4.2%	1	0.3%	1	0.3%		

The summary indicated images of 'Not a Reef' and 'Low Reef' occurred on all four transects (Figure 3.9). Only one transect (ECC_39) contained stills of 'Medium Reef' and 'High Reef' (Figure 3.9), but related to a very small area of the transect with no distinctive change in the geophysical data (SSS/MBES).

The second stage of the *Sabellaria* reefiness investigation was to assess the average reef structure for each delineated patch of *S. spinulosa* against the delineated patch area to assess the overall patch 'reefiness' (Table 3.5). In such circumstances, an approximation of the aerial extent of each *S. spinulosa* patch can be made from the transect length, by assuming that reefs occupied circular areas of seabed (i.e. reef extent or distance equates to the diameter of a circle, whose area is calculated using πr^2). There were 15 areas delineated as 'Low Reef' with the remaining delineated as 'Not a Reef' (Appendix IV). The aerial extent of 'Low Reef' ranged from 25.1m^2 (ECC_38) to 305.1m^2 (ECC_39) which were significantly below the 'Medium' extent threshold of 10,000m^2 (Table 3.5; Appendix IV).

The habitat assessment results have highlighted the presence of *Sabellaria* in isolated patches in the western extent of the ECC. However, the ground-truthing data indicates that these *Sabellaria* aggregations do not constitute Annex I reef habitat. While the presence of biogenic reefs within the area cannot be ruled out, the evidence suggests they are unlikely to be numerous or of a significant size.

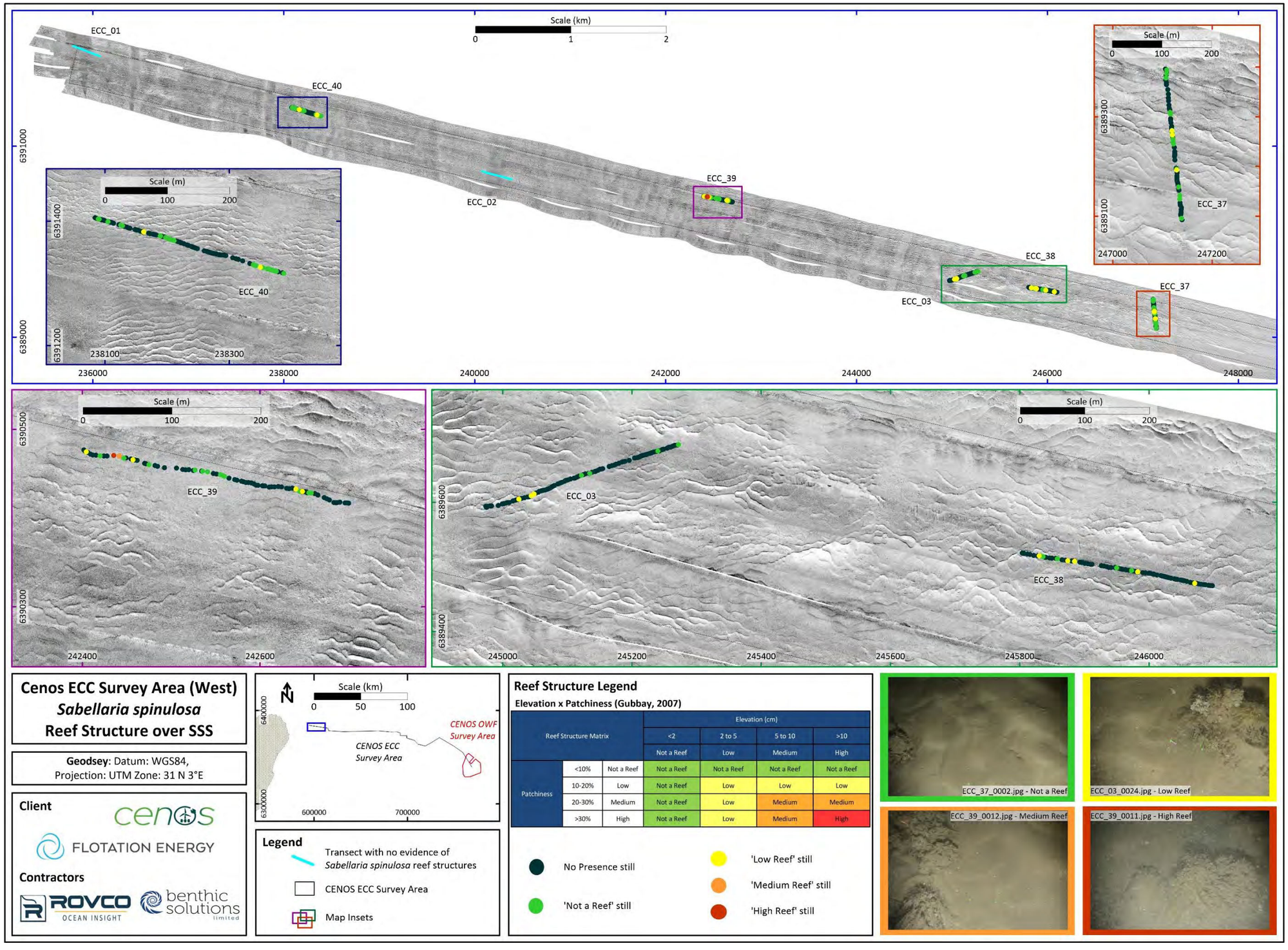


Figure 3.9 Sabellaria spinulosa reef habitat assessment for the ECC survey area

3.3.4 Ocean Quahog (*Arctica islandica*)

The ocean quahog (*A. islandica*) bivalve is a protected species that is afforded status under the OSPAR Commission due to its inclusion on the OSPAR List of Threatened and/or Declining Species in the Greater North Sea area as a priority (OSPAR, 2009). This species is also listed as a marine conservation zone (MCZ) feature of conservation importance (FOCI) for both inshore and offshore protection (JNCC and Natural England, 2016). Ocean quahogs grow very slowly and are at particular risk from bottom fishing gear, and like other slow-growing animals, once their numbers have reduced the populations can take a long time to recover. The species prefers sand and muddy sands ranging from fine to coarse grains and live buried vertically within the top few centimetres of the sediment, with retractable inhalant and exhalant siphons occasionally visible at the surface.

No live adult (shell diameter >5cm) specimens of ocean quahogs were identified during field operations, nor was there any sighting of their distinctive siphons observed following review of the acquired video footage and photographic stills. The potential occurrence of juvenile specimens (<5 cm), which are difficult to distinguish from other bivalves in the field, will be explored in the subsequent EBS report following taxonomic review of the faunal samples.

3.3.5 Submarine Structures Made by Leaking Gases

This habitat is listed as an Annex I habitat under the EC Habitat Directive (92/43/EEC). These structures consist of methane-derived authigenic carbonates (MDAC) structures which take the form of rocks, pavements, or pillars of carbonate cement (JNCC, 2014). MDAC is formed by the microbial anaerobic oxidation of methane coupled with sulphate reduction within the sulphate-methane transition zone (SMTZ), which typically lies beneath the seabed surface immediately above the boundary between well-oxygenated aerobic sediments and underlying anaerobic sediments. As a by-product of this process, carbonate precipitates out into the pore spaces and binds together the surrounding sediments into a hard, rock-like substance (Judd *et al*., 2019). While MDAC may form in isolation in sandy substrate, it is often found in association with seabed depressions, known as pockmarks, which can form in muddy seabed when shallow gas is unable to escape freely from the sediment into the water column. As a result, the surficial sediments become gas-charged and once sufficient pressure builds, the surface sediments become fluidised by the escape of the shallow gas and a pockmark is formed. During pockmark formation, any MDAC present at the sub-seabed SMTZ layer may be exposed at the surface.

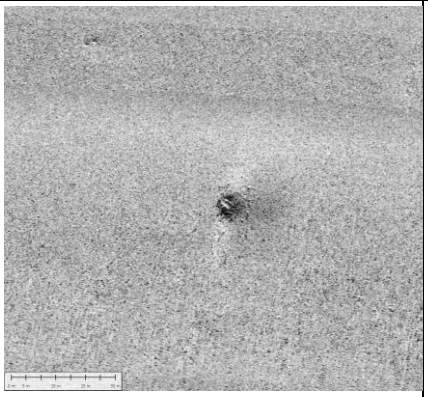
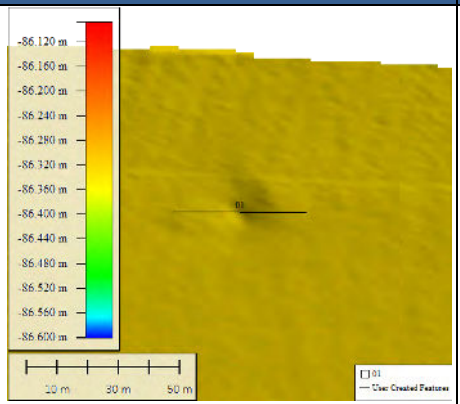
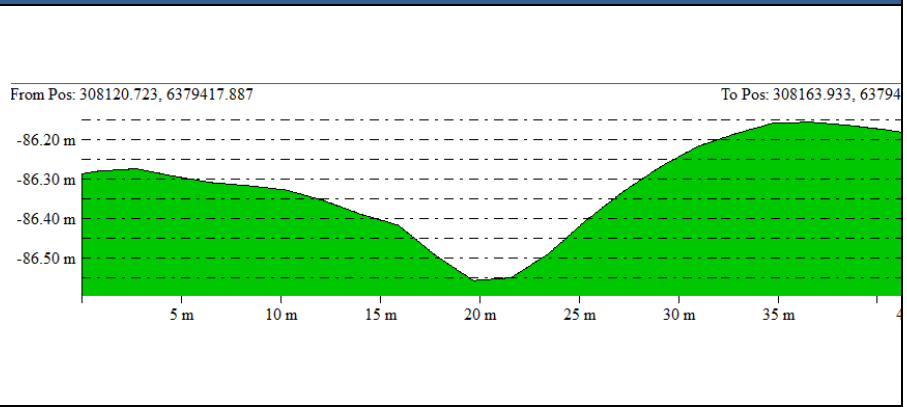
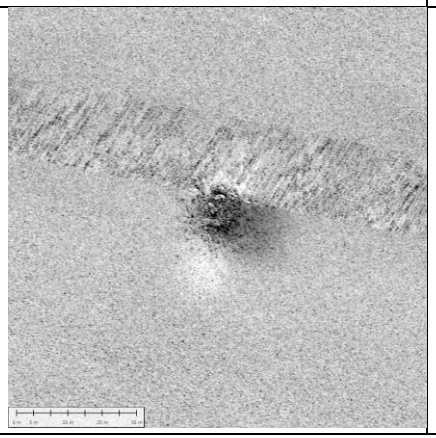
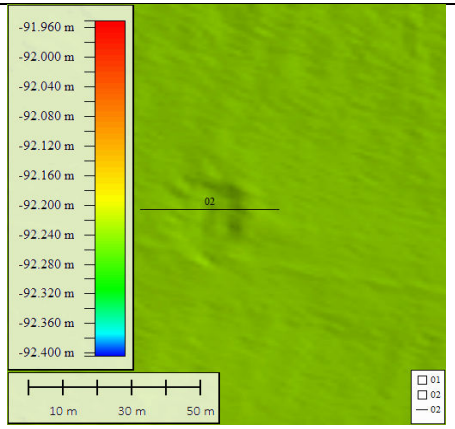
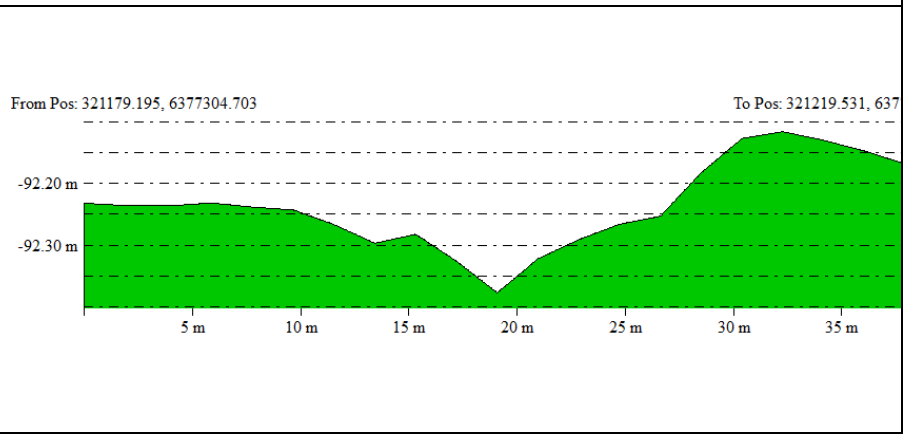
MDAC concretions function as habitat islands within otherwise soft sediment habitat and their rough, reef-like structures provide shelter for a variety of fauna (JNCC, 2014). In addition, should seepage of shallow gas continue then a number of chemosynthetic fauna may be supported which derive their nutrition fully or in part from methane or hydrogen sulphide in the sediment porewaters and/or seawater (Webb *et al.*, 2009).

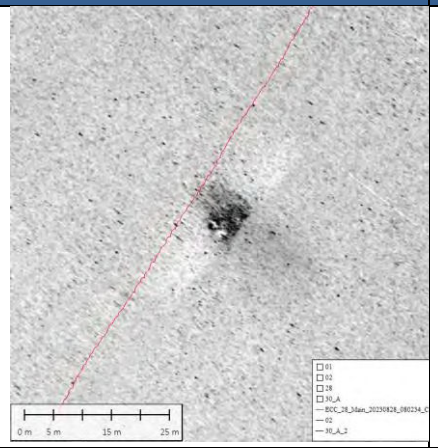
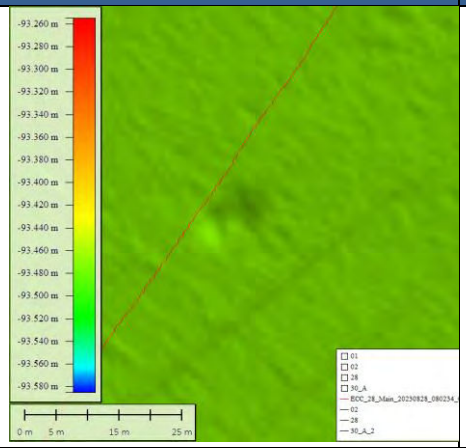
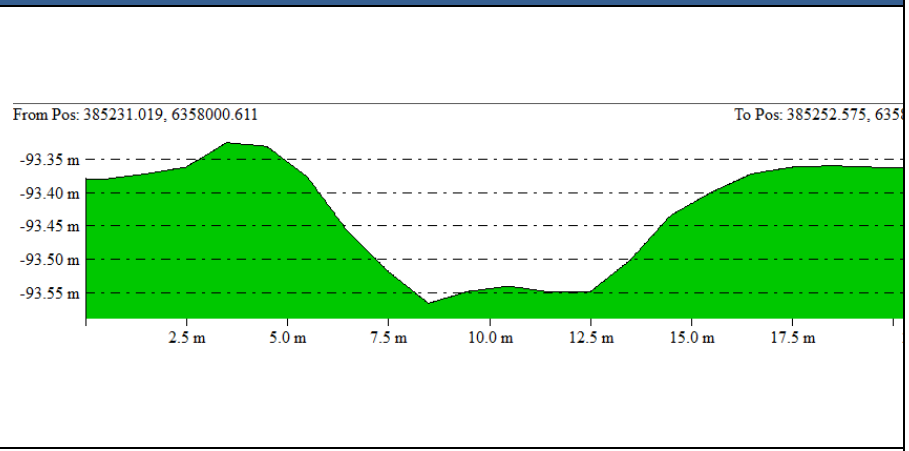
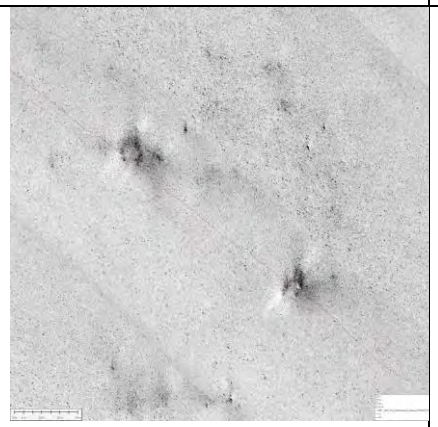
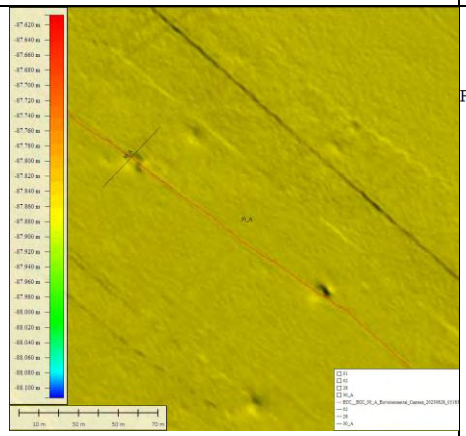
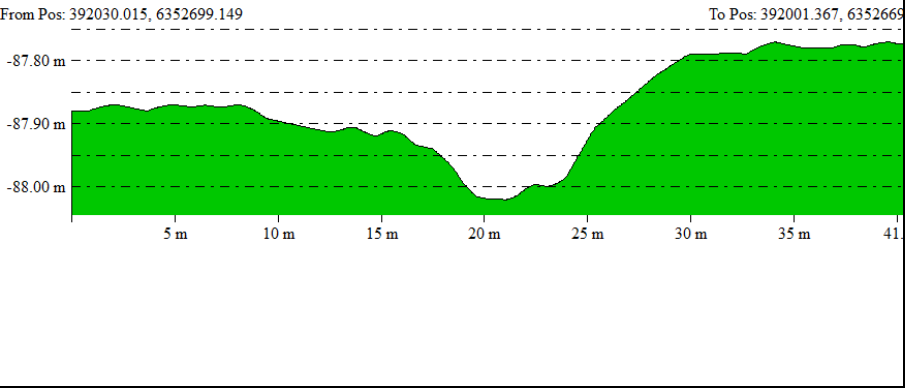
The survey contained a number of seabed depression that resembled unit pockmarks which are displayed in (Table 3.7 and Figure 3.10). These pockmarks have central areas of high reflectivity which can be an indicator for the presence of MDAC. Three depressions were ground-truthed which revealed

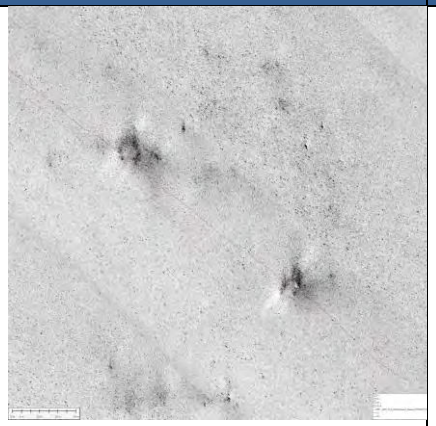
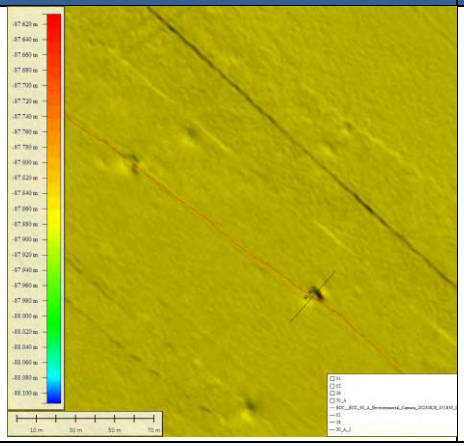
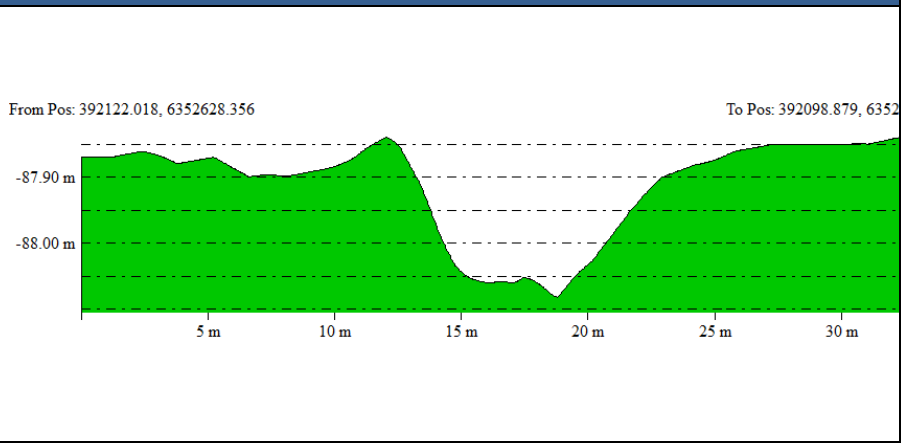
the sediment inside the pockmarks to be composed of mud with aggregations of relic shell fragments in the centre of the depression. There were no indicator species, such as the chemotrophic bivalve *Lucinoma borealis* often associated with active pockmarks (Dando *et al.,* 1986). In addition, there was no evidence of MDAC within either depression or other visible cues which might indicate active seepage of shallow gas, i.e. no gas bubbles, anoxic sediments, or bacterial mats (*Beggiatoa* sp.). Seabed depressions which were not ground-truthed were of a similar size, depth and sonar reflectivity to the aforementioned sites, and are likely to reflect the same muddy sediment composition with aggregations of relic shell fragments in the centre.

Given the lack of evidence of shallow gas in the vicinity of depressions and the absence of MDAC on camera ground-truthing data, there is no evidence to suggest that the EC Habitats Directive Annex I habitat 'Submarine structures caused by leaking gases' occurs within the survey area.

Table 3.7 Example Images of Seabed Depressions on Side Scan Sonar, Bathymetry and Bathymetric Cross Section profile

	SSS	MBES	Path Profile
Seabed Depression 1			
Seabed Depression 2			

	SSS	MBES	Path Profile
ECC_28			
ECC_30_A			

	SSS	MBES	Path Profile
ECC_30_A			

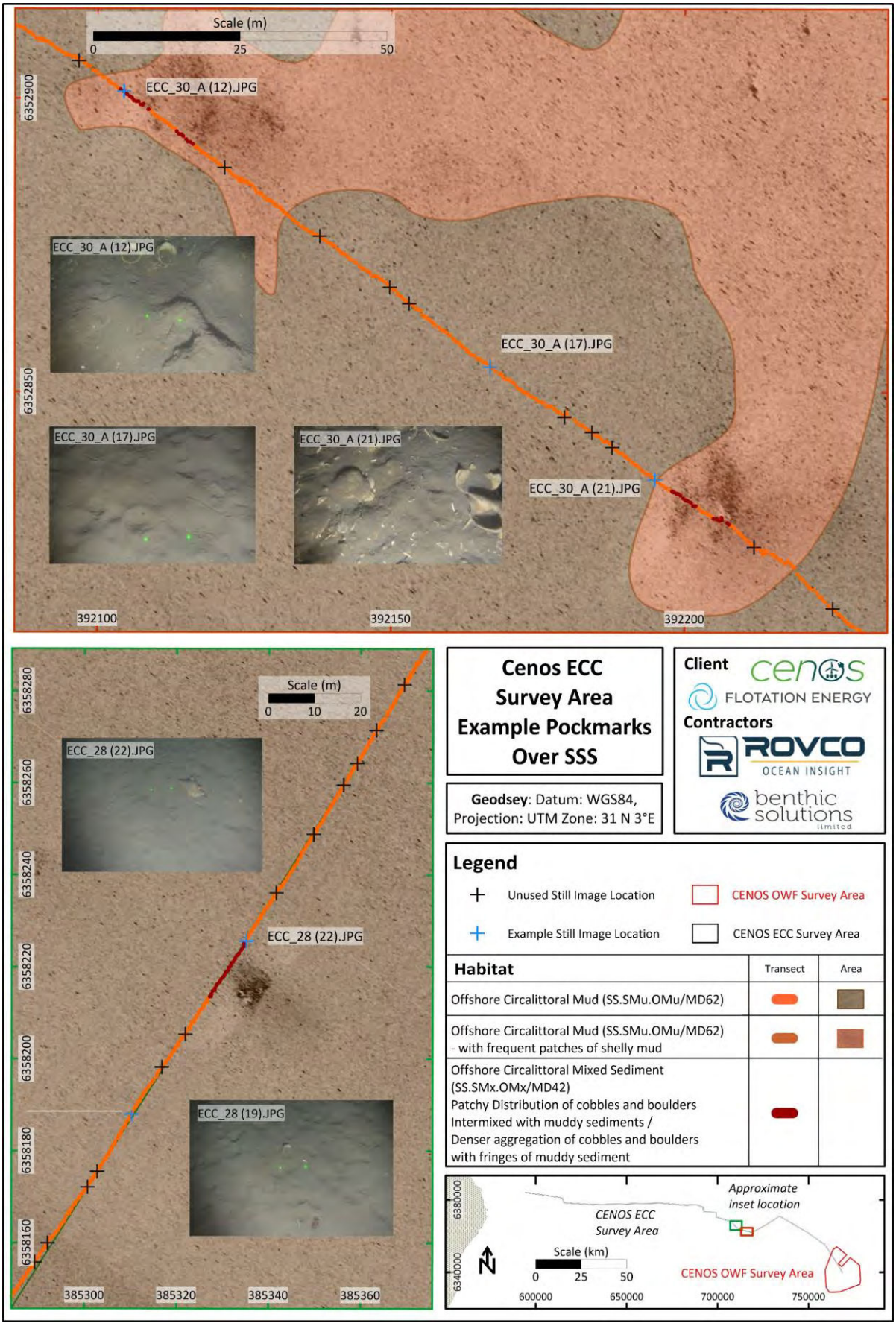


Figure 3.10 Ground-truthed Pockmarks along the ECC Route

4 Conclusion

The seabed along the ECC route was relatively flat, with water depths ranging from 78m to 107m below LAT. The SSS data indicated low to moderate reflectivity across most of the ECC survey area with areas of high reflectivity. Lower reflectivity seabed of characterised the ambient muddy sand/sand/sandy mud substrate and a Munsell colour of dark reddish brown (5Y 3/2 and 2.5Y 3/3). Areas of high reflectivity were typically associated with patches of shell fragments and pebbles, with a Munsell colour of dark reddish grey (5YR 4/2). Smaller isolated areas contained mixed sediment, with varying dense matrices of pebbles and shell debris.

The seabed across the proposed CENOS ECC survey area was predominantly comprised of the JNCC/EUNIS habitat classification of SS.SSa.OSa/ MD52 'Offshore Circalittoral Sand'. This biotope equates to the delineated areas of 'Holocene 01' up to station ECC_25, and all areas delineated as 'Holocene 02' interpreted SBF within the survey area. As the ECC route progressed to the east the percentage of fines increased and gradually transitioned into the seabed habitat SS.SMu.OMu/MD62 'Offshore Circalittoral Mud'. Two variants of SS.SMu.OMu were delineated along the route based on the observed features, seabed texture and reflectivity within the SSS data. 'Offshore Circalittoral Mud Sediment' (SS.SMu.OMu/MD62) was typically assigned to areas delineated as 'Holocene 01' and 'Holocene 03' in the seabed features, with the appearance of shell fragments. While 'Offshore Circalittoral Mud Sediment with frequent patches of shelly mud' (SS.SMu.OMu/MD62) was assigned to areas that showed more visible aggregations of shell fragments, demonstrating an outcropping of the underlying Fitzroy and Whitehorn formations. Smaller areas conforming to the JNCC/EUNIS classification of 'Offshore Circalittoral Mixed Sediment' (SS.SMx.OMx/MD42) were identified along the route and were typically characterised by a poorly sorted mosaic of shell fragments and pebbles overlaying the predominant muddy substrate.

Conspicuous fauna within the ECC survey area were across most stations and included sessile faunal assemblages such as seapens (*Pennatula phosphorea*, *Virgularia mirabilis* and *Funiculina quadrangularis*) and anemone (*Synarachnactis lloydii*). Small aggregations of the Ross Worm (*Sabellaria spinulosa*) were present across the stable mixed sediment transects. Mobile fauna included hermit crabs (*Pagurus* sp.), sea stars (Asteroidea, *Asterias rubens*), brittlestars (Ophiuroidea), urchin (Echinoidea), whelk (Buccinidae), squat lobster (Munididae), spider crab (Majidae) and sea slugs (Nudibranchia). Free-swimming megafauna mainly consisted of flatfish (Pleuronectiformes), gadoid fish (Gadidae) and the hagfish (*Myxine glutinosa*); with gurnards (Triglidae), and rays (Batoidea) also observed on occasion.

The high-definition video analysis revealed small aggregations of *Sabellaria spinulosa* along five transects exclusively in the western extent of the ECC. There were 15 areas delineated as 'Low Reef' with the remaining delineated as 'Not a Reef' The aerial extent of 'Low Reef' ranged from 25.1m^2 to 305.1m^2 which were significantly below the 'Medium' extent threshold of 10,000m^2, indicating the isolated patches present do not constitute Annex I reef habitat.

No live adult (shell diameter >5cm) specimens of *Arctica islandica* were observed during field operations, nor was there any evidence of their distinct siphons following review of the acquired video and photographic stills. Insights into the presence of juvenile specimens (shell diameter <5 cm) will be reviewed in the subsequent environmental baseline report once the macrofauna data becomes available.

Areas of 'Circalittoral Mixed Sediment' identified within the survey area could be considered to represent the UKBAP and Scottish PMF 'Subtidal Sands and Gravel' habitat.

Ground-truthing of three pockmarks revealed the sediment to be composed of mud with aggregations of relic shell fragments in the centre of the depression. There was no MDAC within either depression or other visible cues which might indicate active seepage of shallow gas, i.e. no gas bubbles, anoxic sediments, or bacterial mats (*Beggiatoa* sp.). As such there was no evidence to suggest that the EC Habitats Directive Annex I habitat 'Submarine structures caused by leaking gases' occurs within the survey area.

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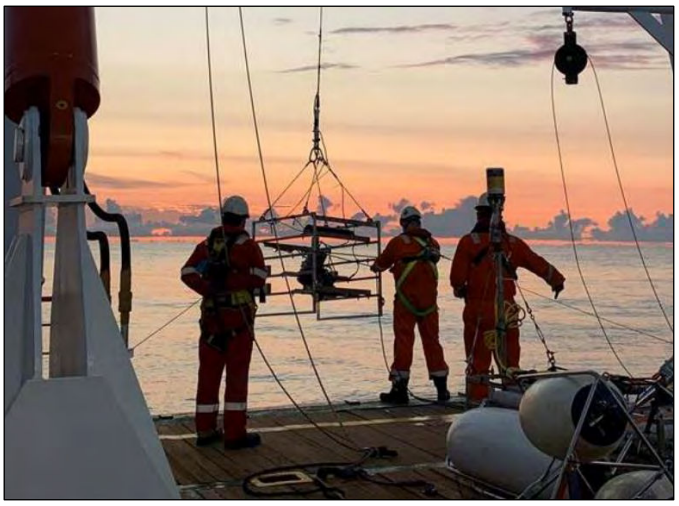
Appendix I – Field Operations

Appendix I presents a summary of the different methods employed during the field. For additional information, please refer to the Environmental Field Report (Doc Ref: CEN-ROV-01-CON-ENV-RPT-0002).

Seabed Photography and Video

Seabed video footage was acquired using the BSL MOD4 camera system fitted with laser scaling of 9.5cm, to ground-truth all grab locations, and additional transects were performed to increase coverage of the site and target features observed within the geophysical data. All transects were selected with the aim to facilitate a robust benthic ecology and habitat assessment. Once at the seabed, the camera was moved along the length of the transect at a speed of 0.3-0.5 knots, at an elevation of between 0.3 - 1.0 m above the seafloor. Best efforts were made to minimise the contact with the seabed throughout the transects. Live video footage, overlaid with the date, time, position and site details were viewed in real-time, and were recorded by BSL personnel. High-definition stills images were taken at regular intervals (>1 per 10 m) along the transects. Upon recovery of the camera, data was backed onto a second storage medium to prevent inadvertent loss of information.



MOD4 Camera Deployment

Water Sampling

Water sampling was performed at six locations in the ECC survey area. Water profiles were obtained using a Valeport MIDAS CTD and water samples were obtained at three depths (surface, middle and bottom) using five litre Niskin bottles triggered using a messenger weight. The preservation of water was undertaken using standard techniques. All physico-chemical samples were stored in appropriate containers (i.e., glass for hydrocarbons, and plastics for metals and chlorophyl) and appropriately stored (frozen at < -18°C for metals and chlorophyl and chilled at 5°C for hydrocarbons) for later transportation to the laboratory upon demobilisation.

Environmental Baseline Seabed Sampling

A BSL double grab or Hamon grab was used for sampling along the ECC. The BSL double grab was designed for operations in soft sediments, compacted sands, and shallow stiff clays, while the Hamon grab is designed for coarse and mixed sediments. The DVV device consists of two 0.1 m^2 samplers set into a ballasted frame, while the Hamon grab consists of one 0.1m^2 sampler set into a ballasted frame.

DVV Deployment

Pre-deployment procedures included the cleaning of the inner stainless grab buckets, cable and shackles so that they were generally grease free. Samples were subject to quality control on retrieval and were retained in the following circumstances:

- Water above sample was undisturbed;
- Bucket closure complete allowing no sediment washout;
- Sampler access doors had closed properly enclosing the sample;
- No disruption of the sample through striking the side of the vessel;
- Sample was taken within the acceptable target range <10m;
- Sample represented greater than 5L capacity;
- No hagfish or other mucus coagulants were found in the sample;
- There was no obvious contamination from equipment or the vessel, etc.;
- The sample was acceptable to the principal scientist.

Upon recovery, each sample was inspected, described, and photographed prior to processing. Key observations from samples included colour, sediment classification, layering (including RDLs), smell (including the presence of H_2S), obvious fauna, evidence of bioturbation and evidence of anthropogenic debris. The macrofaunal replicates were processed on-board over a 500 µm aperture mesh by BSL scientists using a *Wilson* Auto-siever.

Sample Processing

Field processing was conducted on board by BSL scientists. Sub-sampling of physico-chemical parameters was undertaken from the grab samples with the following material retrieved from the surface sediments (0-2 cm) for later analysis:

- Hydrocarbons (stored in a pre-washed foil capped glass jar);
- Heavy & trace metals and Total Organic Carbon & Matter (stored in doubled lined ziplock plastic bag);
- Particle size distribution (PSA; stored in doubled lined ziplock plastic bag).

The preservation of materials was undertaken using standard techniques. All physico-chemical samples were stored in appropriate containers (i.e., glass for hydrocarbons and plastics for metals and PSA) and immediately frozen and stored (< -18°C) for later transportation (frozen) to the laboratory upon demobilisation. Macrofaunal samples were fixed and stained in 5-10% buffered formalin and a

vital stain (Rose Bengal) for storage and transportation. This material will be later transferred to Industrial Methylated Spirit. All biological samples were double-labelled with internal tags.

Appendix II – Sampling Log Sheets

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
59	ECC_33	DVV	100	23:07	27/08/2023	20% 30%	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
60	ECC_33	DVV	100	23:20	27/08/2023	50% 50%	F PC	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	5Y 3/2	Sandy Mud	-
									2-5	5Y 3/2	Sandy Mud	
									5-10	5Y 3/2	Sandy Mud	
61	ECC_31	DVV	100	03:13	28/08/2023	20% 20%	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
62	ECC_31	DVV	100	03:30	28/08/2023	25% 30%	NS	-	0-2	-	-	Shell in jaws, washout
									2-5	-	-	
									5-10	-	-	
63	ECC_31	DVV	100	03:39	28/08/2023	40% 20%	PC NS	3 Bags, 2 Jars, 1 FT	0-2	5Y 3/2	Sandy Mud	-
									2-5	5Y 3/2	Sandy Mud	
									5-10	5Y 3/2	Shell Layer	
64	ECC_31	DVV	100	03:52	28/08/2023	-	NS	-	0-2	2.5Y 3/2	Sandy Mud	NS - Shell in jaws Relocated 50m for this sample
									2-5	-	Shell Layer	
									5-10	-	-	
65	ECC_29	DVV	95	07:19	28/08/2023	50% 50%-	F PC	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	5Y 4/2	Muddy Sand	Polychaetes
									2-5	5Y 4/2	Muddy Sand	
									5-10	5Y 4/2	Muddy Sand	
66	ECC_27	DVV	100	10:50	28/08/2023	40% 20%	PC NS	3 Bags, 2 Jars, 1 FT	0-2	5Y 4/2	Shelly Muddy Sand	Shell in jaws
									2-5	5Y 4/2	Shelly Muddy Sand	
									5-10	5Y 4/2	Shelly Muddy Sand	

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
67	ECC_27	DVV	100	11:02	28/08/2023	20% 10%	NS	-	0-2	5Y 4/2	Shelly Muddy Sand	Shell in jaws
									2-5	-	-	
									5-10	-	-	
68	ECC_27	DVV	100	11:08	28/08/2023	40% 10%	F NS	-	0-2	5Y 4/2	Shelly Muddy Sand	Shell in jaws, sample wash out
									2-5	-	-	
									5-10	-	-	
69	ECC_26	DVV	100	13:05	28/08/2023	40% 20%	PC NS	-	0-2	5Y 4/3	Muddy Sand with shell	-
									2-5	5Y 4/3	Muddy Sand with shell	
									5-10	5Y 4/3	Muddy Sand with shell	
70	ECC_26	DVV	97	13:15	28/08/2023	40%	F	3 Bags, 2 Jars, 1 FT 1 × 3L	0-2	5Y 4/3	Muddy Sand with shell	-
									2-5	5Y 4/3	Muddy Sand with shell	
									5-10	5Y 4/3	Muddy Sand with shell	
71	ECC_25	DVV	90	15:12	28/08/2023	15% 15%	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
72	ECC_25	DVV	90	15:18	28/08/2023	40% 20%	PC NS	-	0-2	5Y 4/3	Muddy Sand with shell	-
									2-5	5Y 4/3	Muddy Sand with shell	
									5-10	5Y 4/3	Muddy Sand with shell	
73	ECC_25	DVV	90	15:27	28/08/2023	20% 10%	NS NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
74	ECC_25	HG	90	15:51	28/08/2023	20%	NS	-	0-2	-	-	Switched to HG at client's request.
									2-5	-	-	
									5-10	-	-	
75	ECC_25	HG	90	15:56	28/08/2023	15%	NS	-	0-2	-	-	HG deployment issues
									2-5	-	-	
									5-10	-	-	
76	ECC_25_A	DVV	90	16:24	28/08/2023	50% 50%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/2	Slightly Muddy Sand	Relocated before reattempt
									2-5	2.5Y 3/2	Slightly Muddy Sand	
									5-10	2.5Y 3/2	Slightly Muddy Sand	
77	ECC_23	DVV	85	19:55	28/08/2023	40% 40%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/2	Muddy Sand	Polychaetes, Urchin, Bivalve, Ophiuroid
									2-5	2.5Y 3/2	Muddy Sand	
									5-10	2.5Y 3/2	Muddy Sand	

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
78	ECC_22	DVV	85	21:35	28/08/2023	40% 50%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/2	Muddy Sand	Cirripedia, Annelida, Ophiuroid
									2-5	2.5Y 3/2	Muddy Sand	
									5-10	2.5Y 3/2	Muddy Sand	
79	ECC_21	DVV	75	23:35	28/08/2023	60% 50%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/2	Muddy Sand	Polychaete, Bivalve
									2-5	2.5Y 3/2	Muddy Sand	
									5-10	2.5Y 3/2	Muddy Sand	
80	ECC_18	DVV	75	04:14	28/08/2023	30% 25%	NS	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/2	Muddy Sand	Sample Washout
									2-5	2.5Y 3/2	Muddy Sand	
									5-10	2.5Y 3/2	Muddy Sand	
81	ECC_18	DVV	75	04:25	28/08/2023	60% 50%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Muddy Sand	-
									2-5	2.5Y 3/3	Muddy Sand	
									5-10	2.5Y 3/3	Muddy Sand	
82	ECC_17	DVV	75	05:17	28/08/2023	50% 10%	PC NS	3 Bags, 2 Jars, 1 FT	0-2	2.5Y 3/3	Muddy Sand	-
									2-5	2.5Y 3/3	Muddy Sand	
									5-10	2.5Y 3/3	Muddy Sand	
83	ECC_17	DVV	75	05:29	28/08/2023	50% 40%	F	1 × 1L	0-2	2.5Y 3/3	Muddy Sand	Gastropod, Bivalve
									2-5	2.5Y 3/3	Muddy Sand	
									5-10	2.5Y 3/3	Muddy Sand	

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
84	ECC_15	DVV	90.6	08:53	30/08/2023	50% 40%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Muddy Sand	Polychaetes,
									2-5	2.5Y 3/3	Muddy Sand	
									5-10	2.5Y 3/3	Muddy Sand	
85	ECC_14	DVV	89.8	11:26	30/08/2023	65% 60%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Muddy Coarse Sand	Hermit Crab, Tusk Shell, Deck slate say ECC_17
									2-5	2.5Y 3/3	Muddy Coarse Sand	
									5-10	2.5Y 3/3	Muddy Coarse Sand	
86	ECC_12	DVV	99.12	14:40	30/08/2023	50% 55%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Muddy Coarse Sand	
									2-5	2.5Y 3/3	Muddy Coarse Sand	
									5-10	2.5Y 3/3	Muddy Coarse Sand	
87	ECC_11	DVV	96.9	16:32	30/08/2023	50% 55%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Slightly Muddy Sand	Polychaete
									2-5	2.5Y 3/3	Slightly Muddy Sand	
									5-10	2.5Y 3/3	Slightly Muddy Sand	

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
88	ECC_09	DVV	91.47	21:10	30/08/2023	55% 70%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 3/3	Muddy Sand	Tubeworm, Ophiuroid, Bivalve
									2-5	2.5Y 3/3	Muddy Sand	
									5-10	2.5Y 3/3	Muddy Sand	
89	ECC_08	DVV	89.24	22:31	30/08/2023	50% 65%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 4/3	Muddy Sand	Wormcast
									2-5	2.5Y 4/3	Muddy Sand	
									5-10	2.5Y 4/3	Muddy Sand	
90	ECC_06	DVV	96.3	00:17	31/08/2023	65% 75%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 4/2	Muddy Sand	Squat Lobster, *Sabellaria*
									2-5	2.5Y 4/2	Muddy Sand	
									5-10	2.5Y 4/2	Muddy Sand	
91	ECC_04	DVV	105.5	01:52	31/08/2023	70% 60%	PC F	3 Bags, 2 Jars, 1 FT 1 × 1L	0-2	2.5Y 2/3	Muddy Sand	Phosphorescent seapen
									2-5	2.5Y 2/3	Muddy Sand	
									5-10	2.5Y 2/3	Muddy Sand	
92	ECC_02	DVV	89.2	03:24	31/08/2023	80% 80%	PC F	3 Bags, 2 Jars, 1 FT 1 × 3L	0-2	2.5Y 3/3	Coarse Sand	-
									2-5	2.5Y 3/3	Coarse Sand	
									5-10	2.5Y 3/3	Coarse Sand	
93	ECC_02	NB	91	04:31	01/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			48	04:57		5L	Middle		2-5			
			2	05:03		5L	Surface		5-10			
94	ECC_37	NB	85	10:29	01/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			50	10:38		5L	Middle		2-5			
			2	10:40		5L	Surface		5-10			

Cast#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered	Sample Name	Container Type/Quantity	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm	Munsell Colour	Sediment Description	
95	ECC_06	NB	92	15:48	01/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			57	15:56		5L	Middle		2-5			
			2	15:59		5L	Surface		5-10			
96	ECC_09	NB	90	21:08	01/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			54	21:22		5L	Middle		2-5			
			2	21:26		5L	Surface		5-10			
97	ECC_18	NB	87	14:11	02/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			54	14:18		5L	Middle		2-5			
			2	14:26		5L	Surface		5-10			
99	ECC_24	NB	90	02:58	02/09/2023	5L	Bottom	6 × glass bottles 9 × plastic bottles	0-2			
			50	03:11		5L	Middle		2-5			
			2	03:15		5L	Surface		5-10			

Appendix III – Camera Transect Log Sheets

For electronic copies of this report, the Appendix below has been made available separately within the https://marine.gov.scot supporting documentation for Cenos Offshore Windfarm, as well as on our website at www.cenosoffshorewind.com.

For hard copies of this report please see information included below.

Appendix IV – *Sabellaria spinulosa* Assessment

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Appendix V – Sample and Seabed Photographs

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Appendix VI – 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 of 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.